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The Value of Inland Waterways in England and Wales

Final Report

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Executive summary

The inland waterways of England and Wales provide many benefits; social, economic and environmental. The provision of these benefits varies from waterway to waterway, ranging from minor to highly significant.

It is the UK Government's aim to ensure that the wider uses and benefits of the waterways are understood so that their potential to add value and help deliver objectives at the national, regional and local level is realised. To this end the Department of Environment, Food and Rural Affairs (Defra) have commissioned Jacobs to assess the diverse range of benefits provided by inland waterways in England and Wales and provide an aggregated picture of the implications of changing policy scenarios on the value of these benefits.

The project aim is to apply a benefits transfer based valuation framework produced in the earlier phase of the research programme to evaluate the key social, economic and environmental benefits that the inland waterways in England and Wales deliver, against two policy scenarios (i.e. reduced or increased funding). It has not been possible to include values for all of the public benefits that the inland waterways deliver; however following consultations and discussions it is thought that the key benefits have been captured. These include informal recreation on towpaths and pathways, boating, angling and property premiums as a proxy for amenity values.

In many cases benefits cannot be measured directly in monetary terms, such as the pleasure experienced by ramblers of walking along towpaths. In such cases there are a variety of indirect techniques to estimate benefits, for example careful assessment of the travel costs incurred by the beneficiaries as well as structured surveys of waterway users. No original research has been undertaken in order to derive the benefit estimates. The analysis relies on values obtained from the existing literature, some of which is dated and relates to specific geographical locations. Therefore there is a degree of additional uncertainty in the values estimated and the results should be interpreted accordingly.

Key messages for the assessment

- The benefits currently provided by navigable waterways, both at the case study level and the national level, are clearly significant.
    - The baseline benefits have been found to range between £109k per kilometre per year to over £730k per kilometre per year for the key benefit categories considered here.
    - In general, the categories covering canals showed higher baseline values for the key benefits than river categories showed.
- The Scenario 1 assessment shows that reduced funding would result in the loss of benefits through inaction or poor maintenance, and subsequent degradation of the waterways and associated assets.
    - Based on a range of assumptions, between £250M and £790M could be lost annually should Scenario 1 be realised. Using the best estimate (£790M), this equates to between £16k and £336k per km per year in lost benefits depending on the nature of the waterway in question.
- The assessment also shows that significant value could be realised under Scenario 2 where additional investment is made into the waterway. Again based on a series of assumptions, these could range from £186M and £677M annually over the whole of the network. The best estimate is £300M per year in additional benefits.
    - Per kilometre, the range in benefits which could be achieved is between £18k and £109k per km per year depending on the nature of the waterway.
- The majority of these gains or losses in benefits are driven by towpath/pathway visits.
    - The analysis shows that over 80% of the possible loss or gain in benefits would come from informal use of the towpaths along canals and pathways along rivers. It is therefore clear that in order to maximise the benefits which could be realised by investment, this is a key area to focus on.

- The losses projected under Scenario 1 are greatest for canals (£335k and £266k per km per year for rural and urban canals, respectively) and significantly lower for rivers (£16k and £67k per km per year for rural and urban rivers, respectively). Similarly, the potential gains which could be realised by Scenario 2 are also higher for canals than rivers.
- While it has been very difficult to relate the assumptions under each scenario to real funding changes, it can be seen from a simple review of the current expenditure by BW, that the possible savings in funding which might be realised under Scenario 1 are likely to be far outweighed by the loss in benefits which would result. This conclusion is not sensitive to any of the key assumptions made in the analysis.
- In relation to Scenario 2, waterway funding would have to increase by around 150% before it would be in the same order as the expected benefits of this scenario.

Case Study Analysis

The assessment is based on a series of case studies, categorised by waterway type. The categories of waterway are defined as:

- 1 – Rural canal; of high (a), medium (b) and low (c) boat density;
- 2 – Urban canals; of high (a), medium (b) and low (c) boat density;
- 3 – Rural rivers; of high (a), medium (b) and low (c) boat density;
- 4 – Urban rivers; of high (a), medium (b) and low (c) boat density.

It should be noted that the Broads and other waterbodies such as harbours, estuaries and tidal waterways have been excluded from the categorisation as they exhibit significantly different characteristics from rivers and canals and are not within the scope of this study.

Table A below shows the list of case studies undertaken and the value of the benefits estimated (covering towpath visits, boating, angling and property premiums as a proxy for amenity values). Scenario 1 represents a loss of funding and therefore degradation in the amenity of and access to the waterway. Scenario 2 represents the benefits which could be realised following further investment in the waterway.

Looking across the results of the case studies, there is significant variation in the total value of benefits. This difference may be partially attributed to the length of case study stretch analysed; therefore it may be more informative from a policy perspective to compare the benefit values arising per kilometre of waterway (as shown in Table B).

Table A: Case study summary results (£M, Equivalent Annual Value (EAV))

Case Study site/ Category*	Baseline	Scenario 1	Scenario 2
Kennet and Avon (1b)	19.4	8.7	35.5
Caldon (1b)	4.0	1.8	7.5
Lancaster (1c)	6.3	2.4	11.7
Pocklington (1c)	2.8	1.2	5.3
Leeds and Liverpool Canal (1b)	21.2	9.0	39.9
Coventry (2a)	9.3	3.1	20.3
Rochdale (2c)	30.3	-0.3	69.0
Basingstoke (2c)	11.9	3.8	26.4
River Ancholme (3)	3.9	3.3	4.6
River Great Ouse (3)	3.3	2.6	4.1
River Medway (urban) (4)	0.8	0.4	1.3
River Medway (rural) (3)	1.5	0.9	2.8
River Wey (4b)	6.7	2.9	12.4
Lee Navigation (4b)	9.8	3.4	20.5
River Severn Navigation (4a)	3.9	1.6	8.4

**Note – case studies refer to specific stretches of these waterways, not the whole length.*
Where boat density (a,b or c) is not specified, this is because information on boat movements was not available.

Table B - Benefits per km per case study, by scenario (£000, EAV)

Case Study site/ Category	Baseline	Scenario 1	Scenario 2
Kennet and Avon (1b)	491	217	903
Caldon (1b)	337	147	629
Lancaster (1c)	396	153	734
Pocklington (1c)	346	145	662
Leeds and Liverpool Canal (1b)	730	311	1,375
Coventry (2a)	549	191	1,195
Rochdale (2c)	705	240	1,604
Basingstoke (2c)	292	93	644
River Ancholme (3)	129	108	151
River Great Ouse (3)	118	93	148
River Medway (urban) (4)	113	51	190
River Medway (rural) (3)	109	62	203
River Wey (4b)	208	89	388
Lee Navigation (4b)	447	156	932
River Severn Navigation (4a)	322	132	698

Aggregation of benefits to the national level

The benefit values estimated through the case studies are aggregated, by category, to provide an estimate of the marginal value of the key benefits for each policy scenario considered. While under the case studies the total values for each scenario are presented, under the aggregation the **marginal change from the baseline** is presented in order to better inform discussions around policy decisions. Table C below also shows the marginal change per kilometre per category under each scenario.

Table C: Aggregated results - marginal change from baseline- (£'000)

Category		Category Details	Scenario 1	*£k/km*	Scenario 2	*£k/km*
1	a	**Canal** / **Rural** / High Boat Density	-96,308	*-283*	31,287	*92*
	b	Canal / Rural / Medium Boat Density	-161,336	*-307*	53,052	*101*
	c	Canal / Rural / Low Boat Density	-72,613	*-181*	23,279	*58*
	-	Canal / Rural / Unknown Boat Density	-4,757	*-67*	1,578	*22*
		Category sub-total	*-335,014*		*109,196*	
2	a	**Canal** / **Urban** / High Boat Density	-47,492	*-333*	20,110	*140*
	b	Canal / Urban / Medium Boat Density	-144,705	*-290*	60,031	*120*
	c	Canal / Urban / Low Boat Density	-169,915	*-271*	69,656	*111*
		Canal / Urban / Unknown Boat Density	-17,404	*-153*	6,532	*57*
		Category sub-total	*-379,815*		*156,329*	
3	a	**River** / **Rural** / High Boat Density	-130	*-19*	74	*11*
	b	River / Rural / Medium Boat Density	-1,750	*-18*	931	*10*
	c	River / Rural / Low Boat Density	-7,267	*-27*	4,532	*17*
		River / Rural / Unknown Boat Density	-8,218	*-11*	6,635	*9*
		Category sub-total	*-17,364*		*12,172*	
4	a	**River** / **Urban** / High Boat Density	-1,825	*-24*	1,188	*16*
	b	River / Urban / Medium Boat Density	-14,765	*-128*	6,265	*54*
	c	River / Urban / Low Boat Density	-29,194	*-129*	11,273	*50*
		River / Urban / Unknown Boat Density	-11,917	*-28*	4,696	*11*
		Category sub-total	*-57,701*		*23,421*	
		Sum	**-789,894**		**301,118**	

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Contents

Appendices are provided in a separate report.

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List of Abbreviations

AINA – Association of Inland Navigation Authorities
BW – British Waterways
Defra – Department of Environment, Food and Rural Affairs
EA – Environment Agency
EAV – Equivalent annual value
EFRA – Environment, Food and Rural Affairs
GIS – Geographic Information System
IMD – Index of Multiple Deprivation
IWAC – Inland Waterways Advisory Council
IWDVS – Inland Waterways Day Visitor Survey
LSOA – Lower Super Output Area
NRD – National Receptors Dataset
PCAS – Pocklington Canal Amenity Society
PSG – Project Steering Group
SSSI – Site of Special Scientific Interest
VIVA – Volunteer and Investment Value Audit
WTA – Willingness to accept
WTP – Willingness to pay

1 Introduction

1.1 Background

The inland waterways of England and Wales provide many benefits beyond those arising directly from their navigation function, which in recent decades has increasingly been for leisure use rather than the original commercial transport purpose (O'Gorman et al. 2010)[1]. These additional benefits include angling, towpath/ pathway recreation (walking and cycling), amenity benefits, heritage benefits, land drainage, water supply, waste disposal, energy generation and nature conservation. The provision of these benefits varies from waterway to waterway, ranging from minor to highly significant. It is the UK Government's aim to ensure that the wider uses and benefits of the waterways are understood so that their potential to add value and help deliver objectives at the national, regional and local level is realised. These benefits include leisure and recreation opportunities which contribute to improving physical and mental health, urban and rural regeneration, and benefits to the environment.

To this end the Department of Environment, Food and Rural Affairs (Defra), supported by the Inland Waterways Advisory Council (IWAC) commissioned Jacobs to assess the diverse range of benefits provided by inland waterways in England and Wales. The outputs of these studies include a valuation tool and guidance on its application, tailored for use by non-economists and range of case studies to test the tool and guidance[2]. These studies were part of Defra's Benefits of the Inland Waterways Research and Development Programme aimed at enhancing the evidence base for investment in inland waterways.

This project is the third in Defra's Research Programme and as such builds on the work undertaken in the first two projects. The research programme was set up in order to provide an evidence base which demonstrates the benefits provided by navigable inland waterways and which will be used to inform policy making. The request for much firmer evidence on the benefits arising from inland waterways initially came from the EFRA select committee. Several subsequent publications have also confirmed the need to appropriately value the widest set of possible benefits, including the Natural Environment White Paper (Defra)[3], 'No charge; valuing the natural environment' by Natural England[4] and 'A Living Wales' produced by the Welsh Assembly Government[5].

1.2 Aims and Objectives

The project aim is to apply a benefits transfer based valuation framework produced in the earlier phase of the research programme to evaluate the key social, economic and environmental benefits that the inland waterways in England and Wales deliver, against two policy scenarios (i.e. reduced or increased funding).

In order to achieve this outcome and the ultimate goal of a national picture of the benefits provided by inland waterways, the project first categorises the waterways of

[1] O'Gorman, Stefanie; Bann, Camille and Caldwell, Valerie (2010). The Benefits of Inland Waterways (2nd Edition). A report to Defra and IWAC. Reference number, WY0101

[2] These reports which include the valuation tool and case studies can be downloaded from www.iwac.org.uk/reports.

[3] http://www.defra.gov.uk/environment/natural/whitepaper/

[4] http://naturalengland.etraderstores.com/NaturalEnglandShop/NE220

[5] http://wales.gov.uk/topics/environmentcountryside/consmanagement/nef/?lang=en

England and Wales based on a series of parameters which can influence the realisation of benefits. This categorisation process facilitates the application of a valuation framework to case study sites to evaluate the key social, economic and environmental benefits they provide and to assess the degree to which the provision of these benefits changes according to different policy or funding scenarios.

Once completed, this information will be used to inform policy making across Defra and other Government Departments. As well as enabling the key benefits for individual waterways to be identified and the value derived by investment in them, it will also allow the loss of benefits associated with withdrawing investment to be better understood.

The Government is currently undertaking a reform of public bodies and has decided to transfer the British Waterways (BW) in England and Wales from the public sector into civil society (i.e. a third sector organisation also referred to as a charity or trust). This transition is intended to allow British Waterways to close its funding gap and give stakeholders greater involvement in the running of the inland waterway network. While the information presented in this study is relevant to the new funding models under consideration, it was not part of the original scope of this work to directly inform any of the decisions currently being made as part of that process. The information presented within this report may however be used to support decisions associated with the coming transfer of British Waterways to civil society.

1.3 Approach and Methods

The approach applied here is based on welfare economics assessment. It follows the valuation tool and guidance produced during Phase 1 of this Research Programme[6] and is in line with the Treasury's Green Book. It is however not a cost benefit analysis, but rather focused on the benefits side of the equation. Any reference to cost information presented here is to provide context to the benefit estimates presented.

The study approach is based around the completion of a series of tasks, which have allowed an iterative approach to development of the categorisation and case study completion.

The key project tasks are summarised below in the following sub-sections.

- Appraisal scenario identification
- Identification of key benefits
- Categorisation of waterways
- Case study identification and assessment
- Aggregation

Further detail on these is provided within the appropriate main section of the report. See Section 1.4 for details of each section.

1.3.1 Appraisal scenarios

Two distinct policy scenarios have been identified. These were developed in consultation with the Project Steering Group (PSG) with specific consideration of their suitability in informing real policy choices in the future.

[6] http://www.iwac.org.uk/reports/#research

The first scenario represents a situation where there is a significant reduction in funding. This does not necessarily mean a reduction in government funding, but could refer to a reduction in private/ charitable contributions for instance. Under this scenario, it has been assumed that all health and safety related spending would continue, however other spending commitments would be significantly limited. The implications associated with this reduction in funding are the eventual degradation of the navigation function of the waterway along with access restrictions for towpath users.

The second scenario reflects a situation where spending is increased to the extent that significant benefits might be realised. Again, this does not specifically refer to an increase in government funding but could refer to an increase in private/ charitable contributions. There is a range of implications associated with the provision of additional funding, for instance it might result in a more attractive waterway or a more accessible waterway; in turn resulting in increased usage levels, or increased value of each visit which is captured by willingness to pay (WTP) or expenditure. The details of this scenario have therefore been developed for each category of waterway through the completion of the case studies.

1.3.2 Key benefits

As noted in Section 1.2 above, it is the key benefits which this study is primarily interested in. 'Key' benefits are defined as those which are likely to provide significant value currently and under the policy scenarios assessed.

The framework of benefits produced in the Phase 1 project was reviewed and consideration was given to how each benefit category might be expected to respond to the scenarios under review. This exercise highlighted a limited set of benefits for consideration. See Table 2 in Section 3.3 for a summary of this screening process along with a further discussion of the benefits selected for inclusion in the case study analyses.

It should be noted that wider economic impact related benefits, such as the support of local jobs, are not included within the scope of this assessment. These impacts may however be significantly affected under the policy scenarios considered here.

1.3.3 Categorisation

The objective of the categorisation process is to enable a representative number of case study sites to be identified and to assess the implications of the policy scenarios on the benefits realised at these sites. It is also designed to assist in the aggregation of benefits to present a national picture of how the policy scenarios might be expected to influence the provision of these benefits.

Data were collated from a range of sources and reviewed for suitability for use in the categorisation process. Gaps were filled using expert knowledge wherever possible. For instance, boat density data were not available for non-British Waterways navigations requiring alternative data sources and methods to be applied in order to estimate boat density; in this case mostly anecdotal evidence provided by waterway managers.

This process produced 5 waterways categories. These are outlined in Section 3. It should be noted that the Broads and other waterbodies such as harbours, estuaries and tidal waterways have been excluded from the categorisation as they exhibit significantly different characteristics from rivers and canals and are not within the scope of this study.

1.3.4 Case studies

The process for selecting case study sites is outlined below.

Firstly, all of the GIS-based datasets were collated and mapped alongside the categorisation of the waterways. This allowed the waterways that share certain attributes which may impact on how they provide benefits to be grouped; for instance the presence of certain canal features, services and attractions or places to visit (where data on these are available). In addition to considering the spread of these features by category of waterway, the intention was also to provide a geographical spread of case study sites.

Secondly, the availability of suitable data to undertake the assessment at these case studies sites was considered. This process resulted in 14 case studies being selected for assessment. These are outlined in Section 4.

For each of the case studies, the value of the benefits under the baseline and the two policy scenarios was assessed using the valuation guidance produced as part of the earlier projects in this Research Programme. Any variation from the approach outlined in the guidance is described where appropriate under each of the case study sections.

1.3.5 Aggregation

The aggregation task aims to provide an estimate of the marginal benefits which could be lost or generated under each of the policy scenarios being considered across the whole waterways network.

The benefit assessments undertaken for each of the case study sites resulted in unit values (predominantly expressed as £/km/year) per category and scenario which were scaled up across the waterways of England and Wales.

The value of the benefits for each of the key benefit categories was aggregated separately, based on a series of assumptions. These are outlined clearly in Section 5.

1.4 Report Structure

The remainder of this report is structured as follows:

Section 2 outlines the process applied to identify the categories of waterways. The key issues faced are discussed, along with details of the data review, collation and manipulation. The results of the categorisation process are also outlined, showing the proportion of the total inland waterways that are thought to fall within each category.

Section 3 outlines in detail the nature of the policy scenarios applied in the assessment process. It also discusses the key benefits which will are valued.

Section 4 presents an overview of the case study sites selected and the results of the assessment undertaken, through the application of the valuation guidance, for the baseline and the two policy scenarios considered.

Section 5 outlines the objectives of the aggregation exercise, the key issues faced in undertaking this task, the approaches selected and the results estimated.

Section 6 presents the overall messages and conclusions that can be drawn from the assessment and the results calculated.

Appendices are presented in a separate report. They comprise:
Appendix A - GIS datasets;
Appendix B - case study assessments;
Appendix C – map of case study sites
Appendix D – map of waterways in England and Wales by waterway category
Appendix E – map of waterways in England and Wales by boat density
Appendix F – example case study calculations
Appendix G – benefits per km by recreation type and waterway category

2 Categorisation

2.1 Introduction

The objective of the categorisation process is to group inland waterways according to common function and character, with the understanding that waterways in the same category would respond similarly to policy scenarios. The intention is to produce a manageable number of categories that are meaningful, intuitively sensible and that would also offer variation in their response to research scenarios across categories.

The use of GIS to facilitate categorisation is intended to allow the systematic allocation of categories to waterways using recognised national datasets of information concerning the wider environment. To enable this, the first step was to establish a baseline of waterways for which the categorisation would be undertaken. Data were collated for British Waterways, Defra and other freely available sources to populate the GIS database.

2.2 Categorisation

The difference between a canal and a river was recognised as a key waterway distinction as it influences likely usage and acts as a parameter to represent physical form. Similarly, the difference between urban and rural nature of the waterway environment was identified for incorporation as this influences both the types of user and features of the waterway which require maintenance. The urban /rural split is also considered to represent current and potential visitor levels to some extent as these are expected to be higher in urban areas than rural areas.

Once the range of influencing parameters were identified and considered, it quickly became apparent that the number of sub-categories would have to be limited to keep the categorisation manageable. Therefore, only canal / river and urban / rural were selected as the main parameters. Applying just these parameters, results in four potential combinations and therefore four waterways categories. A final variable was sought to represent usage of the waterway. The inclusion of a distinction between usage volumes or rates was considered to be imperative to realising the variation in waterway response to scenario benefits. Boat density data were selected to represent this.

Inland waterways data were provided by British Waterways in two GIS shapefiles, namely BW_waterways.SHP and AINA_waterways.SHP, which were used as the baseline for categorisation. The data are made up of short polyline reaches (mainly 1km in length) which are assigned a common waterway name; therefore multiple reaches comprise a single waterway. Presented in this format, the data are summarised by the following statistics for England and Wales:

- BW_waterways.SHP: 3213 reaches, 3081km total length
- AINA_waterways.SHP: 3320 reaches, 1921km total length[7]

There was some consideration of whether the study should dissolve waterway reaches into longer polylines on the basis of common name; however this approach

[7] The Association of Inland Navigation Authorities (AINA) dataset relates to waterways managed by other AINA members excluding British Waterways.

was resisted as several other British Waterways datasets are available which match to the original lengths (namely boat density data)[8]. The only manipulation of the original geometry data were to merge the two shapefiles into one overall waterways GIS polyline file for ease of categorisation and subsequent analysis. On this merged dataset, an attribute field was generated to record whether the waterway polyline originated from British Waterways or AINA.

Datasets used to define the categorisation of baseline waterways are described as follows:

- Canal / River. As the GIS datasets provided by British Waterway and AINA have a number of types of waterways, the following assumptions have been made to ensure that all waterways are allocated to a sub-category;
    - The waterways data were searched by keyword to identify where "canal" or "river" appeared in the waterway name;
    - Of those waterways that did not find a match, 'navigations' have been assumed to be rivers, unless explicitly noted otherwise by a key stakeholder;
    - The remainder of waterways were reviewed manually to allocate them to a Canal or River sub-category;
    - The Broads have not been re-classified and remain as a separate sub-category;
    - A final sub-category of 'Other' has also been identified to capture other types of waterways in the dataset, specifically harbours.
    - The Broads and all 'other' waterways were subsequently removed and are not considered further in the analysis.

- Urban / Rural. This classification was based on analysis of the 2004 definition[9] of three settlement types for England and Wales at Lower Super Output Area (LSOA) geography. Again, all waterways are allocated to a sub-category at this level and the following assumptions are made:
    - Urban has been assigned to waterways which intersect LSOA zones of 'Urban >10K population' settlement type;
    - The remainder of waterways are allocated to sub-category Rural, where 2004 LSOA settlement type is 'Town and Fringe' or 'Village, Hamlet and Isolated Dwellings'.

- Boat density levels. Unfortunately this data are not universally available or consistent so several assumptions have been made:
    - Data provided by British Waterways represent boat density, expressed as boat movements per year (i.e. if you stood at any point along the waterway stretch for a year you would expect to see that number of boats passing). The numbers include both upstream and downstream movements[10];
    - The data provided by other Navigation Authorities[11] vary and in most cases are based on informed guess work by those familiar with the waterway (including Canal and Navigation Managers);

[8] This approach was ultimately carried out to analysis the deprivation levels across all categories. This is further discussed in Section 5.
[9] http://www.ons.gov.uk/about-statistics/geography/products/area-classifications/rural-urban-definition-and-la-classification/rural-urban-definition/index.html
[10] Although in theory the boat density figures could include both recreational and commercial traffic, in the case studies selected the densities relate almost entirely to the former.
[11] Represented collectively by AINA.

- Based on the following boat movements where available, the sub-category bands identified were: Low (0-3,000), Medium (3,000 - 7,500) and High (>7,500).
- Significant gaps still remain in this dataset.

2.3 Other data sources

In addition to data collation for categorisation, many other GIS datasets were collated to provide contextual information on the environment surrounding the waterways. These were primarily used to assist in the identification of case study sites and to provide data to facilitate the understanding of how funding scenarios may affect features and facilities, extending also to the impact of waterway condition on the wider scope of visitor numbers and nearby property prices. A full list of datasets and sources is provided in Appendix A. Some of the key layers are however described below.

- British Waterways "waterscape" data on services and features of the waterway (moorings, docks etc.) were analysed and mapped to contextualise the relationship between categories and provision of facilities.

- National datasets of listed buildings, heritage sites and monuments were consulted within 20m of a waterway to appreciate the cultural environment of a waterway, paying particular attention to where a feature falls under the responsibility of the waterway managing agent (e.g. a lock or bridge as a listed building).

- Datasets of waterside pubs, long distance walking routes, cycleways and towpaths were consulted to give context to the user attractions of a waterway.

- The natural environment was considered through inclusion of data on National Parks, nature reserves and other national and international environmental designations.

- The Index of Multiple Deprivation (IMD, 2008[12]) was used to generate socio-demographic information for profiling the context of each case study. IMD score and rank were extracted for all Lower Super Output Areas (LSOA) within 1km of each case study, allowing analysis of deprivation statistics and comparison to national averages.

- The National Receptors Dataset (NRD, 2011) was retrieved from the Environment Agency and represents registered property addresses from the Ordnance Survey Address Layer 2 product. It was filtered for residential property and used to generate counts of property type (Detached, Semi-Detached, Flat and Terrace) by distance bands from case study reaches (25m, 50m, 100m).

2.4 Categorisation results

The assessment resulted in the identification of 5 categories of waterways. These can be further spilt down to show variation in boat density on the waterways. The categories are presented in Table 1 below.

[12] IMD 2010 was not available in time for use in this study.

Once sub-category data had been allocated to waterway features within the national dataset, a cross-tabulation on the data were run to generate counts and statistics of waterways by category. Again, the results of this exercise are presented in Table 1 below.

This table shows that in terms of the count of waterways in each category, the largest number of reaches fall into Category 3 (~35%), whereas all other categories have a broadly similar number (~21% - 23%). However by length, Categories 1 and 2 contain the greatest proportion of all waterways (~29% and ~30% respectively), with Category 3 having ~24% and Category 4 ~18%.

Table 1 Categorisation results and statistics

Category Reference		Category Details	Waterway Count	*Waterway %*	Length / km	Length %
1	a	**Canal** / **Rural** / High Boat Density	349	*5.83%*	340	*7.28%*
	b	Canal / Rural / Medium Boat Density	535	*8.94%*	525	*11.24%*
	c	Canal / Rural / Low Boat Density	377	*6.30%*	400	*8.56%*
		Canal / Rural / Unknown Boat Density	66	*1.10%*	71	*1.52%*
2	a	**Canal** / **Urban** / High Boat Density	147	*2.46%*	144	*3.08%*
	b	Canal / Urban / Medium Boat Density	474	*7.92%*	499	*10.68%*
	c	Canal / Urban / Low Boat Density	625	*10.44%*	628	*13.44%*
		Canal / Urban / Unknown Boat Density	109	*1.82%*	114	*2.44%*
3	a	**River** / **Rural** / High Boat Density	7	*0.12%*	7	*15.69%*
	b	River / Rural / Medium Boat Density	105	*1.75%*	95	*0.15%*
	c	River / Rural / Low Boat Density	255	*4.26%*	269	*2.03%*
		River / Rural / Unknown Boat Density	1,699	*28.39%*	733	*5.76%*
4	a	**River** / **Urban** / High Boat Density	77	*1.29%*	76	*1.63%*
	b	River / Urban / Medium Boat Density	158	*2.64%*	115	*2.46%*
	c	River / Urban / Low Boat Density	214	*3.58%*	227	*4.86%*
		River / Urban / Unknown Boat Density	788	*13.17%*	429	*9.18%*
TOTAL			5,985	*100%*	4,672	*100%*

Note: These figures exclude the Broads, harbours, tidal & estuarine waterbodies and other unclassified waterways.

3 Appraisal Scenarios and Benefits

3.1 Objectives

The development of policy scenarios aims to provide useful information to policy makers in order to better understand the nature of benefits provided by navigable inland waterways and how the provision of these benefits may be influenced by policy decisions. In addition, the development of a representative sample of case studies should provide decision makers at all levels across the country, from site managers to local stakeholders to local and regional government, with relevant information to inform decisions related to inland waterways.

The implications of each of the scenarios will vary by case study site, depending on the nature of the site and the benefits currently realised there. Every attempt has been made to identify case study sites which are representative of the category they sit within and to define a set of implications under each scenario which could reasonably be considered to apply at all locations within the category of waterway.

3.2 Selected Scenarios

As noted in Section 1.3 the scenarios have been developed in consultation with the PSG in order to ensure that they are both realistic in nature and provide the basis from which variations could be considered in future, without the need to undertake new assessments.

Two scenarios are identified; the first (Scenario 1) considers where a reduction in investment results in the loss of benefits, the second (Scenario 2) where an increase in investment results in an increase in benefits. The marginal change in the level of investment is not assumed to be the same in the two scenarios as it is thought that in most cases a reduction in funding would cause a greater loss in benefits than would be gained by the same amount of increased funding. However, in both scenarios it is expected that the loss/gain in benefits outweigh the financial savings/costs incurred.

3.3 Benefits

As noted under Section 1.2, it is the key benefits which this study is primarily concerned with. 'Key' benefits are defined as those which are likely to provide significant value currently and under the policy scenarios assessed.

The framework of benefits produced in the Phase 1 project was reviewed and the following benefits were identified as key benefits for consideration within this project.

- Property premium (new residential properties)
- Property premium (existing residential properties)
- All forms of recreation

It should be noted that property premia are included here as a proxy value for amenity benefits provided by the waterways. They are therefore not considered a welfare benefit in themselves[13].

[13] There is a small risk that in some cases there is an overlap of these values with towpath WTP values, where the towpath visitor is the also a local resident along the waterway. However, this risk of double counting is considered low and therefore not likely to significantly impact on the overall results.

In addition to these benefits, the following benefits were also considered for inclusion specifically at a case study level:

- Provision of water
- Volunteering
- Flood protection/alleviation
- Water Quality Improvements
- Visiting heritage sites

Wider environmental and habitat benefits are excluded from the assessment here. It is not possible to define a generic impact of these funding scenarios on habitats (see Table 2).

Where adequate information is available and/or where these benefits are likely to respond significantly to the policy scenarios, the value of the change is included in the case study assessments, as presented in Section 4. However, these benefit categories are also likely to be very site-specific and are therefore not able to be included in the aggregation task (see Section 5).

Community benefits are considered 'key', however it was viewed as unlikely that changes to these could be adequately predicted or valued for inclusion in all case studies. Therefore community benefits are only discussed within the case studies where adequate information is available.

While non-use values are considered important, they have not been included at a case study level for a number of reasons. Firstly, few primary studies are available on non-use values derived from waterways. Secondly, how these non-use values would respond to changes in the quality of the waterway is highly dependent on the local population and the significance of the waterway in the area. However, the impact of the policy scenarios on non-use values has been considered at the aggregate level (i.e. the loss of boating activity and towpath/ pathway maintenance across the inland waterways network as a whole and the heritage value associated with this). See Section 5 for a further discussion.

Table 2 Identification of key benefits using an Ecosystem Services Framework

	Included for all case studies
	Included for case studies where information is available
	Included at the aggregate (national) level only
	Not valued in this assessment

Ecosystem Service Category	Category of Benefits	Benefit	Response to funding - positive	Response to funding - negative
Provisioning	Economic	Property premium (new residential properties)	M- potential increase in property premium/ speed of sale if quality of environment is significantly improved (visual amenity)	M - potential decrease in property premium/ speed of sale if environment is significantly degraded (e.g. graffiti, rubbish, etc)
		Property premium (existing residential properties)	M - potential increase in property premium/ speed of sale if quality of environment is significantly improved (visual amenity)	M - potential decrease in property premium/ speed of sale if environment is significantly degraded (e.g. graffiti, rubbish, etc)
		Rental premium (office properties)	L - potential increase in ability to attract/ retain business if quality of environment is significantly improved. Data are highly variable as to whether office rental premiums are significantly influenced by the presence of waterway.	L - potential decrease in ability to attract/ retain business if degradation of environmental leads to anti-social behaviour in the area, for example. Urban settings only.
		Renewable energy provision	L - Very site specific. If additional funding was used specifically for renewable energy projects, benefits could be significant.	L - Very site specific. Not likely to be loss of funding/maintenance where renewable energy projects are already in place.
		Transport	L - Very site specific/ lack of data available. If additional funding was used specifically for transport projects, benefits could be significant.	L - If loss of funding meant that navigation/ access was no longer possible, loss in benefits could be significant but again, very site specific / lack of data available.
		Provision of water	L - Unlikely to be significant/ measurable benefits to water provision (e.g. abstraction) linked to increase in funding.	M - potential impact on treatment costs, loss or reduction in abstraction benefits if decrease in funding resulted in decreased water quality.
		Volunteering	H - potentially significant benefits arising from increased community pride & funding for specific projects leading to increase in volunteering.	H - potentially significant reduction in benefits due to loss of community projects, loss of access, waterways falling into disrepair, etc. causing reduction in volunteering.

Ecosystem Service Category	Category of Benefits	Benefit	Response to funding - positive	Response to funding - negative
Regulating	Environment	Carbon emissions associated with renewable energy generation	L - Lack of data, very site specific and not likely to be significant.	L - Lack of data, very site specific and not likely to be significant.
		Carbon emissions associated with transport	L - Lack of data, very site specific and not likely to be significant.	L - Lack of data, very site specific and not likely to be significant.
		Flood protection/alleviation	L - unlikely that funding would result in significant increase in flood protection benefits unless specific projects were funded for that purpose.	M - potentially significant flood damages if loss in funding resulted in lack of channel access/maintenance. Quite site specific.
		Water regulation and pollution dilution	L - potential increase in benefits if additional funds are directed towards improving natural functions (e.g. increased riparian habitat). Very difficult to value.	L - potential reduction in benefits if loss of funds resulted in degradation of natural functions (e.g. decreased riparian habitat). Very difficult to value.
		Water Quality Improvements	See above	See above
Cultural	Recreation – land based	All users	H - potentially significant benefits arising from improved access, facilities & visual amenity to attract additional users.	H - potentially significant reduction in benefits due to towpath/ pathways falling into disrepair, loss of access, increased anti-social behaviour, etc.
		Walking		
		Short-cut taking		
		Cycling		
		Visits to leisure/heritage/ museum sites		
		Visiting pubs		
		Running/jogging		
		Visits 'to get somewhere'		
		Informal use - day visits		
		Informal use - overnight visits		
		Informal use - improvements to access		
		Bird watching		
	Recreation – water based	Boating	H - potentially significant benefits arising from increased opportunity for in-stream recreation.	H - potentially significant reduction in benefits due to loss of access, decreased environmental quality/ visual amenity, ill maintained facilities, etc.
		Canoeing/ kayaking		
		Angling		

Ecosystem Service Category	Category of Benefits	Benefit	Response to funding - positive	Response to funding - negative
Cultural	Regeneration	Visual amenity	L - potential significant increase in visual amenity benefits due to improved maintenance, habitat improvements, etc however thought to be largely captured by recreation & property premium.	L - potential significant increase in visual amenity benefits due to improved maintenance, habitat improvements, etc however thought to be largely captured by recreation & property premium.
	Heritage/ Cultural values	Visiting heritage sites	L - quite site specific. If funding were specifically directed towards heritage projects, benefits may be significant.	L - quite site specific. If loss of funding meant that access to heritage sites was loss or heritage assets were allowed to fall into disrepair, loss of benefits could be significant.
	Cultural values	Education	L - quite site specific. If additional funding was specifically directed towards education projects, benefits may be significant however unlikely to be able to measure/quantify.	L - quite site specific. If loss of funding meant that education opportunities are lost, reduction in benefits could be significant; however unlikely to be able to measure/quantify.
		Volunteering	Benefits likely to be significant; however not able to value the cultural aspect of volunteering.	Benefits likely to be significant; however not able to value the cultural aspect of volunteering.
		Community benefits	M - likely to be significant community benefits in terms of cohesion / civic pride, etc. however very difficult to value. Partially captured by recreational visits, volunteering, etc.	M - likely to be significant reduction in benefits in terms of community cohesion / civic pride if loss of funding means reduced maintenance - leading to increase anti-social behaviour, etc. however very difficult to value.
	Heritage & Environment	Non-use values	M - potentially significant; however difficult to value/aggregate due to assumptions around population & area of influence. Benefits include non-use and option use value of improved recreation opportunities (i.e. benefits of knowing others get enjoyment from it), also non-use benefits of improved habitat & environment.	M - potentially significant; however difficult to value/aggregate due to assumptions around population & area of influence. Loss of benefits include reduced non-use and option use value of recreation opportunities, also reduced non-use benefits from habitat degradation, etc.
Regulating	Environment	Biodiversity non-use values		
Regulating		Water quality non-use values		

3.4 Valuation of benefits

The benefits provided under the baseline and the two contrasting scenarios are estimated using economic valuation approaches and follows the guidance provided in 'The Benefits of Inland Waterways' (O'Gorman *et al.*, 2010)[14]. Economic valuation of the environment has its foundations in neo-classical welfare economics. Welfare economics is based on the premise that the purpose of economic activity is to increase the well-being of individuals, and that individuals are the best judges of their own welfare. Well-being is therefore based on what people prefer. Since these preferences are regularly revealed in the market place there is a logical link from preferences to willingness-to-pay (WTP) for goods and services. WTP can be shown to be a measure of preference satisfaction and hence a measure of well-being and is therefore applied here.

For recreational visits, WTP is comprised of expenditure (this could include travel costs, accommodation, entrance fees/ hire charges, and food and drink) plus consumer surplus (CS). CS is defined as the difference between what consumers are willing to pay and what they actually spend[15]. It is assumed that CS decreases under Scenario 1 and increases under Scenario 2, while expenditure values remain constant under the baseline and both policy scenarios. Table 3 presents the WTP values broken down into expenditure and CS for each type of recreation assessed in the case studies.

However, as Scenario 1 assumes a loss in welfare as a result of a policy change, willingness-to-accept (WTA) may provide a more appropriate indicator of value. WTA is the minimum amount of compensation people would be willing to accept for foregoing a benefit. WTA values are not used within this assessment for two reasons. Firstly, the guidance being applied here does not cover WTA values, and secondly, WTA values tend to be higher than WTP values as the loss of one unit of benefit is often considered more valuable than the gain of one unit of benefit. In addition, there is insufficient data on WTA transfer values, especially with regard to waterways[16]. As a result of this, the loss in benefits presented for Scenario 1 is likely to underestimate the value society places on the continued provision of benefits from the inland waterways.

[14] This report is the first of this three-phase Defra research programme.
[15] For non-market goods and services, CS can reflect the total value.
[16] Whilst there may be asymmetry between the value of marginal gains and losses (with WTA>WTP); true WTA can rarely be measured accurate or reliably, so for practical purposes it is not usually adopted in economic evaluation appraisals.

Table 3: WTP values for each scenario by recreation type (2010 prices)

Recreation type	WTP Component	Baseline (£/visit)	Scenario 1 (£/visit)	Scenario 2 (£/visit)	Reference
Private boats (powered)	Expenditure	12.84			GHK (2004)
Hire boats (powered)	Expenditure	30.64			Mid range value from Jacobs Gibb (2001) and GHK (2004)
Unpowered boats	Expenditure	3.62	3.62	3.62	IWDVS (2008)
Boating (all)	CS	0.57	0.00	0.84	Baseline & Scenario 2 – mid and high range from Willis and Garrod (1990)
Towpath/ pathway visits – Local	Expenditure	3.53			Value for walking/ rambling from IWDVS (2008)
	CS	0.75	0.00	3.12	Baseline – mid range from Willis & Garrod (1991). Scenario 2 – baseline plus additional WTP for improved access (British Waterways, 2008)
Towpath/ pathway visits – Day	Expenditure	4.87			Mid range value for day visitors from Ecotec (2006) and Glaves (2007)
	CS	8.08	0.00	10.47	Baseline – value for non-local visits from Willis & Garrod (1991). Scenario 2 – baseline plus additional WTP for improved access (British Waterways, 2008).
Towpath/ pathway visits – Overnight	Expenditure	64.20			Ecotec (2006)
	CS	8.08	0.00	10.47	Same assumptions as per day visits.
Cycling	Expenditure	4.61			IWDVS (2008)
	CS	0.58	0.00	0.85	Baseline – value from Willis & Garrod (1990). Scenario 2 increase over baseline calculated from boating CS.
Angling – Coarse Canal	WTP	19.97			Spurgeon et al. (2001)
Angling – Coarse River	WTP	26.83			

The benefits which are valued at the case study level are presented in Section 4. All benefits have been appraised over a 15 year period. This appraisal period was chosen to reflect that, under Scenario 1, the withdrawal of regular maintenance and capital expenditure would eventually cause all boating activity to cease and that this

would occur after approximately 15 years. All benefit values are presented as equivalent annual values[17] (EAV).

3.5 Scenario development

After selecting two policy scenarios (reduced and increased funding) and identifying the key benefits likely to be impacted as well as able to be valued at a case study level, the scenarios were refined and developed further.

Table 4 outlines all the key assumptions made as part of the completion of this study. Assumptions relating to specific changes under each scenario are outlined in Table 5 and Table 6.

Table 4 Key assumptions

Relevant to:	Assumption	Scenario
Boating activity	Reduction in funding will lead to eventual loss of all boats on the waterways by year 15. Increased funding will result in an annual increase in the number of boats which directly correlates with growth in boating visits (person boat days).	Scenario 1 Scenario 2
Boating activity	The reduction and growth rates applied to generate benefits have not been varied by category of waterway as no evidence for such variation has been identified.	Scenario 1 and 2
Towpath visits	Reduction in funding will cause decline in access to towpaths, degradation and eventual loss of towpaths due to bank failure, deterioration of surfaces, obstruction by vegetation, etc. Additional investment may result in improved towpath conditions (e.g. resurfacing), additional visitor facilities, signage, etc., leading to increased usage levels.	Scenario 1 Scenario 2
Towpath visits	For informal towpath/ pathway visits a split of 78:20:2 is assumed for local/ day/ overnight visits, respectively. A higher rate of reduction and increase in towpath visits is applied in urban locations (categories 2 and 4) versus rural locations.	Scenario 1 and 2
Angling visits	Angling is assumed to decline at the same rate as towpath visits. This applies to canals only – for river locations angling is assumed to remain constant at baseline levels. Angling is assumed to remain at baseline levels for all waterway categories.	Scenario 1 Scenario 2
Visitor numbers (all recreational visits)	Displacement is not accounted for at a case study level. Therefore decreases and increases in visitor numbers are not adjusted to account for the fact that the visits may in fact be displaced to or from other locations on the inland waterway network and therefore may not be a true welfare loss at a UK level. A displacement adjustment has, however, been applied to the aggregated results (see Section 5).	Scenario 1 and 2

[17] Equivalent annual value is the net amount of benefits that, if received as a uniform annual amount for the duration of the appraisal period, would have a present value equal to all benefits anticipated.

	It is assumed that the increase in recreational visits can be accommodated with increased investment – i.e. there are no capacity issues that cannot be overcome with investment.	Scenario 2
WTP values (all recreational visits)	The decrease in investment may result in decreased benefit values placed on each visit – this is captured by reducing the consumer surplus component of WTP to zero. Expenditure values remain the same as under the baseline. Increased investment could result in increased benefit values placed on each visit. The upper range of the consumer surplus values chosen for each recreation type has been applied (see Appendix B) – thereby increasing the overall WTP for recreational benefits. Congestion impacts have not been accounted for in WTP values – i.e. fewer visits may lead to an increased benefit value per visit and increased visits may lead to a decreased benefit value per visit if people prefer a quieter location.	Scenario 1 Scenario 2 Scenario 1 and 2
WTP values (towpath visits)	There is some evidence to suggest that WTP for towpath visits increases when there are boats present on the waterway. This effect has not been accounted for as there is not enough evidence to support the assumption. This also ensures that a conservative approach has been applied.	Scenario 2

3.5.1 Scenario 1 - Reduced maintenance and regular capital spending

This scenario assumes that investment in maintenance and regular capital expenditure is significantly reduced. Eventually, by the end of the 15 year appraisal period, the waterways would effectively become a 'remainder' waterway. These waterways are no longer navigable, however they still incur costs to manage the water, for environmental or health and safety reasons for example.

The impact on loss of water supply to other connecting waterways has not been accounted for at a case study level. For instance, blockages or changes in water levels due to reduced maintenance at one location may have knock-on impacts to connecting waterways in the network; however only the effects at the case study sites themselves have been valued.

While it is not possible to estimate with any accuracy the exact value of the investment change at any given site or across the network of waterways, it has been assumed that a reduction in investment in the region of millions of pounds[18] in equivalent annual spending[19] would result in the implications assumed below.

These implications would mean the eventual loss of all boats on the waterway at the end of the 15 year appraisal period. This might result from closure of the navigation caused by breaches, failing lock gates, lack of dredging or vegetation clearance or bridge repairs. This reduction is assumed to be staged over the appraisal period.

[18] This is based on the British Waterways estimate that around £10m spent on functionality changes is assumed to lead to around a 6% increase in annual visits. This assumption is used in Defra's 'Impact Assessment for moving inland waterways into a new charity in England and Wales (March 2011), and is based on an interpolation of a calibration which relates a £40m functionality cut to a 30-40% reduction in the number of visits and the value per visit respectively. It may not be correct however to assume that the loss of this spending would result in a similar reduction in visits.

[19] Equivalent annual spending includes annual maintenance spending and annualised regular capital spending.

In addition, it is assumed that reduction in access to towpaths or river pathways and eventual degradation and loss of access to these due to bank failure, deterioration of surfaces, obstruction by vegetation etc. would result in year on year reduction in user numbers.

The decreased investment may not only reduce user numbers but could result in a decreased benefit value placed on each visit. This has been accounted for in consumer surplus estimates used for this scenario which decreases the overall WTP for recreational benefits. See Section 3.5 for details of the unit values applied.

Assumptions have been applied in order to estimate the change in the value of the key benefits from the baseline to Scenario 1. These assumptions are outlined in Table 5 below for the benefits which are applicable across all case study sites only. Changes to amenity value (as captured by property premiums) and towpath/ pathway visits are assumed to vary by category of waterway; however changes to the level of boating activity are the same for each category as no evidence for variation has been identified.

Under the baseline, it is assumed that properties adjacent to waterways benefit from a waterside premium of +5% above average prices. This is reflective of the amenity value that waterways provide. For urban locations this is assumed to decline to -5% below average prices (a net change of -10%) under Scenario 1. This may be attributed to the waterway becoming full of rubbish and generally unsightly, as well as perhaps attracting anti-social behaviour and therefore being perceived as unsafe. For rural locations, the loss in amenity benefits is not thought to be as severe. Rural canals may become dewatered and therefore essentially an 'empty ditch' which would provide no amenity benefits but would presumably not detract from the value of a property – therefore a 0% premium is applied to this category. Rural rivers are assumed to retain more of their amenity value – despite a lack of boats passing by and perhaps becoming overgrown, they would still offering pleasing views. Therefore a +1.5% premium (the lower-bound figure for waterside premium presented in the guidance) has been applied.

For Scenario 1, a higher rate of reduction in towpath/ pathway visits is applied in urban locations versus rural locations. The reasoning behind this is that urban locations may be considered unsafe or unsightly if maintenance is not kept up; this could lead to a 'snowball' effect where fewer and fewer people use the towpath or pathway. Rural locations on the other hand may be perceived as becoming 'more natural' if maintenance were to slow or cease and this may be less off-putting than the urban case.

To capture this difference it is assumed that visitor numbers in urban locations will decline to 10% of the baseline by year 15. On rural canals it is assumed that visitor numbers decline by 7% per annum[20] so that visitor numbers are approximately 33% of the baseline by year 15. For rural rivers, where the decline is thought to be least severe, pathway visits are assumed to decline at half the rate of rural canals – or 3.5% per year so that visitor numbers are approximately 60% of the baseline by year 15. It should be noted that the difference between rural canals and rivers may be attributed to a lack of features on canals aside from their navigation function which would be lost under Scenario 1. Rural rivers, on the other hand, would

[20] There is no data available with regard to the rate of decrease in towpath visits following a decline in maintenance. Instead, it is assumed that the annual reduction in visits would be similar to the average annual growth in visits following an improvement; therefore the average growth rate of 7% per annum has been taken from the Rochdale and Huddersfield Narrow Canals Restoration – Economic Evaluation 2010 (Jacobs, 2010).

presumably retain some of their appeal; however there would still be a decline in visitor numbers due to lack of maintenance on pathways and access issues.

Table 5: Assumptions of change in benefits; Baseline to Scenario 1

Benefit type	Baseline	Scenario 1
Property* – change in premiums of properties within 25m of an urban water location and 50m of a rural water location.	+5%	• Urban rivers and canals: -5% • Rural canals: 0% • Rural rivers: +1.5%
Boating – change in use levels	0%	Staged decrease (all categories): • Baseline; years 1-4, • 33% reduction; years 5-9, • 67% reduction; years 10-14 • 0; year 15.
Towpath visitors** - change in use levels	0%	• Urban: reduced to 10% of baseline by year 15 (linear decrease) • Rural canals: 7% annual decrease each year (equivalent to a reduction to 33% of baseline by year 15) • Rural rivers: 3.5% annual decrease each year (equivalent to a reduction to 60% of the baseline by year 15)
Angling *** – change in use levels	0%	• Canals and Urban Rivers: same reduction applied as per towpath visitors, including difference between rural and urban locations. • Rural Rivers: no reduction assumed – baseline levels applied over years 1-15.

**Baseline premium – mid range of Powe et al. (2000) and Willis and Garrod (1994). Scenario 1 premium – 1.5% premium on rural rivers based on low range of Powe et al. (2000) and Willis and Garrod (1994); 10% reduction on urban locations based on marginal change from fully navigable to non-navigable canal for properties within 100m (Jacobs Gibb, 2001).*

***The decrease in use levels is based on other assessments which show how an increase in investment can result in increased use levels on towpaths. The rate of reduction under Scenario 1 is assumed to be the inverse of these average growth rates. It is assumed that use levels will start to decrease from year one, in a linear manner to the end of the appraisal period.*

**** It is thought that angling will decrease – particularly on canals due to reduced towpath access and increased siltation, etc. It is not known how angling activity on rivers would be impacted as data are scarce; therefore angling is assumed to remain unchanged under this scenario for river locations.*

3.5.2 Scenario 2 - Increased maintenance and regular capital spending

This scenario assumes that investment on maintenance and regular capital expenditure is increased across the waterways network. It is assumed that the increased investment would go towards increasing capacity to accommodate growth in boating demand, improvement in towpaths and on-site visitor facilities (e.g. access to the waterway and mooring facilities for instance)[21].

While it is not possible to estimate with any accuracy the exact value of the investment change at any given site or across the network of waterways, it has been assumed that an increase in investment of around £10 to £20 million in equivalent

[21] It is assumed under the Baseline that current usage levels would continue into the future without an increase or decrease in funding; therefore the Baseline is non-deteriorating. In reality this may not be the case in which case additional funding may be spent on major repairs rather than additional facilities.

annual spending[22], would result in the implications below. However, the investment requirements to support continued increases in boating use of the waterways is likely to be additional to this estimate.

There are a range of implications associated with the provision of additional funding which could be included within the assessment of this scenario. For instance it might result in a more attractive waterway or a more accessible waterway; in turn resulting in increased usage levels. There is evidence that improvements in towpaths through investment can result in significantly increased usage levels. For example, data provided by British Waterways suggest that annual growth rates in some locations after towpath improvements can be as high as 15% - 20% per year over the first five years, equating to a total growth of 100% - 300% after improvement[23].

In addition, the increased investment could result in an increase in the value of each visit. This has been accounted for in the consumer surplus estimates used for this scenario which increases the overall WTP for recreational benefits. See Appendix B for details of the unit values applied[24].

As is the case for Scenario 1, assumptions have been applied in order to estimate the change in the value of the key benefits from the baseline to Scenario 2. These include annual increases in use levels, varying each year of the appraisal period. The assumptions applied are outlined in Table 6 below for the benefits which are applicable across all case study sites only. With the exception of towpath visits, they have not been varied by category of waterway as no evidence for such variation has been identified.

Boating is assumed to increase by 2.5% year on year throughout the entire 15 year appraisal period[25]. All boating activity is assumed to be recreational as there is currently very little commercial traffic on the case study sites selected and the extent to which commercial use might be impacted by increased funding is not known.

For Scenario 2, a higher growth rate has been applied to towpath/ pathway visits in urban locations versus rural locations. The reasoning behind this is that urban locations are closer to population centres and other attractions and amenities; therefore there is a higher potential to draw visitors particularly in relation to informal towpath visits. To capture this difference, it is assumed that visitor numbers in urban locations will increase by a total of 83% from year 1 to year 6 and by 51% in rural locations[26].

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[22] This assumption is referenced in Defra's 'Impact Assessment for moving inland waterways into a new charity in England and Wales' (March, 2011) and is based on the British Waterways estimate that around £10m spent on functionality changes is assumed to lead to around a 6% increase in annual visits. It has been assumed here that growth in visits of between 50-80% would result depending on location. This value is unlikely to include any significant investment on boating facilities.

[23] This evidence originates from pedestrian counters on ten waterway locations throughout England and Scotland. Total % growth in towpath visits after improvement ranged from 21 – 343%, with an average of 96%.

[24] It may be the case that increased funding leading to increased usage levels may *decrease* the value of each visit due to congestion; however this has not been dealt with in the underlying assumptions. Instead, a sensitivity test has been undertaken on the results for Scenario 2 without this change in consumer surplus (see Section 5).

[25] It is assumed that where existing capacity cannot meet the predicted growth in boating activity, the additional funding would be allocated to increase capacity in line with increased demand.

[26] According to BW, data from pedestrian counters at various locations in England and Scotland have revealed an average of 100% growth over five years (15% per year) following improvements. A conservative approach has been applied here in selecting growth rates of 83% and 51% for urban and rural locations, respectively. This is because some of the case study sites selected have already

Table 6 Assumptions of change in benefits; Baseline to Scenario 2

Benefit type	Baseline	Scenario 2
Property* – change in premiums of properties within 25m of an urban water location and 50m of a rural water location.	5%	8%
Boating – change in use levels	0%	2.5% annual growth
Towpath visitors - change in use levels	0%	Urban rivers and canals: • 30% annual growth (yrs 1-2) • 2% annual growth (yrs 3-6) • 83% total compound growth year 1 to year 6 • Stabilises (yrs 7-15) Rural rivers and canals: • 18% annual growth (yrs 1-2) • 2% annual growth (yrs 3-6) • 51% total compound growth year 1 to year 6. • Stabilises (yrs 7-15)
Angling** – change in use levels	0%	0% - no change assumed.

**The 8% change reflects the high end of the range of premiums for existing properties taken from Powe et al. (2000)*
***It is not known whether angling activity would increase under Scenario 2 and if so, by how much. For the purpose of this study is assumed to remain constant across all waterway categories.*

undergone significant improvements in recent years and it is thought that usage levels would grow at a more modest rate in these locations as a result of additional funding.

4 Case Study Analysis

4.1 Introduction

Originally, it was expected that a case study matrix would be developed using the available GIS data in order to assist in the identification of the case study sites. This matrix would have presented the waterways against the key variables for which GIS data were available and which may influence how the waterways provide benefits.

However due to the that fact that the waterways data are in most cases disaggregated to 1km stretches, it was not feasible to produce a case study matrix as originally envisaged. Instead, the waterways were viewed in map format with the relevant attributes displayed where data were available.

Consideration of the GIS data and knowledge of the waterways, along with consideration of the availability of suitable data to facilitate the completion of the case study assessments, resulted in the case studies being selected. These are presented in Table 7 below. The case study sites area also shown in Appendix C.

Table 7 Selected case studies

No.	Case Study Site Name	Waterway Category
1	Kennet and Avon Canal - Newbury to Pewsey (BW)	1b - Canal/ Rural/ Medium boat density
2	Caldon canal - Hazelhurst Junction to Froghall Basin (BW)	1b - Canal/ Rural/ Medium boat density
3	Lancaster Canal – outskirts of Lancaster to Tewitfield (BW)	1c - Canal/ Rural/ Low boat density
4	Pocklington Canal (BW)	1c - Canal/ Rural Low boat density; has Protected areas
5	Leeds and Liverpool Canal - Colne to Skipton (BW)	1b - Canal/ Rural/ Medium boat density
6	Coventry Canal - Coventry to Nuneaton (BW)	2a - Canal/ Urban/ High boat Density
7	Rochdale Canal - Manchester to Todmorden (BW)	2c - Canal/ Urban/ Low boat density
8	Basingstoke Canal – Woking to Fleet (Basingstoke Canal Authority)	2c - Canal/ Urban / Low boat density; has protected areas adjacent.
9	River Ancholme (EA)	3 - River/ Rural/ No density information
10	River Great Ouse – outskirts of St. Ives to confluence with River Cam (EA)	3 - River/ Rural/ No density information
11 (a&b)	River Medway - Tonbridge to Allington lock (EA)	3c/4c – River/ Rural and Urban/ No density information
12	River Lee Navigation - Limehouse Basin to M25 crossing (BW)	4b - River/ Urban/ Medium boat density
13	River Wey (National Trust)	4b - River/ Urban/ Medium boat density
14	River Severn Navigation - through Worcester (BW)	4a - River/ Urban/ High boat density

Note: ( ) shows the navigation authority responsible for the waterway.

Sections 4.2 to 4.15 below provide details of the case study analyses. In each case a short description of the site is provided along with details of the category it belongs to. The specific assumptions applied under each scenario are outlined, where these differ from the assumptions set out in Section 3. The implications with regard to the change in benefits realised under each scenario are discussed. Finally, the results are presented as the equivalent annual value (EAV) of the benefits and the percentage change in benefits from the baseline.

The Treasury Green Book highlights the need to consider distributional impacts in assessing the implications of any policy or project. It is not considered appropriate to include weighting for distributional impacts at the case study level for a number of reasons. Firstly, very little is known about the nature of the visitors to the sites. Assumptions have been made as to the proportion of towpath/ pathway visits that are local (as opposed to day or overnight visits); however no assumption has been made regarding the origin of boating, cycling or angling visitors. As a result, any weighting applied is likely to present a level of accuracy that does not exist in the data and provide misleading results. Second, it is not appropriate to apply distributional weighting to property premiums (employed here as a proxy for amenity value) as property values are already directly correlated with income. Finally, the purpose of the case study assessments is to feed into the aggregation of benefits at a national level; therefore the locations have been chosen as representative of the category of waterway they sit within. Any information as to the demographic nature of the area/ visitors is very location specific and would not be applicable across every waterway in that category.

However, for illustrative purposes, distributional weighting has been applied for Case Study 7 – Rochdale Canal. This is intended to demonstrate how changes in welfare to beneficiaries of above/below average income deprivation levels can be accounted for at a specific site. This weighting has not been carried through into the aggregation (see Section 5 for further discussion).

4.2 Case Study 1 – Kennet and Avon Canal

The Kennet and Avon canal is located in the South of England. The full length of the canal runs for 140km from Bristol to Reading and includes the Kennet Navigation and the Avon Navigation at either end. This case study considers a 39km stretch, from Pewsey to Newbury.

The Kennet and Avon canal has a 200 year history. Over this period it has seen peaks and declines in its state and levels of use. Lack of maintenance led to parts of the canal being inaccessible in the 1900s and the canal was eventually closed in 1955 by the British Transport Commission, as it was no longer required for transportation of goods. The canal was finally restored and re-opened in 1990, owing to the volunteer efforts of the Kennet and Avon Canal Trust. Today it exists mostly as a recreational waterway.

The section of the canal from Pewsey to Newbury flows through an Area of Outstanding Natural Beauty, an Area of Special Landscape Importance (east of Kintbury, as far as Newbury) and a heritage site (through Hungerford). The canal also passes under 44 bridges and through 35 locks along this section. There is a

towpath along the entire stretch, much of which is designated as a National Cycle Route. These features are shown in Figure 1[27].

The data underlying the baseline assessment originate from British Waterways user statistics on boat traffic and days spent by boaters on the canal, as well as towpath user data from the 1996 National Count.

According to the monitoring data, there are approximately 4,200 boat movements per year on the stretch from Newbury to Hungerford and 3,700 from Hungerford to Pewsey. This implies that the case study section falls into the medium boat density category (category 1b: Canal / Rural / Medium boat density). By applying British Waterways' assumptions with regard to average cruising speed and crew size, it is estimated that 38,000 boating visits (expressed as person boat days) occur annually on this stretch of the Kennet and Avon Canal[28].

In 1996 there were approximately 1.17m towpath visits (including informal visits, cycling, angling and canoeing visits). To arrive at current baseline figures, the 1996 data were increased by 108%, a proportional uplift based on the percentage increase between the total British Waterways user estimates in 1996 and 2009 (166.7 and 346.3 million users respectively). This percentage increase is thought to be representative of the growth in visitors on the Kennet and Avon Canal, owing to the significant restoration improvements made in recent years.

Information such as cycling expenditure, angling numbers and a general description of the area was also sourced from a study carried out by Ecotec in 2006[29].

Economic Evaluation of the Restoration of the Kennet and Avon Canal: an Update of the 2002 Study. A Final Report to British Waterways. Ecotec, April 2006. (C3083)

Information on the number and type of volunteers, as well as visits specific to the Crofton Pumping Station was sourced from the Kennet and Avon Canal Trust[30].

According to the Trust there were an estimated 10,800 volunteer hours spent on the case study stretch in 2010 comprised of professional, skilled and unskilled labour. Also in 2010 there were 6,300 people visited the Crofton Pumping Station[31], 3,900 of which visited while it was in operation. These visits are assumed to be additional to the estimated informal towpath visits and are included under the category of benefit 'visiting heritage sites'.

[27] The level of detail presented in the figures for each case study site varies depending on the GIS data available for the area. As a general rule, BW waterways have significantly more data available than other waterways.

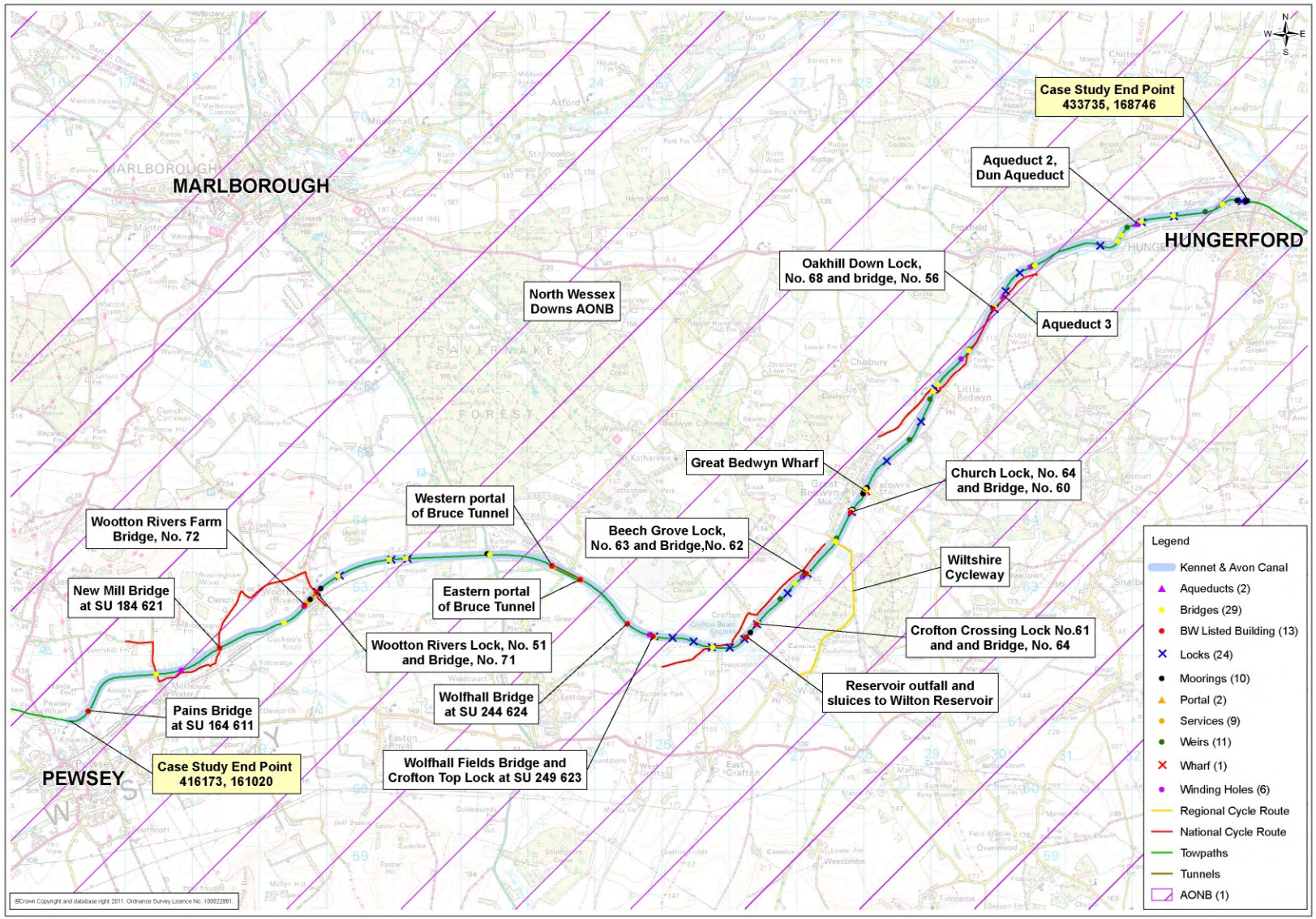
[28] Note these figures include powered boat movements and associated visits only. The total number of person-boat-days including unpowered boating visits (canoeing/ kayaking) is estimated to be 59,000 per year under the baseline.

[29] Economic Evaluation of the Restoration of the Kennet and Avon Canal: an Update of the 2002 Study. A Final Report to British Waterways. Ecotec, April 2006. (C3083)

[30] This information is presented only where readily available and is not included in the aggregation.

[31] The Crofton Pumping Station is an original steam-powered pumping station which still operates on selected weekends. It contains one of the oldest operational Cornish engines in the world which supplies the summit pound of the Kennet and Avon Canal with water. Visitors to the pumping station while it is 'in steam' (in operation) pay £8 for entry; while visitors pay £5 when it is not in steam.

Figure 1 Kennet & Avon Canal – Case study stretch



Key assumptions applied in the assessment are listed in Tables 4, 5 and 6 for each of the benefit categories. Individual observations under each scenario are noted below.

Baseline: In estimating the EAV of this scenario, the annual benefits estimated for 2010 were assumed to remain stable over the entire fifteen year appraisal period.

Management and maintenance spending, which could be considered to deliver these benefits, along the full length of the canal was £3.75M in 2010/2011. This does not include any capital expenditure which may have been spent. When apportioned by length over the relevant section of the canal only, this equates to approximately £1M in 2010/2011.

Under Scenario 1, boating visits (including unpowered boats) are predicted to decrease from 59,000 per year to 35,000 per year when averaged over the 15 year appraisal period[32], resulting in a reduction in benefits from £930k to £624k in EAV. Towpath visits are expected to decrease from 2.35M to 1.38M per year on average, resulting in a reduction in benefits from £17.2M to £7.2M in EAV.

A summary of how these values were derived is presented in Table 8 and Table 9 below[33]. A full worked example showing all categories of recreation is presented in Appendix F.

Table 8 Example calculation of Baseline benefits

Category of Recreation	Baseline visits per year	Baseline total visits (yrs 1-15)	Baseline WTP (£/ visit)	Baseline PV	Baseline EAV
Towpath visits – local	1,765,865	26,487,981	£4.28	£90,054,481	£7,554,576
Towpath visits – day	452,786	6,791,790	£12.95	£69,885,409	£5,862,614
Towpath visits – overnight	45,279	679,179	£72.28	£39,015,166	£3,272,942
Cycling visits	89,311	1,339,665	£5.19	£5,523,558	£463,336
Total towpath	**2,353,241**	**35,298,615**	**-**	**£204,478,615**	**£17,153,497**

Table 9 Example calculation of Scenario 1 benefits

Category of Recreation	Scenario 1 visits per year	Scenario 1 total visits (yrs 1-15)	Scenario 1 WTP (£/ visit)	Scenario 1 PV	Scenario 1 EAV
Towpath visits – local	Declining 7% year on year	15,561,517	£3.53	£45,634,736	£3,828,250
Towpath visits – day	Declining 7% year on year	3,990,133	£4.87	£16,144,591	£1,354,353
Towpath visits – overnight	Declining 7% year on year	399,013	£64.20	£21,293,825	£1,786,317
Cycling visits	Declining 7% year on year	787,045	£4.61	£3,015,789	£252,991
Total towpath	**-**	**20,737,708**	**-**	**£86,088,942**	**£7,221,911**

Angling is assumed to decline at the same rate as towpath visits, resulting in an average of 29,000 visits per year, down from 50,000 per year under the baseline.

[32] The number of visits is predicted to decline year-on-year; therefore the average number over the 15 year appraisal period is presented here.

[33] This detail is presented in the first case study only to demonstrate how the physical data (visitor numbers) and WTP values were combined to arrive at the benefit estimates.

Visits to the Crofton Pumping Station are also assumed to decline at the same rate as general towpath visits, from 6,300 under the baseline to 3,700 per year on average. These visits are included separately from general towpath visits and valued according to the entrance fees charged (see Footnote 31).

As previously explained, properties in close proximity to a waterway generally display higher market values than similar properties in the area. This increase in market value can be used to infer the amenity value of the waterway. There are 53 residential properties within 50m of the case study stretch with an estimated total value of £10.9M. The reduction in funding under Scenario 1 is expected to cause a decrease in the quality of the waterway environment such that property values decline from +5% above average property prices in the area to 0% above average prices – thus the premium is lost. For this case study site this equates to a loss of £82k (EAV).

Scenario 2 predicts that boat movements will increase by 2.5% per annum, resulting in an increase from 59,000 visits to 72,000 visits per year, on average. Towpath visits are expected to increase by 18% per annum for the first two years and experience a modest 2% annual growth over years 3-6 before stabilising. This equates to an increase from 2.35M to 3.45M visits per year per year, on average.

A summary of how the benefit values were derived is presented in Table 10 below. A full worked example showing all categories of recreation is presented in Appendix F.

Table 10 Example calculation of Scenario 2 benefits

Category of Recreation	Scenario 2 visits per year	Scenario 2 total visits (yrs 1-15)	Scenario 2 WTP (£/ visit)	Scenario 2 PV	Scenario 2 EAV
Towpath visits – local	18% annual growth yrs 1-2; 2% annual growth yrs 3-6	38,832,638	£6.65	£8,469,584	£710,505
Towpath visits – day	18% annual growth yrs 1-2; 2% annual growth yrs 3-6	9,957,087	£15.32	£203,901,597	£17,105,092
Towpath visits – overnight	18% annual growth yrs 1-2; 2% annual growth yrs 3-6	995,709	£74.65	£120,463,595	£10,105,565
Cycling visits	18% annual growth yrs 1-2; 2% annual growth yrs 3-6	1,964,013	£5.46	£58,710,195	£73,703
Total towpath	**-**	**51,749,446**	**-**	**£391,544,970**	**£32,846,499**

The application of the unit WTP values presented in Table 3 combined with the increase in visits over years 1-15 is presented in Table 11 below. The benefit values are expected to increase by £627k EAV (+35%) for boating and £15.82M EAV (+91%) for towpath visits.

Angling has been assumed to remain constant at 50,000 visits per year under Scenario 2. This assumption is supported by the Ecotec report, which states that the number of angling visits remained static over the period 2002 – 2005 even after significant investment into the restoration of canal infrastructure.

The property premium under Scenario 2 is assumed to increase from +5% to +8% which equates to of £131k in annual benefits, a growth of £49k over the baseline (EAV).

Visits to the Crofton Pumping Station are also assumed to increase at the same rate as general towpath visits, from 6,300 under the baseline to 9,200 per year on average. These visits are included separately from general towpath visits and valued according to the entrance fees charged (see Footnote 31).

As previously stated, volunteering hours totalled 10,800 in Crofton and Hungerford in 2010. This effort is estimated to have an EAV of £268k under the baseline, based on the VIVA values[34] for skilled, unskilled and professional man hours. This level of volunteering is assumed to remain constant across both Scenario 1 and 2 due to the nature of volunteering and the lack of definitive information on which to base assumptions on the trends resulting from variations in available funding[35].

The application of these assumptions across a 15 year appraisal period has resulted in the benefit estimates as shown in Table 11. Overall, the application of Scenario 1 could result in a 55% reduction in the benefits which are realised at this site. Scenario 2, as modelled, is expected to result in an 83% increase in benefits above those currently realised under the baseline.

It is noted here that displacement is not considered at case study level. This means that the estimated loss of visits under Scenario 1 has not been adjusted to take into account the fact that these visits may be displaced to another area/ waterway and therefore may not be a true welfare loss at a national level. Similarly, the additional visits predicted under Scenario 2 are new to the Kennet and Avon canal, but may be displaced from another location on the waterway network and therefore may not represent a true welfare gain at a national level. British Waterways use a rule of thumb estimate (derived from surveys) that 20% of the visits would be lost and not simply displaced to an alternative waterway (representing a true loss in welfare) and 20% of additional visits would not be displaced from another location (representing a real increase in visits to the waterway network and a true welfare gain). These adjustment have not been made here or any of the other case studies as displacement is considered at the aggregate level instead (see Section 5).

Table 11 Case Study 1 - Kennet and Avon Canal – Results (£'000, EAV)

Benefit	Baseline	Scenario 1	Scenario 2
Property premium	£82	£0	£131
Boating*	£930	£624	£1,252
Towpath visits**	£17,153	£7,222	£32,846
Angling	£995	£612	£995
Visiting heritage sites	£43	£27	£74
Volunteering	£191	£191	£191
Sum Value	**£19,395**	**£8,676**	**£35,489**
Percentage change over baseline	**-**	**-55%**	**83%**

** Includes canoeing/ kayaking*
***All visits include walkers, cyclists and other casual users (picnics, photographers etc).*

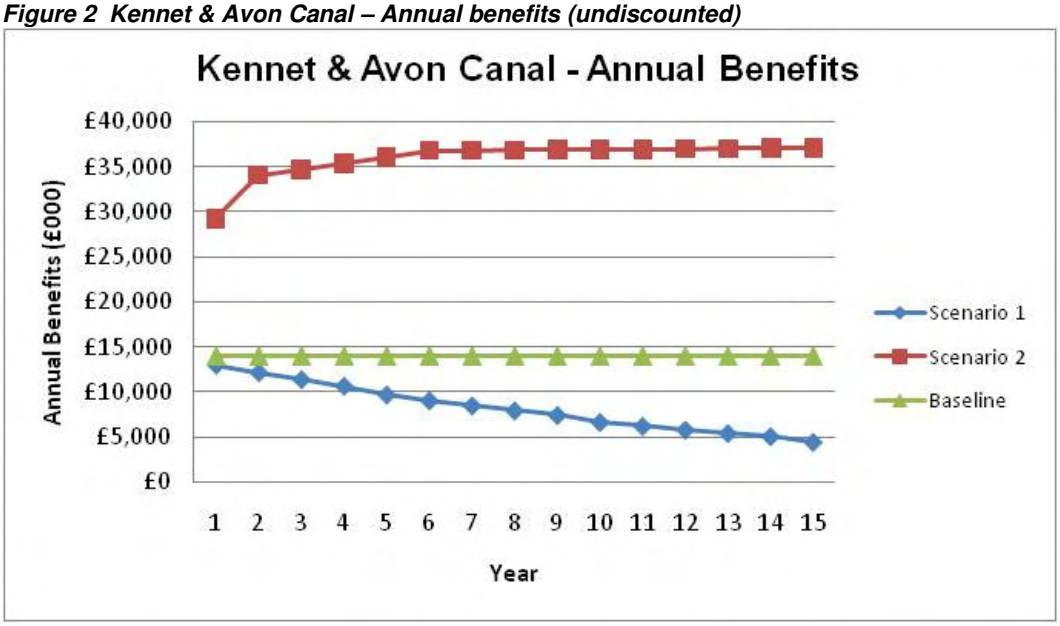
[34] Volunteer investment and value audit guide (Institute for Volunteering Research, 2003). VIVA values range from £52 per day for unskilled labour to £366 per day for professional labour (2010 prices) and are based on average market wages for the equivalent paid work.
[35] Volunteering may in fact increased under Scenario 1; however the relationship between funding and levels of volunteering is not well understood.

Note: See Appendix B for details of how these values have been estimated.

Figure 2 presents the undiscounted benefits arising in each year for those benefit categories valued. It can be seen that under the baseline, the key benefits which are valued here far outweigh the management and maintenance spending on the canal annually. Although this excludes consideration of one-off capital expenditure, the benefits appear to be significantly larger than the costs incurred.

Even on a medium boat density waterway such as this, the benefit values are dominated by towpath visits. The decline in benefits over years 1-15 in Scenario 1 therefore appears linear as towpath visits are assumed to decline at a constant rate year on year. In Scenario 2 the benefits increase sharply over the first two years, driven by towpath visits and continue to increase at a modest rate over years 7-15 due to a steady 2.5% annual growth in boating visits. There is an immediate rise in benefits in year 1 as no time lag is assumed (i.e. growth in visitors is immediate) and a higher WTP values are applied.

Figure 2 Kennet & Avon Canal – Annual benefits (undiscounted)



4.3 Case Study 2 – Caldon Canal

The Caldon Canal is a branch of the Trent & Mersey Canal which runs for 18 miles from Etruria in Stoke-on-Trent where it leaves the Trent and Mersey Canal, to Froghall basin in Staffordshire. There are 17 locks along the canal as well as the 69 metre long Froghall Tunnel, infamous with boaters for its low headroom. These assets make it a challenge to navigate.

Water to the canal is supplied by three reservoirs (Stanley, Knypersley and Rudyard) as well as the River Churnet. The Caldon is thus a valuable source of water to the Trent and Mersey system.

In 1958 the canal was earmarked in the Bowes Committee report as one which should no longer be maintained. Although the canal was never legally closed, traffic had declined to such an extent that by the 1960s the canal was almost unusable. In 1972 the government introduced a scheme (Operation Eyesore) to help local authorities to fund work on local infrastructure which had fallen into disrepair. The Caldon Canal was selected for restoration under the programme and work began the same year.

The main branch from Etruria in Stoke-on-Trent to Froghall in Staffordshire was initially designated by British Waterways as a remainder waterway. However in 1983 it was reclassified and upgraded to Cruising Waterway Standard. Restoration continued until 2003 when Froghall Wharf, the southern terminus, was reopened to boats. Despite lowering the water level to improve headroom, many modern vessels are not able to pass through the tunnel – thus the new moorings are infrequently used.

The Caldon Canal is now described as one of England's most picturesque and interesting waterways. It is just possible to travel the main line from Etruria to Froghall in a day; however the canal trust recommends allowing three or four days for a visit to enjoy the views and stop in at the famous Black Lion Pub.

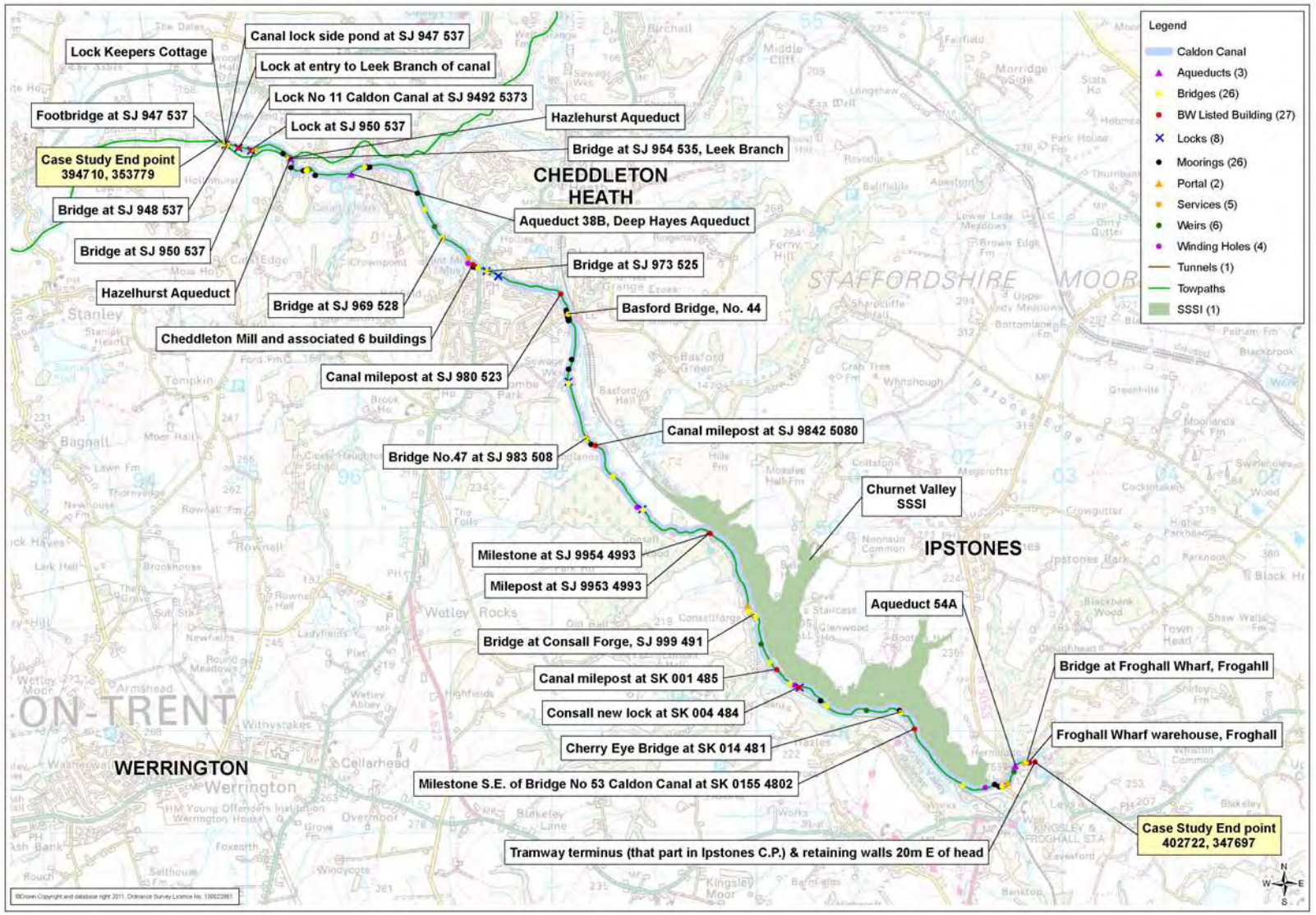
The canal was closed for eight months in November 2009 following the collapse of 15m length of canal embankment which led to 21 million gallons spilling across agricultural land and into the River Churnet. A £500k investment from British Waterways saw the canal reopen in July 2010 'in time to enjoy the remaining summer months on the canal'[36].

This case study considers the 12km section from Hazelhurst Junction to Froghall which is classed as category 1b – Canal/ Rural/ Medium boat density. See Figure 3 for a schematic of this stretch.

According to British Waterways data, there are 3,000-4,000 boat movements per annum on the Hazelhurst – Froghall stretch, equating to approximately 11,400 person boat days. Data on towpath and angling visits are based on the 1996 Inland Waterways Day Visitor Survey (IWDVS), which is considered to be reflective of current use levels. According to this data, there are approximately 500,000 towpath visits (a density of 41,000 per km per year).

[36]http://www.waterscape.com/features-and-articles/news/2769/british-waterways-reopens-caldon-canal

Figure 3: Caldon Canal – Case study stretch



Key assumptions applied in the assessment are listed in Tables 4, 5 and 6 for each of the benefit categories. Individual observations under each scenario are noted below.

Baseline: In estimating the EAV of this scenario, the annual benefits estimated were assumed to remain stable over the entire fifteen year appraisal period.

Under Scenario 1, it is assumed that the reduction in funding would result in a decline of approximately 40% in total boating visits and 41% in towpath visits over years 1-15 compared to baseline levels. This equates to an average of 11,600 person boat days per year compared to a baseline of 19,300 per year. Towpath visits would decline from 500,000 to an average of 292,000 per year.

Note, boating visits include canoes and unpowered boats and towpath visits include cyclists.

An estimated 5,000 angling visits currently take place on this stretch every year. The reduction in funding under Scenario 1 is likely to cause blockages, overgrowth and other potential access issues due to infrequent upkeep of the towpaths, etc. Angling is therefore expected to decline at the same rate as general towpath visits (see assumptions in Table 5).

There are 40 residential properties within 50m of this section of the Caldon Canal, with an estimated total value of £3M. The reduction in funding under Scenario 1 is expected to cause a change in property premiums from +5% above average prices under the baseline to 0%. This equates to a loss of £43k (EAV).

Under Scenario 2, it is assumed that an increase in funding would have a proportionately different effect on boating and towpath users, resulting in a total increase over the baseline of 23% and 47% respectively over years 1-15. This equates to an increase in boating visits from 19,300 to 23,700 per year on average and an increase in towpath visits from 500,000 to 729,000 on average along this stretch of the canal (see footnote 32).

Angling is not expected to increase under Scenario 2 and is expected to remain at baseline levels throughout the 15 year appraisal period.

Property premiums are expected to increase from +5% to +8% above average property values, resulting in an EAV of £36k compared to £23k for the baseline. This growth of £13k (EAV) is assumed to reflect the increase in amenity value due to improvements in the waterway environment.

The application of these assumptions across a 15 year appraisal period has resulted in the benefit estimates as shown in Table 12. Overall, the application of Scenario 1 could result in a 56% reduction in the benefits which are realised at this site. Scenario 2, as modelled, is expected to result in an 86% increase in benefits above those currently realised under the baseline.

Table 12 Case Study 2 - Caldon Canal – Results (£'000, EAV)

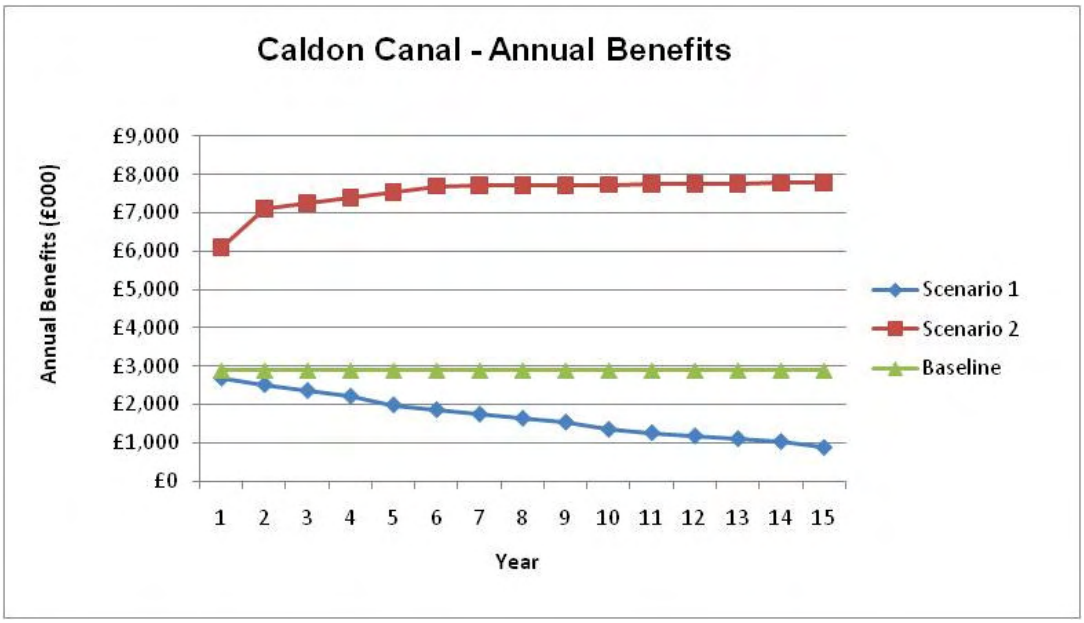
Benefit	Baseline	Scenario 1	Scenario 2
Property premium	£23	£0	£36
Boating*	£287	£178	£413
Towpath visits**	£3,638	£1,527	£6,981
Angling	£100	£61	£100
Sum Value	**£4,048**	**£1,766**	**£7,530**
Percentage change over baseline	**-**	**-56%**	**86%**

** Includes canoeing/ kayaking*
***All visits include walkers, cyclists and other casual users (picnics, photographers etc).*
Note: See Appendix B for details of how these values have been estimated.

Figure 4 presents the undiscounted benefits arising in each year for those benefit categories valued.

Because the benefit values are driven largely by towpath visits, the decline in benefits under Scenario 1 appears linear. There is a sharp increase in benefits over years 1-2 under Scenario 2 attributed to early growth in towpath visits. Towpath visits continue to increase at a modest rate over years 3-6 before stabilising.

Figure 4: Caldon Canal – Annual benefits (undiscounted)



4.4 Case Study 3 – Lancaster Canal

The Lancaster Canal is 55 miles long and extends from Preston to Kendal in Lancashire; however only 42 miles are open to navigation – from Preston to Tewitfield. The northernmost reaches have been severed in three places by construction of the M6 motorway and the A590 road near Kendal.

The Lancaster Canal is described as one of the most scenic canals on the network, offering views of the Silverdale coast, the Forest of Bowland and the rolling countryside of Wyre. Being a contour canal, it boasts the longest stretch of lock-free canal in the country (41 miles).

Though the canal was once heavily used to transport goods to and from Kendal, Preston and Lancaster, it was only connected to the national waterway network in 2002 via the Millennium Ribble Link. This allows boat users from anywhere on the waterway system to access the canal for cruising. There are several boat hire facilities based on the canal as well as a variety of cruises on offer. A waterbus also operates during the summer months, re-enacting a 200 year old tradition.

The canal is also important for both commercial and recreational fishing. Angling is particularly popular between Preston and Carnforth, although the northern reaches offer good opportunities for catching tench and carp.

Thanks to a recent upgrade, the canal towpath is available for cycling from Lancaster to Carnforth and provides an attractive cycle route around the east of Lancaster city centre, avoiding the busy main roads.

Long term plans are being developed to restore the northern section of the canal from Tewitfield to Kendal thanks to the Lancaster Canal Restoration Partnership which is comprised of nine partners including British Waterways, the Inland Waterways Association, Cumbria County Council, and the Waterways Trust, among others.

The restoration will involve restoring the canal in six places where it is currently culverted, restoring the Hincaster Tunnel, as well as minor works on 52 listed structures. It is estimated that the engineering and construction costs will total £60M and will be completed in several phases. The first planned phase will be to restore 3.7 miles of canal from Canal Head in Kendal south to Natland Road. Funding was secured in 2005; however after several delays work had still not commenced at the beginning of 2011.

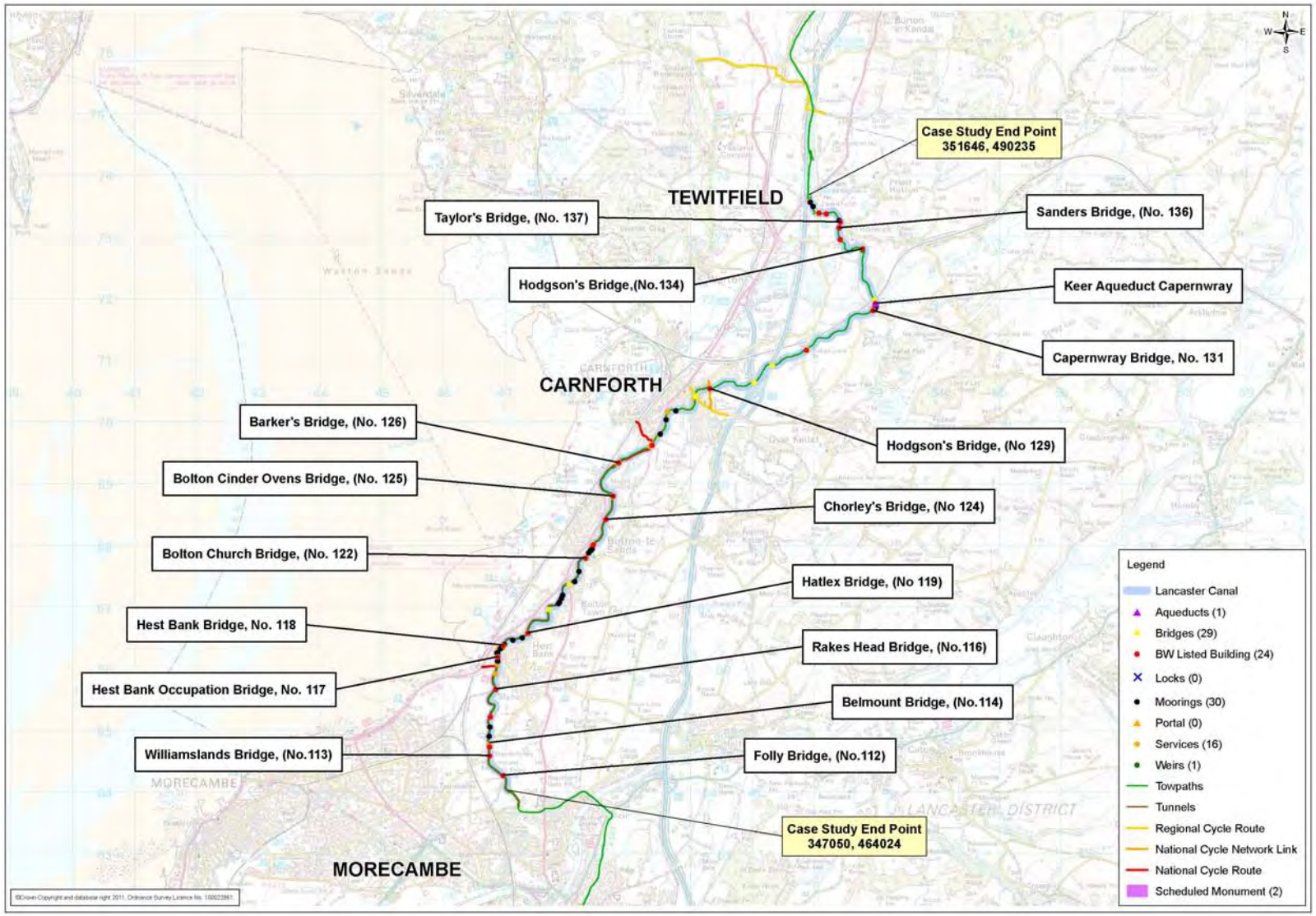
This case study considers the rural stretch of the Lancaster Canal from the northern outskirts of Lancaster to the current canal terminus, approximately 9 miles long (see Figure 5). This stretch is classified as category 1c – Canal/ Rural/ Low boat density. According to British Waterways data there are approximately 3,250 boat movements per year from Lancaster (Lune Aqueduct) to Bolton-le-Sands and 2,500 from Bolton-le-Sands to Tewitfield. This equates to an estimated 9,900 person boat days on the case study stretch[37].

Data on towpath and angling visits are based on the 1996 IWDVS, which is considered to be reflective of current use levels. According to this data, towpath visits are estimated to number 743,000 per year under the baseline – a relatively low density of 46,000 per km per year[38].

[37] Calculated based on BW assumptions for boat speed, hours spent cruising per day and mean crew size.

[38] According to BW data for various locations across the network, densities range from 9,000 to ~821,000 visits per km per year.

Figure 5: Lancaster Canal – Case study stretch



Key assumptions applied in the assessment are listed in Tables 1, 2 and 3 for each of the benefit categories. Individual observations under each scenario are noted below.

Baseline: In estimating the EAV of this scenario, the annual benefits estimated were assumed to remain stable over the entire fifteen year appraisal period.

Under Scenario 1, boating visits are predicted to decrease from 14,000[39] per year to 8,000 per year (averaged over 15 years), resulting in a reduction in benefits from £185k to £114k in EAV. Towpath visits are expected to decrease from 743,000 to 437,000 per year on average, resulting in a reduction in benefits from £5.42M to £2.28M in EAV.

A comparatively small number of angling visits are reported on this stretch – approximately 4,000 per year under the baseline[40]. These visits are expected to decline at the same rate as general towpath visits (see assumptions in Table 5).

The change in property premium assumed for Scenario 1 is equivalent to a loss of 5% of the value for those properties within 50 m of the waterway. For the 670 properties within this distance of the Lancaster Canal case study stretch, this equates to a loss of approximately £651k in benefits (EAV).

Scenario 2 predicts that boat movements will increase by 2.5% per annum and towpath visitors will increase by 18% per annum over years 1-2, by 2% over years 3-6, before stabilising over years 7-15. This results in an increase from 14,000 to 17,000 boating visits and from 743,000 to 1.09M towpath visits per year, averaged over the 15 years. The benefit values associated with this increased recreational usage are £248k in EAV (a 34% increase over baseline) for boating and £10.38M in EAV (a 92% increase over baseline) for towpath visits.

Angling is not expected to increase under Scenario 2 and remain at baseline levels throughout the 15 year appraisal period.

The property premium under Scenario 2 is assumed to increase the value of properties within 50m of the canal by 3% (from +5% to +8% premium above average prices), which equates to ~ £1M in EAV, an increase of £390k over the baseline.

The application of these assumptions across a 15 year appraisal period has resulted in the benefit estimates as shown in Table 13. Overall, the application of Scenario 1 could result in a 61% reduction in the benefits which are realised at this site. Scenario 2, as modelled, is expected to result in an 85% increase in benefits above those currently realised under the baseline.

[39] Note this figure includes unpowered boating visits whereas the previously stated 9,900 person boat days relates to powered boats only.

[40] Angling is thought to be predominantly concentrated on the southern reaches between Preston and Carnforth – outside of the case study stretch.

Table 13: Case Study 3 – Lancaster Canal – Results (£'000, EAV)

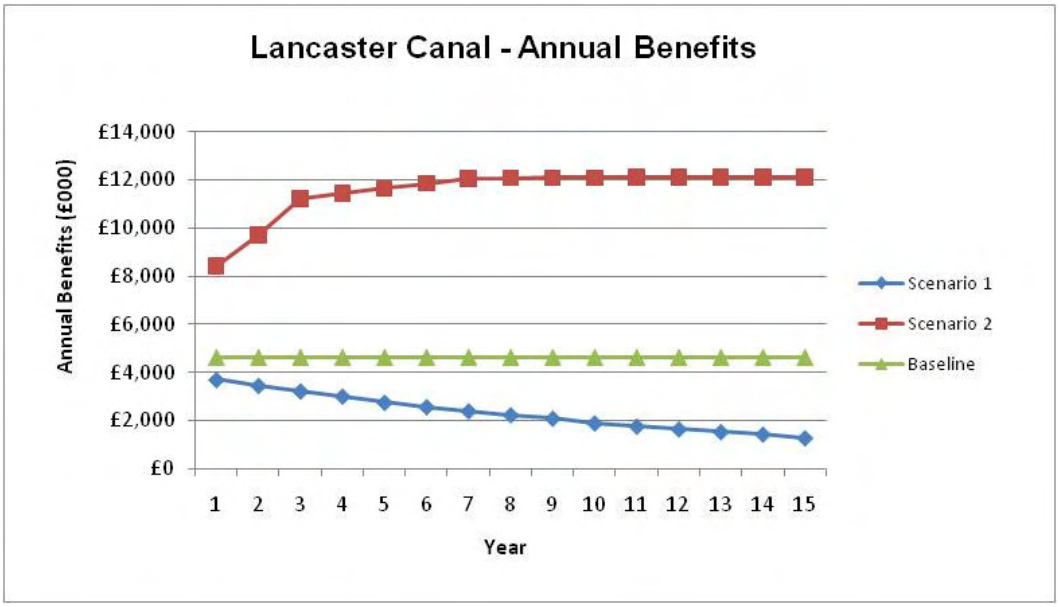
Benefit	Baseline	Scenario 1	Scenario 2
Property premium	£651	£0	£1,041
Boating*	£185	£114	£248
Towpath visits**	£5,420	£2,281	£10,380
Angling	£80	£49	£80
Sum Value	**£6,335**	**£2,444**	**£11,749**
Percentage change over baseline	**-**	**-61%**	**85%**

** Includes canoeing/ kayaking*
***All visits include walkers, cyclists and other casual users (picnics, photographers etc).*
Note: See Appendix B for details of how these values have been estimated.

Figure 6 presents the undiscounted benefits arising in each year for those benefit categories valued.

The benefit values on the Lancaster Canal are dominated by the decrease and increase in towpath visits generated under Scenarios 1 and 2, respectively.

Figure 6: Lancaster Canal – Annual benefits (undiscounted)



4.5 Case Study 4 – Pocklington Canal

The Pocklington Canal is a broad canal which runs for 9.5 miles in East Riding of Yorkshire from Canal Head near Pocklington to the River Derwent at East Cottingwith. It is classified as category 1c – Canal/ Rural/ Low boat density. See Figure 7 for a schematic of the canal.

Originally built in 1818 in order to transport coal and agricultural produce, the Pocklington Canal was never a great financial success, mainly because the proposed extension to continue the canal into Pocklington never came to pass. Goods had to be transferred to horse-drawn carts at the terminus in order to continue the journey down the Hull-York turnpike road.

Like many others, the canal became derelict due to lack of dredging and maintenance work when the waterway fell into railway ownership. When the railways were nationalized in 1948, ownership passed to the British Transport

Commission and then to the British Waterways Board, the precursor to British Waterways. A proposal was put forward to infill the canal with "inoffensive sludge" from a nearby water treatment plant; however this was met with opposition from local residents, landowners and members of the Inland Waterways Association.

Eventually with the support of the Inland Waterway Protection Society, the Pocklington Canal Amenity Society (PCAS) was established in 1969 to protect and restore the canal.

Due to its rural location, the canal has remained essentially as it was built; although considerable work has been carried out over the years to restore it to working condition. Currently, the canal is only partially navigable, from the River Derwent to the Melbourne Arm; this section is approximately 5 miles long and passes through two locks. Of the remaining seven locks on the non-navigable section, four have been restored and three are yet to be restored. The canal passes through three Sites of Special Scientific Interest, which means that all work must have the consent of Natural England.

Perhaps it is because the remaining section is un-restored and therefore undisturbed that the canal is a haven for wildlife. Nature enthusiasts can spot barn owls, thirteen species of dragonflies, waterlilies, forget-me-not, and plenty of grassland plants. The canal is designated as a Site of Special Scientific Interest (SSSI) and British Waterways has recently announced that the Pocklington Canal is in the top ten places for wildlife on their waterways.

In addition to the nine locks on the Pocklington Canal, there are 11 bridges which are all important heritage features.

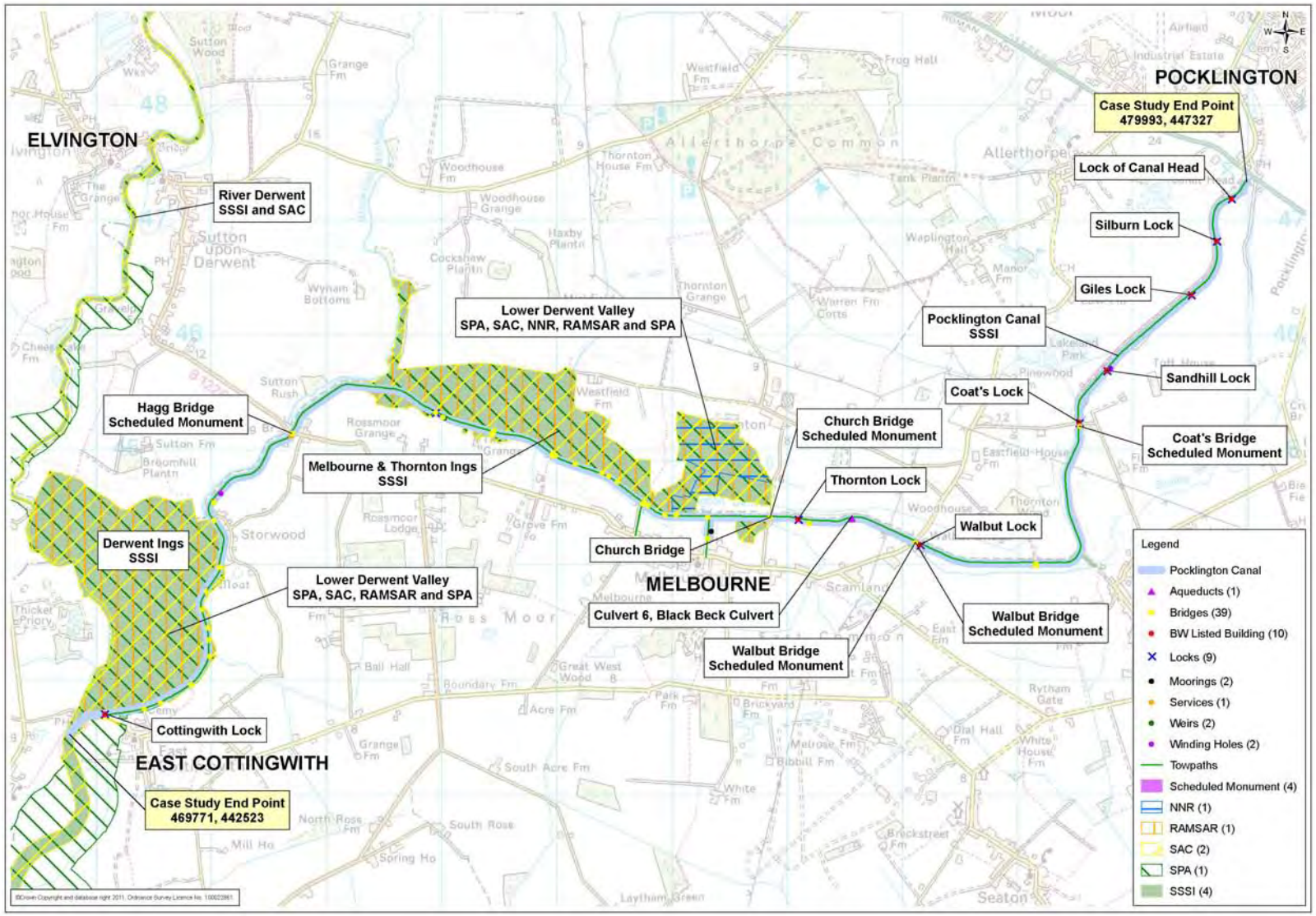
The terminus at Canal Head is a popular picnic site which is signposted on the busy A-road between Hull and York. There are two carparks and an information centre run by the PCAS.

The rest of the canal is usually very quiet. There is a narrow towpath which runs along the entire 9.5 miles of the canal; however cyclists are only permitted for the 1.5 miles from Coates Lock to the canal head in Pocklington. Fishing platforms are also available, although the upper reaches are gradually becoming overgrown with vegetation. The PCAS also runs short boat trips on Sundays and Bank Holidays and the use of small private boats and canoes is encouraged.

According to British Waterways data, there are approximately 140 boat movements per annum on the navigable stretch, equating to approximately 240 person boat days[41] and a relatively high density of towpath users (approximately 371,000 visitors per year or 24,000 per km per year). Approximately 1,000 angling visits also take place on the canal each year. Data on towpath and angling visits are based on the 1996 IWDVS, which is considered to be reflective of current use levels.

[41] This figure does not include canoes and other unpowered boats.

Figure 7: Pocklington Canal – Case study stretch



Baseline: In estimating the EAV of this scenario, the annual benefits estimated were assumed to remain stable over the entire fifteen year appraisal period.

Under Scenario 1, boating visits are predicted to decrease from 1,200[42] per year to 700 per year (averaged over 15 years), resulting in a reduction in benefits from £7k to £4k in EAV. Towpath visits are expected to decrease from 371,000 to 218,000 per year on average, resulting in a reduction in benefits from £2.73M to £1.14M in EAV.

Angling visits are expected to decline at the same rate as general towpath visits (see Table 5), from 1,000 per year to 600 per year, on average.

The change in property premium assumed for Scenario 1 is equivalent to a loss of 5% of the value for those properties within 50 m of the waterway. For the 6 properties within this distance of the Pocklington Canal, this equates to a loss of approximately £7k in benefits (EAV).

Scenario 2 predicts that boat movements will increase by 2.5% per annum and towpath visitors will increase by 18% per annum over years 1-2, by 2% over years 3-6, before stabilising over years 7-15. This results in an increase from 1,200 to 1,500 boating visits and from 371,000 to 544,000 towpath visits per year, averaged over the 15 years. The benefit values associated with this increased recreational usage are £9k in EAV (a 26% increase over baseline) for boating and £5.26M in EAV (a 92% increase over baseline) for towpath visits.

It is worth noting that increase boat traffic on Pocklington could have an adverse impact on the nearby SSSIs. It is assumed, therefore, that adequate mitigation measures would be put in place under Scenario 2 in order to prevent any degradation of the environment.

Angling is not expected to increase under Scenario 2 and remain at baseline levels throughout the 15 year appraisal period.

The property premium under Scenario 2 is assumed to increase the value of properties within 50m of the canal by 3% (from +5% to +8% premium above average prices), which equates to of £11k in EAV, a growth of £4k in annual benefits.

Table 14 shows the total benefit values accrued over the 15 year appraisal period. Overall, Scenario 1 would result in a 58% reduction in benefits realised at this canal site. Scenario 2 on the other hand is expected to result in a 91% increase in benefits above the current baseline.

[42] Note this figure includes unpowered boating visits whereas the previously stated 240 person boat days relates to powered boats only.

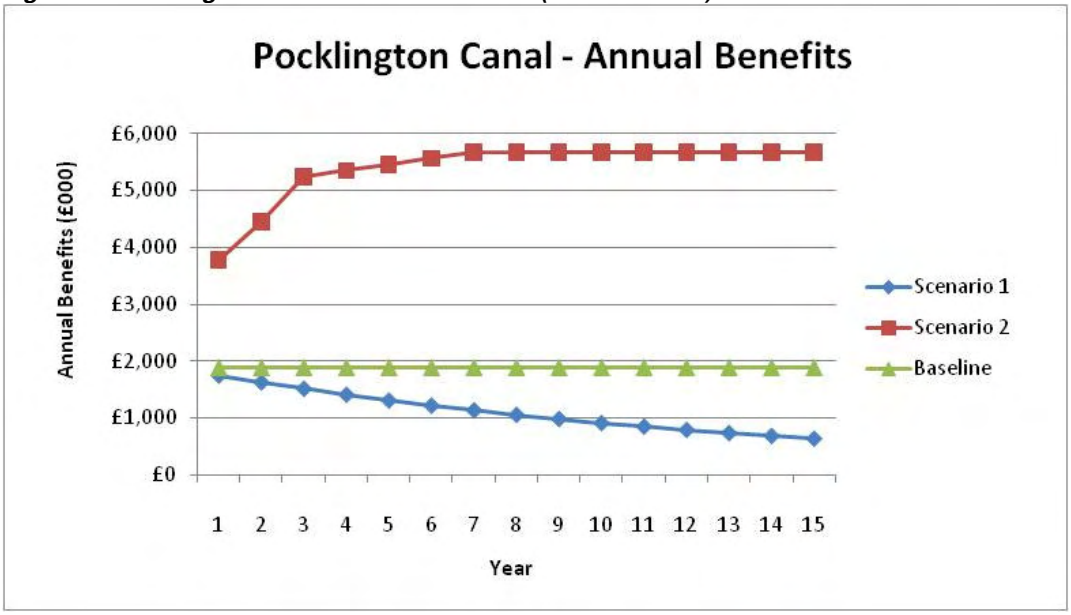
Table 14: Case Study 4 – Pocklington Canal – Results (£'000, EAV)

Benefit	Baseline	Scenario 1	Scenario 2
Property premium	£7	£0	£11
Boating*	£7	£4	£9
Towpath visits**	£2,731	£1,142	£5,255
Angling	£20	£12	£20
Sum Value	**£2,765**	**£1,159**	**£5,295**
Percentage change over baseline	**-**	**-58%**	**91%**

**Includes canoes and unpowered boating visits*
***Includes cycling visits*
Note: See Appendix B for details of how these values have been estimated.

Figure 8 presents the undiscounted benefits arising in each year for those benefit categories valued.

Figure 8: Pocklington Canal – Annual benefits (undiscounted)



4.6 Case Study 5 – Leeds and Liverpool Canal

The Leeds and Liverpool Canal extends over 127 miles from Leeds to Liverpool and is the longest canal in Northern England. The canal joins onto the Aire and Calder Navigation at Leeds, and also provides access to the Ribble Link and the Lancaster Canal.

It was the first of the Trans-Pennine canals to begin construction in 1770 and took 46 years to complete due to the complexity of the route. There are 91 locks and a summit level of 487 feet. The engineering of the canal differs from other Trans-Pennine routes in that most of the locks are concentrated in flights. The most spectacular of these is the five rise lock staircase at Bingley (see Figure 9).

There are long level sections between these flights which are perfect for cruising. Tunnels and cuttings were avoided where possible so the canal follows the contours of the land round bends and loops, allowing boaters to enjoy meandering through the countryside.

Figure 9: Bingley Five Rise Staircase Locks

Unlike other canals which were greatly impacted by the railway age, the Leeds and Liverpool Canal continued to be used through the nineteenth century for carrying stone, coal and other goods. However commercial traffic began to dwindle when lorries were introduced. Commercial traffic ceased in 1964 and regular work stopped in 1972.

The leisure potential of the canal began to be appreciated over time and many boatyards, marinas and boat hire companies are now established along the canal. The canal is popular with boaters, however the number of boat movements per year is less than ten per mile – well under the national average.

Aside from boating, the canal is also popular for walking, cycling and fishing, attracting approximately 10% of the total leisure visits for all Britain's canals[43].

This case study considers a section of the canal from Colne (Foulridge) to Skipton (see Figure 10). This 17.5 mile long stretch is classified as category 1b – Canal/ Rural/ Medium boat density.

A description of the navigation follows:

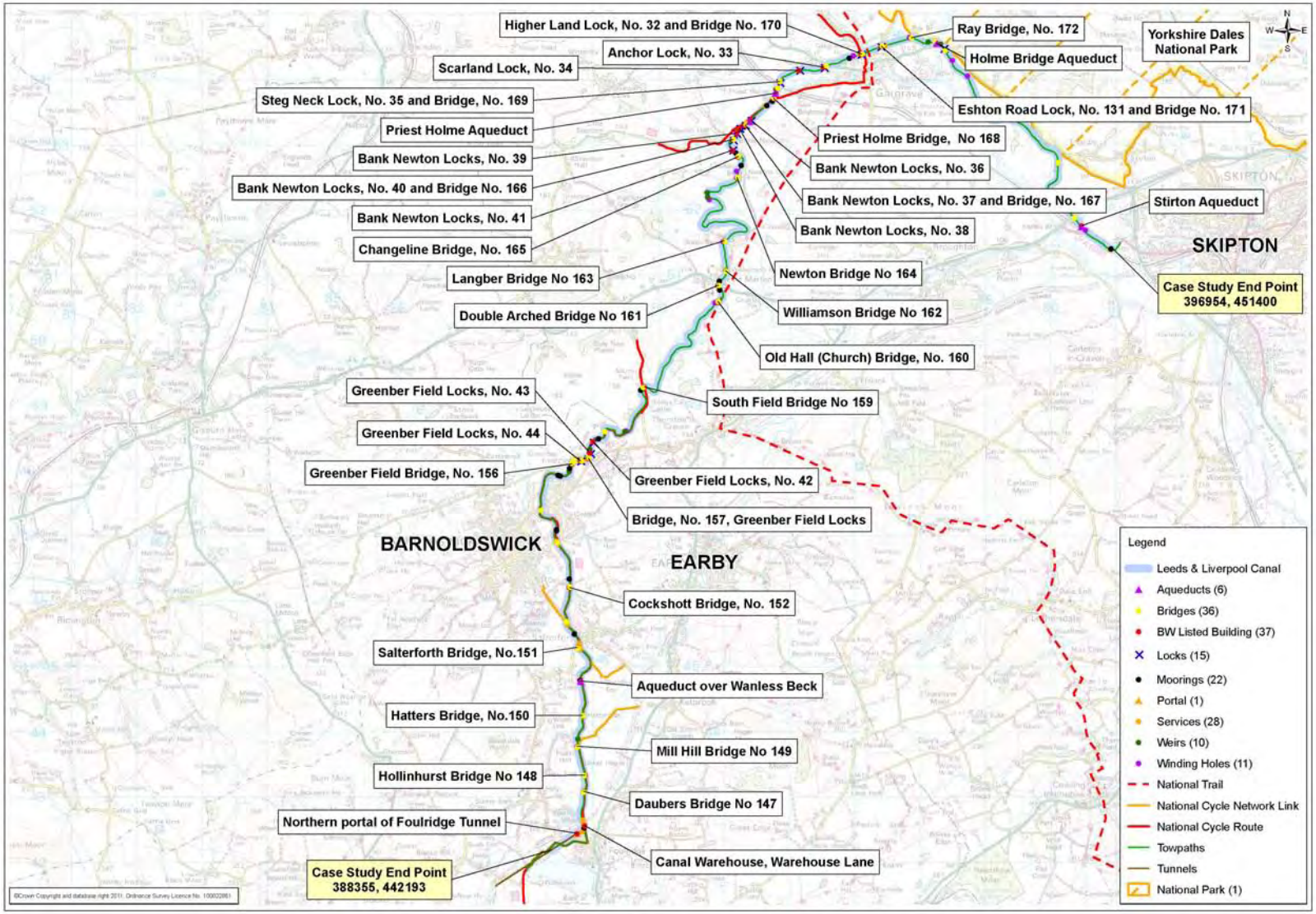
- Foulridge to Greenber Field (5 miles). From the tunnel at Foulridge to the locks at Greenber Field the canal passes through green fields however there are remnants of industry along the way including the Rolls Royce factory at Barnoldswick and abandoned railway embankments at Salterforth and Foulridge.
- Greenber Field to Gargrave (6 miles). From the locks at Greenber Field to the town of Gargrave the canal is 'at its most serpentine' as it winds along the contour.
- Gargrave to Skipton (6 miles). On this stretch the canal follows the Gargrave to Skipton road, passing through green fields and farms.

[43] http://www.llcs.org.uk/whitep14.htm

According to British Waterways data, there are approximately 4,000 boat movements per annum on the stretch from Colne to Skipton, equating to approximately 27,000 person boat days[44]. Data on towpath and angling visits are based on the 1996 IWDVS, which is considered to be reflective of current use levels. According to this data an estimated 2.77M towpath visits take place on the case study stretch every year (a relatively high density of 95,000 per km per year).

[44] Boat movements are converted to person boat days according to BW assumptions around boat speed, the time required to pass through a lock, average hours spent cruising per day and mean crew size.

Figure 10: Leeds and Liverpool Canal – Case study stretch



Key assumptions applied in the assessment are listed in Table 4, 5 and 6 for each of the benefit categories. Individual observations under each scenario are noted below.

Baseline: In estimating the EAV of this scenario, the annual benefits estimated were assumed to remain stable over the entire fifteen year appraisal period.

Under Scenario 1, boating visits are predicted to decrease from 50,000[45] per year to 30,000 per year (averaged over 15 years), resulting in a reduction in benefits from £571k to £349k in EAV. Towpath visits are expected to decrease from 2.77M to 1.63M per year on average, resulting in a reduction in benefits from £21.18M to £9.02M in EAV.

Angling visits are expected to decline at the same rate as general towpath visits (see Table 5), from 14,000 per year to 8,000 per year, on average.

The change in property premium assumed for Scenario 1 is equivalent to a loss of 5% of the value for those properties within 50 m of the waterway. For the 226 properties within this distance of the Leeds and Liverpool canal case study stretch, this equates to a loss of approximately £192k in benefits (EAV).

Scenario 2 predicts that boat movements will increase by 2.5% per annum and towpath visitors will increase by 18% per annum over years 1-2, by 2% over years 3-6, before stabilising over years 7-15. This results in an increase from 50,000 to 61,000 boating visits and from 2.77M to 4.06M towpath visits per year, averaged over the 15 years. The benefit values associated with this increased recreational usage are £775k in EAV (a 36% increase over baseline) for boating and £38.51M in EAV (a 91% increase over baseline) for towpath visits.

Angling is not expected to increase under Scenario 2 and remain at baseline levels throughout the 15 year appraisal period.

The property premium under Scenario 2 is assumed to increase the value of properties within 50m of the canal by 3% (from +5% to +8% premium above average prices), which equates to of £307k in EAV, a growth of £115k in annual benefits.

The application of these assumptions across a 15 year appraisal period has resulted in the benefit estimates as shown in Table 15. Overall, Scenario 1 could result in a 57% reduction in the benefits which are realised at this site. Scenario 2, as modelled, is expected to result in an 88% increase in benefits above those currently realised under the baseline. This is again driven primarily by the increase in towpath visits expected.

[45] Note this figure includes unpowered boating visits whereas the previously stated 27,000 person boat days relates to powered boats only.

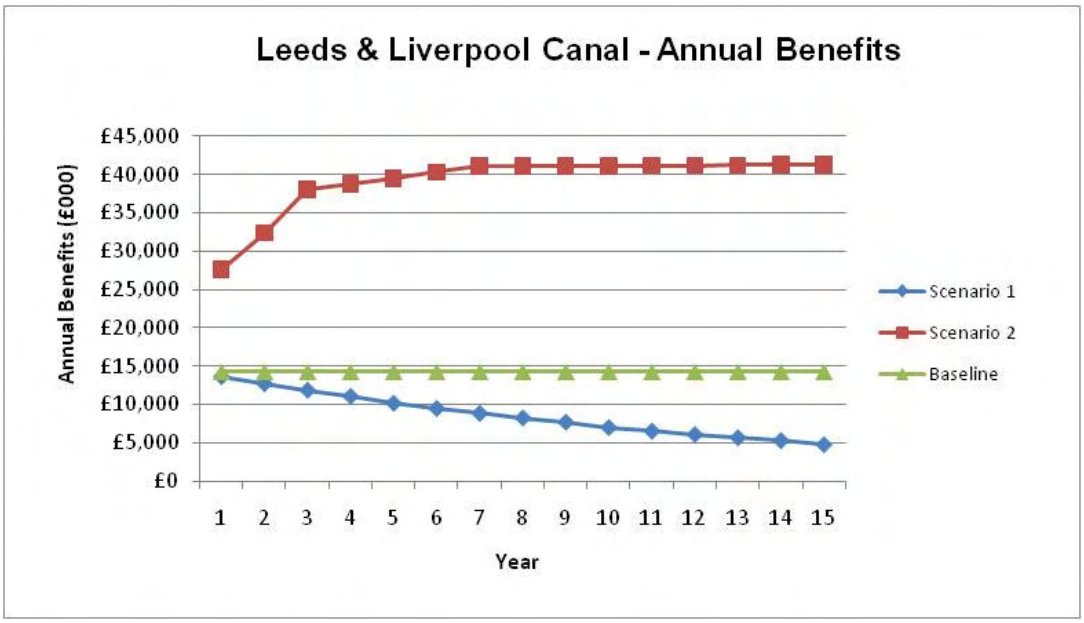
Table 15 Case Study 5 – Leeds and Liverpool Canal – Results (£'000, EAV)

Benefit	Baseline	Scenario 1	Scenario 2
Property premium	£192	£0	£307
Boating*	£571	£349	£775
Towpath visits	£20,135	£8,495	£38,507
Angling	£280	£172	£280
Sum Value	**£21,178**	**£9,016**	**£39,869**
Percentage change over baseline		**-57%**	**88%**

** Includes canoeing/ kayaking*
***All visits include walkers, cyclists and other casual users (picnics, photographers etc).*
Note: See Appendix B for details of how these values have been estimated.

Figure 11 presents the undiscounted benefits arising in each year for those benefit categories valued.

Figure 11 Leeds and Liverpool Canal – Annual benefits (undiscounted)



4.7 Case Study 6 – Coventry Canal

The Coventry Canal begins in Coventry and ends 38 miles north at Fradley Junction, just north of Lichfield, where it joins the Trent and Mersey Canal. The canal passes through a number of small towns – Bedworth, Nuneaton, Atherstone, Polesworth and Tamworth. It also joins onto the Oxford Canal, the Ashby Canal and the Birmingham and Fazeley Canal at various points, forming part of the Warwickshire ring.

Opened in 1789 for the purpose of transporting coal from Coventry to the rest of the midlands, the Coventry Canal is not known for being particularly scenic. However, it is an important link between the northern and southern canal networks, allowing boaters to bypass Birmingham. The canal is very popular with boaters and there are several purpose built marinas with spare moorings difficult to find.

Much of the canal runs through semi-rural surroundings. The section from the junction with the Trent and Mersey Canal at Fradley south to Fazeley is

predominantly rural. From Fazeley south to Coventry, there has been extensive development of what was once derelict land.

This case study considers the 10 mile section from Nuneaton to Coventry which is classed as category 2a – Canal/ Urban/ High boat density (see Figure 12). South of Nuneaton the canal meets the Ashby Canal at Marston Junction. A mile further the canal meets the Oxford Canal at Hawkesbury junction before meandering another 5.5 miles to Coventry city centre.

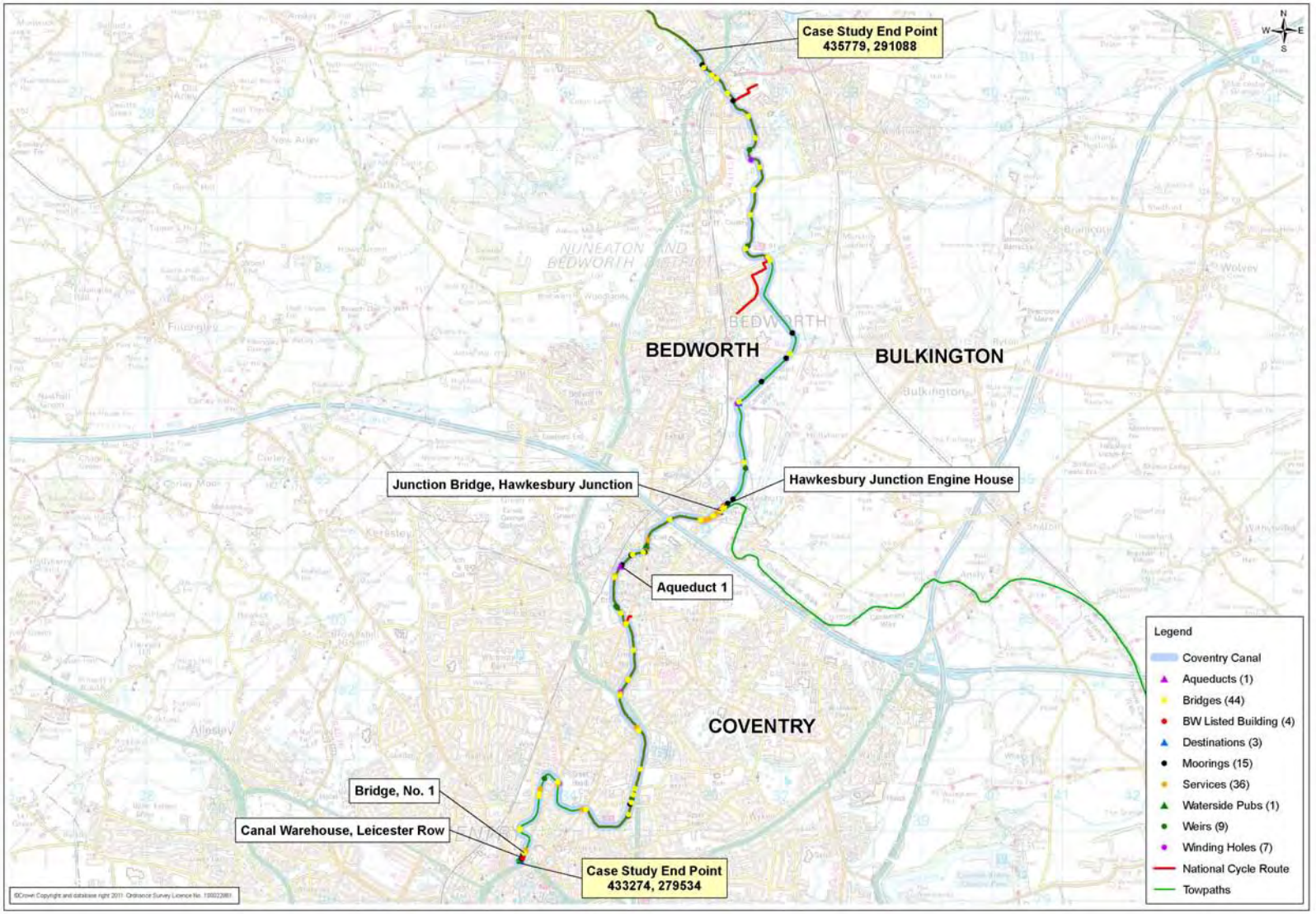
This 5.5 mile stretch was transformed following a major investment programme in the 1990s, which included the creation of 'pocket parks' and towpath improvements. It is now referred to as the Coventry Canal Art Trail as there are 39 art installations adjacent to the canal. There are some 20 new access points, each with an information panel describing the area and distance to the next point.

Thanks to towpath improvements this stretch is also part of the National Cycle Network and provides a flat and traffic-free commuting route through the city.

Coventry is a popular fishing spot, with over ten types of fish present and 12 angling associations registered on the canal. However, it is thought that these are concentrated away from areas of heavy boat traffic.

According to British Waterways data, there are approximately 8,300 boat movements per year from Nuneaton to Hawkesbury and 5,000 from Hawkesbury to Coventry. This equates to approximately 25,500 person boat days on this stretch of the canal. The 1996 Day Visitor Survey reported approximately 528,000 towpath visits (including informal visits and cyclists) on this stretch per year. To arrive at current baseline figures, the 1996 data were increased by 108%, a proportional uplift based on the percentage increase between the total British Waterways user estimates in 1996 and 2009 (166.7 and 346.3 million users respectively). This percentage increase is thought to be representative of the growth in visitors on the Kennet and Avon Canal, owing to the significant towpath improvements made in recent years.

Figure 12: Coventry Canal – Case study stretch



Baseline: In estimating the EAV of this scenario, the annual benefits estimated were assumed to remain stable over the entire fifteen year appraisal period.

Under Scenario 1, boating visits are predicted to decrease from 28,000[46] per year to 17,000 per year (averaged over 15 years), resulting in a reduction in benefits from £465k to £289k in EAV. Towpath visits are expected to decrease from 1.09M to 570,000 per year on average, resulting in a reduction in benefits from £8.01M to £3.06M in EAV.

Angling visits are expected to decline at the same rate as general towpath visits (see Table 5), from 19,000 per year to 10,000 per year, on average.

In urban locations, property premiums are predicted to decrease from +5% under the baseline to -5% below average prices (a net loss of 10%) for those properties within 25m of the waterway. For the 651 properties within this distance of the Coventry canal case study stretch, this equates to a loss of £972k in benefits (EAV).

Scenario 2 predicts that boat movements will increase by 2.5% per annum and towpath visitors will increase by 30% per annum[47] over years 1-2, by 2% over years 3-6, before stabilising over years 7-15. This results in an increase from 28,000 to 34,000 boating visits and from 1.09M to 1.94M towpath visits per year, averaged over the 15 years. The benefit values associated with this increased recreational usage are £637k in EAV (a 37% increase over baseline) for boating and £18.53M in EAV (a 131% increase over baseline) for towpath visits.

Angling is not expected to increase under Scenario 2 and remain at baseline levels throughout the 15 year appraisal period.

The property premium under Scenario 2 is assumed to increase the value of properties within 25m of the canal by 3% (from +5% to +8% premium above average prices), which equates to of £777k in EAV, a growth of £291k in annual benefits.

The application of these assumptions across a 15 year appraisal period has resulted in the benefit estimates as shown in Table 16. Overall, Scenario 1 could result in a 67% reduction in the benefits which are realised at this site. Scenario 2, as modelled, is expected to result in a 118% increase in benefits above those currently realised under the baseline. This means that the benefits currently delivered by the Coventry to Nuneaton stretch of the canal are expected to more than double, primarily due to the increase in towpath visits. This percentage growth is higher than the other case study sites because Coventry is an

[46] Note this figure includes unpowered boating visits whereas the previously stated 25,500 person boat days relates to powered boats only.
[47] Note the higher growth rate in towpath visits assumed for urban locations.

Table 16 Case Study 6 – Coventry Canal – Results (£'000, EAV)

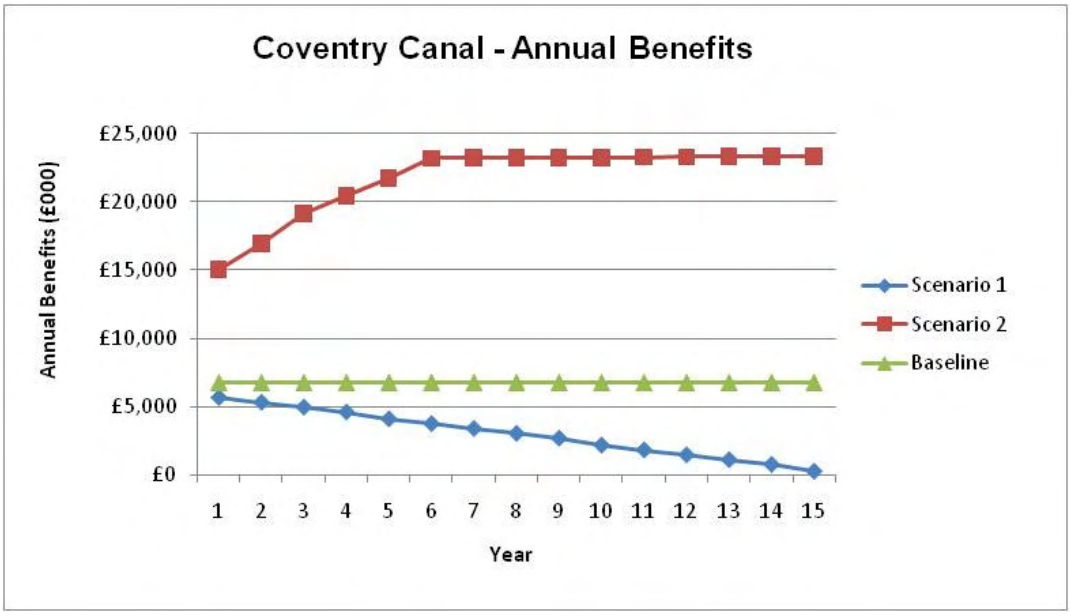
Benefit	Baseline	Scenario 1	Scenario 2
Property premium	£486	-£486	£777
Boating*	£465	£289	£637
Towpath visits**	£8,014	£3,061	£18,529
Angling	£373	£208	£373
Sum Value	**£9,337**	**£3,072**	**£20,316**
Percentage change over baseline	**-**	**-67%**	**118%**

** Includes canoeing/ kayaking*
***All visits include walkers, cyclists and other casual users (picnics, photographers etc).*
Note: See Appendix B for details of how these values have been estimated.

Figure 13 presents the undiscounted benefits arising in each year for those benefit categories valued.

Again, towpath visits are driving the dramatic split between Scenarios 1 and 2 as the number of visitors is expected to decline/ increase at a greater rate due the urban location.

Figure 13: Coventry Canal – Annual benefits (undiscounted)



4.8 Case Study 7 – Rochdale Canal

The Rochdale Canal runs for 51km (32 miles) between Manchester and Sowerby Bridge in West Yorkshire. The canal was known as the "Everest of Canals" thanks to the numerous locks that were built to straddle the Pennines.

Once a busy cross-country commercial route, the canal closed to navigation in 1952. It re-opened in 2002 following an investment of £23.8m for restoration works. This was largely funded by English Partnerships and the National Lottery (Millennium Commission).

The section selected for consideration here stretches from Manchester to Todmorden (see Figure 14) – the urban stretch of the canal which is 43km long. The boat density on this canal is assessed to be low, based on British Waterways'

data sources. This site therefore falls into Category 2b (Low boat density, urban canal).
According to British Waterways data, there are approximately 1,800 boat movements per year from Castlefield to Ducie Street, 500 fro Ducie Street to Summit and 1800 from Summit to Hebden Bridge. Applying British Waterways assumptions with regard to cruising speed, hours spent cruising per day and mean crew size, it is estimated that 9,100 person boat days occur on the case study stretch under the baseline.

The data for towpath visits used to undertake this assessment comes from the recently completed economic evaluation report on the Rochdale and Huddersfield Narrow Canals (Jacobs, 2010) which estimates the benefits that have been realised on the waterway since 2003. From this study, it is estimated that 3.99M towpath visits and 6,000 angling visits occur on the case study stretch each year. It is also from this study that the average growth rates were generated to build up the case study assumptions in Table 5 and Table 6.

Under Scenario 1, boating visits are predicted to decrease from 9,100[48] per year to 5,500 per year (averaged over 15 years), resulting in a reduction in benefits from £163k to £101k in EAV. Towpath visits are expected to decrease from 3.99M to 2.01M per year on average, resulting in a reduction in benefits from £29.07M to £11.13M in EAV.

Angling visits are expected to decline at the same rate as general towpath visits (see Table 5), from approximately 6,000 per year to 3,000 per year, on average.

The change in property premium assumed for Scenario 1 is equivalent to a loss of 10% of the value for those properties within 25 m of the waterway (from +5% above average prices to -5% below average prices). For the 1,222 properties within this distance of the Rochdale canal case study stretch, this equates to a loss of approximately £1.92M in annual benefits (EAV).

Scenario 2 predicts that boat movements will increase by 2.5% per annum and towpath visitors will increase by 30% per annum over years 1-2, by 2% over years 3-6, before stabilising over years 7-15. This results in an increase from 9,100 to 11,100 boating visits per year and from 3.99M to 7.08M towpath visits per year, averaged over the 15 years. The benefit values associated with this increased recreational usage are £637k in EAV (a 37% increase over baseline) for boating and £18.53M in EAV (a 131% increase over baseline) for towpath visits.

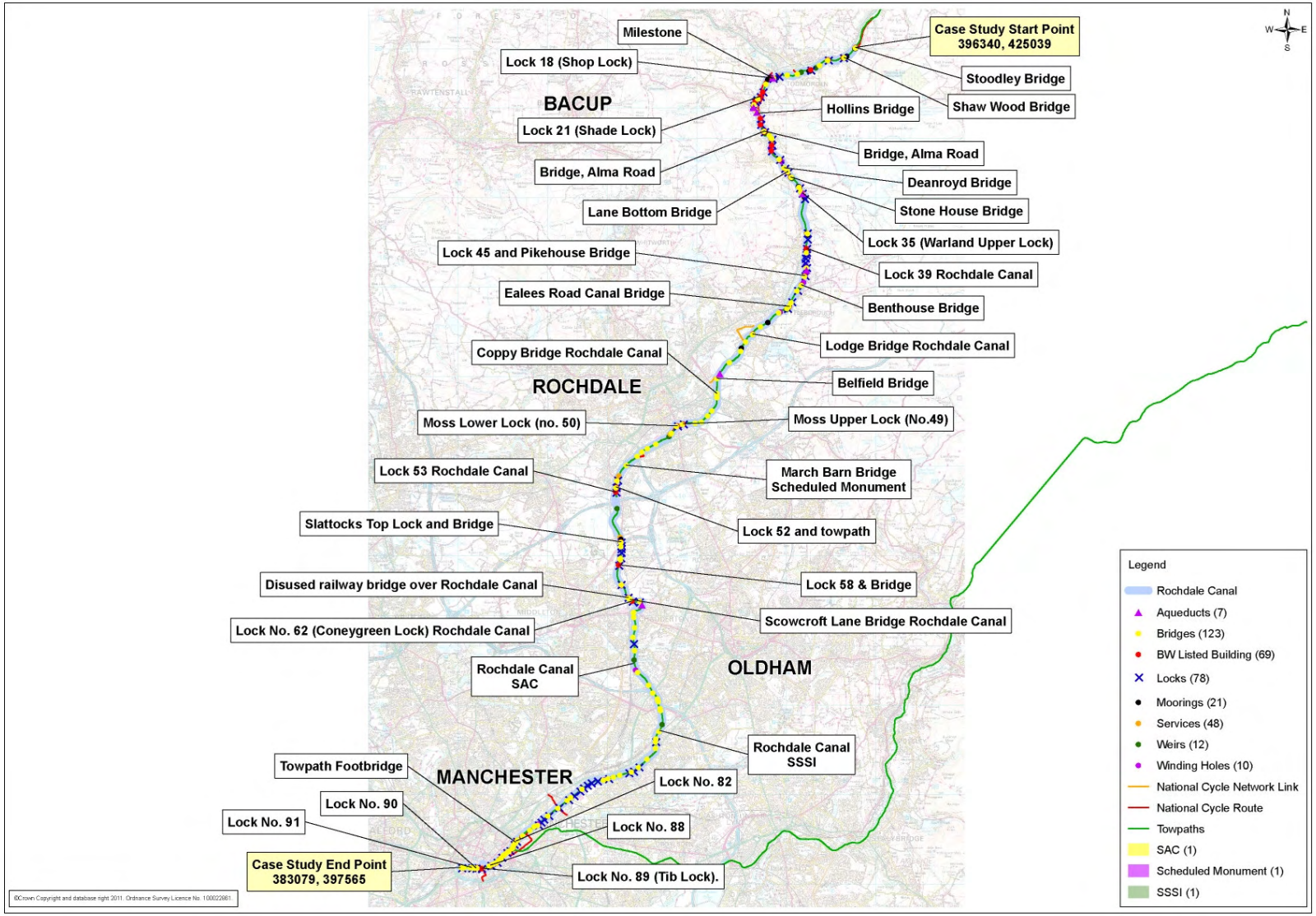
It is important to note here again that these figures have not been adjusted for displacement. This means that a proportion of the increased visits to the Rochdale Canal under Scenario 2 may be displaced from other waterway locations and therefore not represent a true increase across the network.

Angling is not expected to increase under Scenario 2 and remain at baseline levels throughout the 15 year appraisal period.

The property premium under Scenario 2 is assumed to increase the value of properties within 25m of the canal by 3% (from +5% to +8% premium above average prices), which equates to of £1.54M in EAV, a growth of £577k in annual benefits.

[48] Note – there is no data available for unpowered boating activity on the Rochdale Canal; therefore this figure refers to powered boat visits only (person-boat-days).

Figure 14 Rochdale Canal – Case study stretch



As shown in Table 17, the application of these assumptions across a 15 year appraisal period result in a 66% reduction in benefits over the baseline for Scenario 1 and a 128% increase in benefits over the baseline in Scenario 2. The main category of benefit driving the large increase in Scenario 2 is towpath visits which greatly outnumber boating visits and are assumed to experience a high rate of growth of the first two years owing to the urban location of the case study site.

Table 17 Case Study 7 – Rochdale Canal – Results (£'000 EAV)

Benefit	Baseline	Scenario 1	Scenario 2
Property premium	£962	-£962	£1,539
Boating	£163	£101	£223
Towpath visits*	£29,067	£11,128	£67,083
Angling	£113	£63	£113
Sum Value	**£30,304**	**£10,331**	**£68,958**
Percentage change over baseline	**-**	**-66%**	**128%**

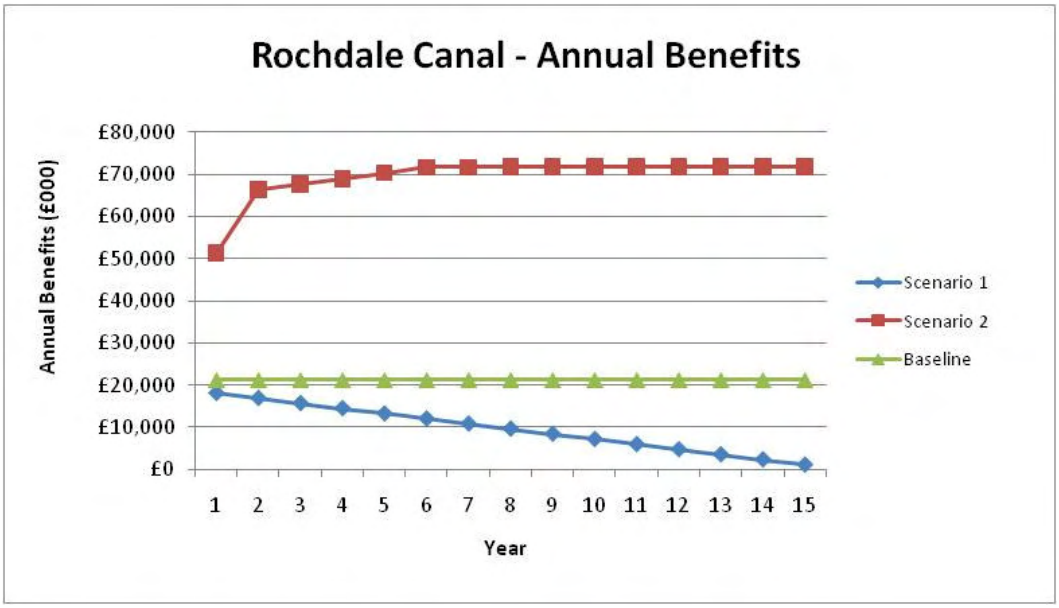
**All visits include walkers, cyclists and other casual users (picnics, photographers etc).*

Note: See Appendix A for details of how these values have been estimated.

Figure 15 presents the undiscounted benefits arising in each year for those benefit categories valued.

The decline in benefits over years 1-15 in Scenario 1 is approximately linear; whereas in Scenario 2 the benefits increase more sharply over the first six years. This is driven by towpath visits which increase over years 1-6 before stabilising. The large gap in benefits emerging early on is again driven by towpath visits which are assumed to increase by 30% in year 1 under Scenario 2, combined with an increase in WTP unit values per visit. Given that towpath visits comprise the large majority of benefits valued under the baseline, these reduction/ growth rates cause a large variation between the scenarios.

Figure 15 Rochdale Canal – Annual benefits (undiscounted)



Of all the case studies, the Rochdale Canal case study stretch is associated with the highest number of deprived LSOAs[49]. As noted in the Treasury Green Book, consideration should be given to the distributional impacts of decisions made and both the policy and project level. As such, an illustrative example of how distributional weighting analysis is completed is presented in Box 1.

[49] All of the LSOAs within a 1km buffer of the case study stretch were extracted using GIS and compared according to their IMD Rank. There are 156 such LSOAs associated with the Rochdale Canal case study stretch, of which 76 are in the top 20% most deprived in England.

Box 1 – Example distributional weighting analysis

According to the Treasury Green Book:

- Applying an explicit distributional adjustment requires quite detailed information about the affected population. A judgement must be made as to whether the necessary socio-economic information is available at an acceptable cost, given the importance of the proposal and the likely scale of the impact of distributional analysis.
- Any distributional effects identified should be explicitly stated and quantified as far as possible. At a minimum, this requires appraisers to identify how the costs and benefits accrue to different groups in society.
- Benefits accruing to households in a lower quintile should be weighted more heavily than those that accrue to households in higher quintiles.
- The impact of a proposal on an individual's well-being will vary according to income; as income grows, the satisfaction derived from an additional unit of consumption declines.
- Broadly, the empirical evidence suggests that as income is doubled, the marginal value of consumption to individuals is halved: the utility of a marginal pound is inversely proportional to the income of the recipient. In other words, an extra £1 of consumption received by someone earning £10,000 a year will be worth twice as much as when it is paid to a person earning £20,000 per annum.

In order to apply a distributional adjustment to the benefit values estimated for the Rochdale Canal case study stretch, the following approach was applied:

There are an estimated 3.99M towpath visits per year on the case study stretch of the Rochdale Canal. Of these, 2.98M are local towpath visits. In this example, distributional weighting has only been applied to local towpath visits. These are assumed to fall equally amongst the 156 LSOAs within 1km of the stretch; equating to 19,099 visits per LSOA per year.

The IMD Rank for each LSOA was assessed to determine which quintile the LSOAs fall into (i.e. the 20% most deprived in England comprising the bottom quintile and 20% least deprived comprising the 5th quintile).

The benefits arising from local towpath visits were then weighted using the distributional weights presented in the Green Book. For example, there are 76 LSOAs in the bottom quintile, therefore 76/156 (49%) of the local towpath benefits were multiplied by 2, as shown in the table below.

Quintile	Distributional Weight	Number of LSOAs	Number of local towpath visits / year
Bottom	2	76	1,451,562
2nd	1.4	44	840,378
3rd	1	22	420,189
4th	0.8	13	248,293
5th	0.5	1	19,099

By applying this weighting, the value of local towpath visits increases from £12.75M to £20.11M under the baseline. The total benefits estimated under each of the scenarios for the Rochdale Canal case study stretch are presented below, with and without distributional weighting.

	Baseline (£k)	Scenario 1 (£k)	Scenario 2 (£k)
Local Towpath visits – without weighting	£12,752	£5,873	£34,820
Local Towpath visits – with weighting	£20,109	£9,261	£54,908
Total benefits – without weighting	£30,304	£10,331	£68,958
Total benefits – with weighting	£37,661	£13,719	£89,046

4.9 Case Study 8 – Basingstoke Canal

The Basingstoke Canal is located in Southern England between the village of Grewell in Hampshire and Woodham in Surrey. It was built in the late 1700s for the purpose of transporting agricultural goods from North East Hampshire to London. Although moderately successful in its early years, competition from the railways meant that the canal lost most of its lucrative traffic by 1850. For some 65 years the canal passed through a series of private ownerships – primarily entrepreneurs trying to make money from pleasure boat hire. During the First World War, it was taken over and used to transport large amounts of materials and military supplies; however by the end of the Second World War traffic had once again declined to such a point that the canal was sold to its last private owner, the Basingstoke Canal Company. Plans were made to sell off dry sections for development until a group of residents campaigned to restore the canal to public ownership for use as a recreational amenity.

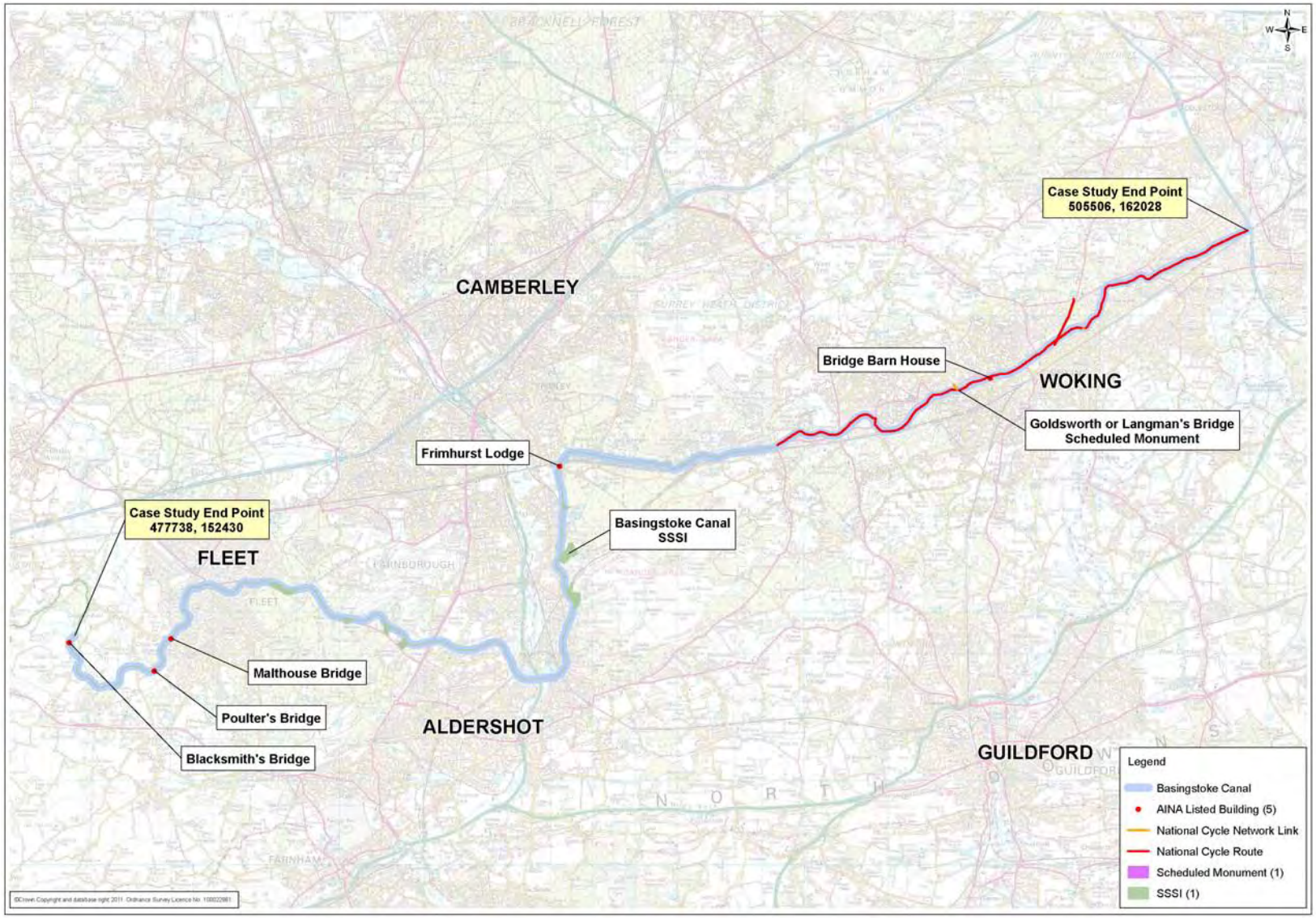
Due to exceptionally heavy rainfall in 1968, the canal burst its banks in two places, prompting a decision to be made as to whether the Basingstoke Canal should be purposefully eliminated or restored to safe standards. It was decided that the canal should be fully restored (including all 29 locks). The 32 mile stretch is now fully navigable, connecting with the River Wey Navigation just east of Woking which in turn connects to the River Thames (see Case Study 13, Section 4.14). However, due to its historic and environmental importance, the number of boat movements on the canal is restricted to a maximum of 1,300 per year.

The canal is jointly owned by Hampshire County Council and Surrey County Council; however the Basingstoke Canal Authority (part of Hampshire Council's Countryside Service unit) is responsible for managing the waterway.

This case study considers a 25 mile (41 km) stretch from Woking to Fleet which is classed as category 2c – Canal/ Urban/ Low boat density. See Figure 16 for a schematic of this stretch.

According to the Basingstoke Canal Authority, there are on average 700 boat movements on the canal per year, along with 1.5m towpath visits. In order to generate baseline visitor numbers, boat movements have been converted to person boat days by applying assumptions as to average speed, hours spent cruising per day and average crew size. Towpath visits have been split into recreational categories as follows – 93% informal visits (including local, day and overnight visitors), 4% cycling visits, 1% angling visits and 1% canoeing/unpowered boating visits. This breakdown is based on the average proportional split across recreation types on all British Waterways waterways.

Figure 16: Basingstoke Canal – Case study stretch



Under the baseline scenario, it is assumed that recreational use remains stable throughout the 15 year appraisal period.

In 2005/2006 the total annual operational costs on the Basingstoke Canal were estimated at approximately £635k. This includes among other activities £169k for routine maintenance (including brickwork, painting and sluice operation), £10k for emergency tree works, £30k for bank inspection and protection, £50k for dredging, £25k for towpath maintenance, £100k for lock and weir maintenance, and £55k for operating the visitors centre and offices. These expenditure figures provide an indication of the minimum costs involved in generating the benefits estimated under the baseline.

Under Scenario 1, boating visits are predicted to decrease from 28,500[50] per year to 17,100 per year (averaged over 15 years), resulting in a reduction in benefits from £284k to £172k in EAV. Towpath visits are expected to decrease from 1.47M to 762,000 per year on average, resulting in a reduction in benefits from £10.66M to £4.09M in EAV.

Angling visits are expected to decline at the same rate as general towpath visits (see Table 5), from approximately 18,000 per year to 10,000 per year, on average.

The change in property premium assumed for Scenario 1 is equivalent to a loss of 10% of the value for those properties within 25 m of the waterway (from +5% above average prices to -5% below average prices). For the 356 properties within this distance of the Basingstoke Canal case study stretch, this equates to a loss of approximately £1.33M in annual benefits (EAV).

Scenario 2 predicts that boat movements will increase by 2.5% per annum and towpath visitors will increase by 30% per annum over years 1-2, by 2% over years 3-6, before stabilising over years 7-15. This results in an increase from 28,500 to 35,000 boating visits per year[51] and from 1.47M to 2.60M towpath visits per year, averaged over the 15 years. The benefit values associated with this increased recreational usage are £384k in EAV (a 35% increase over baseline) for boating and £24.6M in EAV (a 131% increase over baseline) for towpath visits.

Angling is not expected to increase under Scenario 2 and remain at baseline levels throughout the 15 year appraisal period.

The property premium under Scenario 2 is assumed to increase the value of properties within 25m of the canal by 3% (from +5% to +8% premium above average prices), which equates to of £1.06M in EAV, a growth of £399k in annual benefits.

Overall, as shown in Table 18 the application of these assumptions across a 15 year appraisal period result in a 68% reduction in benefits over the baseline for Scenario 1 and a 120% increase in benefits over the baseline in Scenario 2. The main category of benefit driving the large increase in Scenario 2 is towpath visits which greatly outnumber boating visits and are assumed to experience a high rate of growth of the first two years owing to the urban location of the case study site. This table also shows that the key benefits provided by the canal under the baseline greatly exceed the estimated annual operational costs.

[50] Note this figure includes unpowered boating visits.

[51] Based on assumptions around duration of cruising visits and average crew size, it is thought that these visits would be able to be accommodated whilst not exceeding the maximum 1300 boat movements per year allowed on the canal.

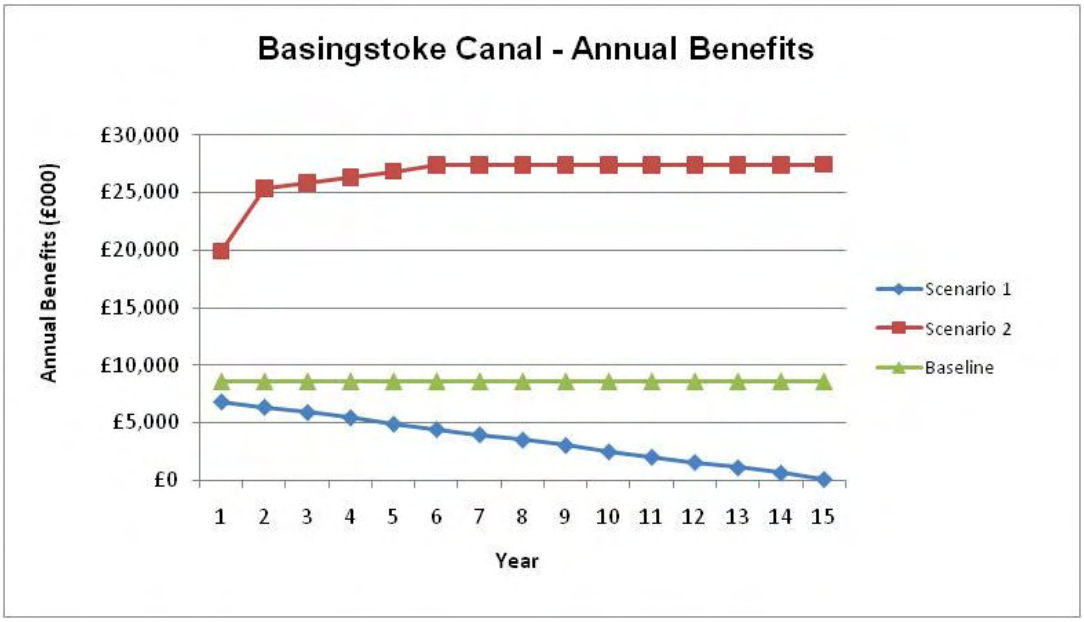
Table 18 Case Study 8 – Basingstoke Canal – Results (£000, EAV)

Benefit	Baseline	Scenario 1	Scenario 2
Property premium	£664	-£664	£1,063
Boating	£284	£172	£384
Towpath visits*	£10,657	£4,085	£24,584
Angling	£367	£205	£367
Sum Value	**£11,972**	**£3,797**	**£26,398**
Percentage change over baseline	**-**	**-68%**	**120%**

Figure 17 presents the undiscounted benefits arising in each year for those benefit categories valued.

Under Scenario 1, the benefits decrease dramatically so that by year 15, nearly all of the key benefits which the canal currently provides would be lost. This is driven by a sharp decrease in towpath visits expected because of the urban location of the canal. The growth in benefits under Scenario 2 is also driven by towpath visits which increase both in number and in value (owing to higher consumer surplus assumed for each visit).

Figure 17 Basingstoke Canal – Annual Benefits (undiscounted)



4.10 Case Study 9 – River Ancholme

The River Ancholme is a tributary of the Humber Estuary and runs for 30.4km (19 miles) from west of Market Rasen through multiple Lincolnshire villages and towns ultimately flowing into the Humber at South Ferriby (see Figure 18). The Ancholme Valley is predominantly rural in character with a landscape dominated by agriculture.

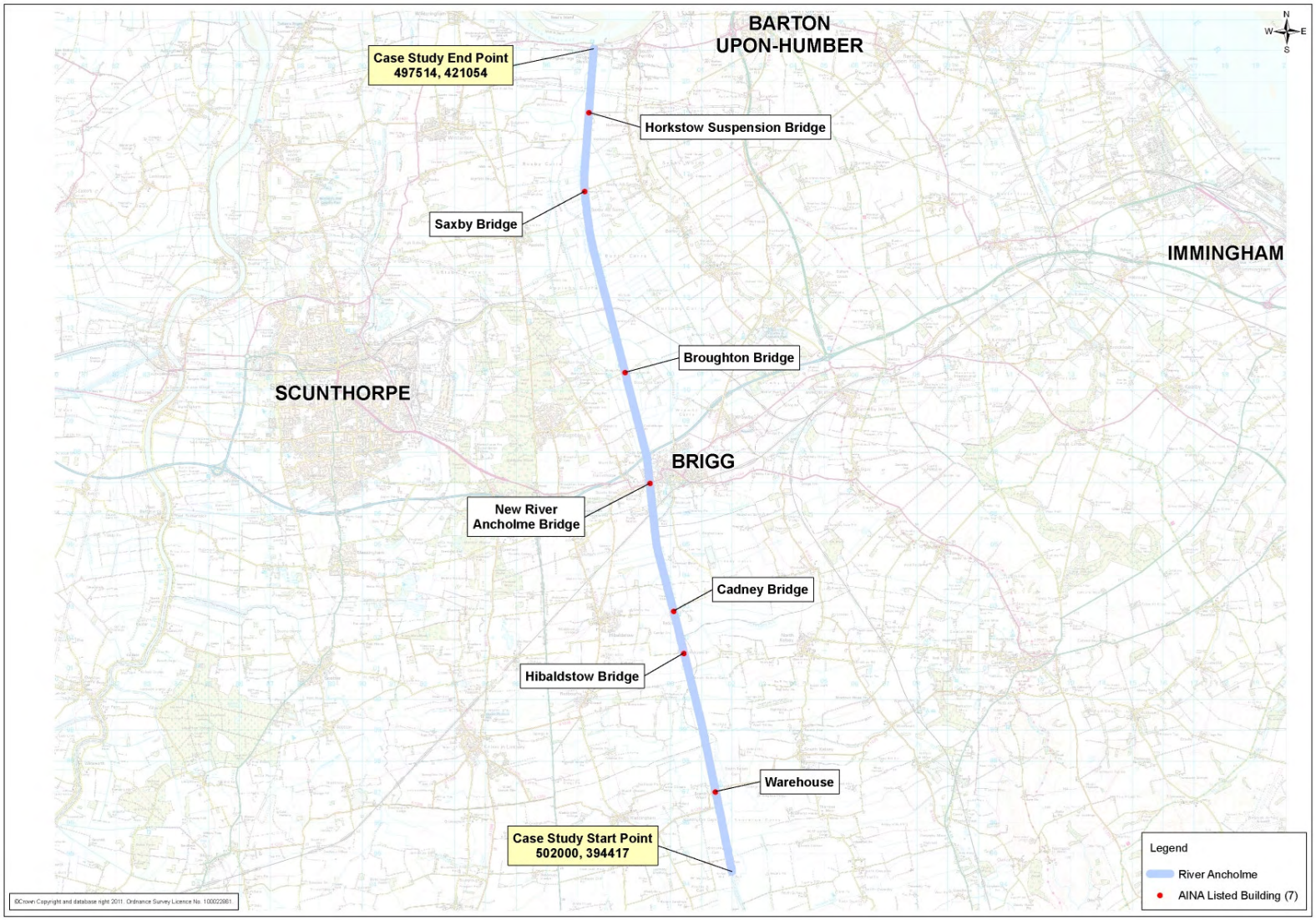
Historically, the Ancholme has been an important route for transporting commercial cargo, such as coal, wool and grain, from rural communities to the towns. Currently, the river is used mostly for recreation including enthusiasts of all types – canoeing, kayaking, rowing and angling along with the towpaths being popular with walkers and cyclists.

The river is classified as Category 3 – rural river. There are no records of boat movements available; however it is expected that the Ancholme is a low density river, thus falling into Category 3c. This is supported by the recent report on the economic valuation of the River Ancholme (Halcrow, 2010) which reveals that there are 226 private boats registered on the Ancholme, along with 71 visitor craft. By estimating the number of visits made per boat per year, the duration of visit and average crew size, the report estimates that approximately 69,000 person-boat days occur on the Ancholme each year.

The estimated density of pathway visits is low - at 3,000 per mile per year[52], or 60,000 per year over the length of the river. There are 4,531 angling licenses existing for the Ancholme, resulting in a further estimated 90,000 angling visits each year under the baseline.

[52] The report refers to a recent study which uses a benchmark figure of 10,000 informal visits per mile per annum of navigable waterway, but suggests that this assumption is likely to be more appropriate in dense urban areas with commercial attractions. Instead, the report adopts a figure of 3,000 per mile per annum derived from consultation with local clubs and community groups.

Figure 18 River Ancholme – Case study stretch



The key assumptions applied to build up the assessment are outlined below.

Under the baseline scenario, the benefits estimated for 2010 were assumed to remain stable every year into the future.

Operational spending on the Ancholme, relating only to navigation (i.e. excluding flood defence spending which can also provide navigation related benefits) is about £30k per year. In addition, approximately £53k per year is spent on capital works. Therefore, it is estimated that approximately £83k is spent annually on delivering benefits on this waterway[53].

Under Scenario 1, boating visits are predicted to decrease from 70, 000[54] per year to 42,000 per year (averaged over 15 years), resulting in a reduction in benefits from £954k to £588k in EAV. Pathway visits are expected to decrease from 60,000 to 46,000 per year on average, resulting in a reduction in benefits from £442k to £234k in EAV.

Angling visits are not expected to decline under Scenario 1[55], but remain at approximately 90,000 per year, valued at £2.42M in EAV.

The change in property premium assumed for Scenario 1 is equivalent to a loss of 3.5% of the value for those properties within 50 m of the river (from +5% premium to +1.5%). For the 70 properties within this distance of the River Ancholme, this equates to a loss of approximately £32k in annual benefits (EAV).

Scenario 2 predicts that boat movements will increase by 2.5% per annum and towpath/ pathway visitors will increase by 18% per annum over years 1-2, by 2% over years 3-6, before stabilising over years 7-15. This results in an increase from 70,000 to 86,000 boating visits per year and from 60,000 to 88,000 pathway visits per year, averaged over the 15 years. The benefit values associated with this increased recreational usage are £1.19M in EAV (a 24% increase over baseline) for boating and £852k in EAV (a 93% increase over baseline) for pathway visits.

Angling is not expected to increase under Scenario 2 and remain at baseline levels throughout the 15 year appraisal period.

The property premium under Scenario 2 is assumed to increase the value of properties within 50m of the river by 3% (from +5% to +8% premium above average prices), which equates to of £71k in EAV, a growth of £26k in annual benefits.

It is worth noting the Halcrow (2010) report states there are 35 hectares of habitat providing flood protection / alleviation along the river which are estimated to deliver £35k per annum in benefits under the baseline. However, there is no evidence to suggest that the size or value of these wetlands would change under the policy scenarios presented here; therefore the benefits are assumed to remain constant under both Scenarios 1 and 2.

[53] The relationship between FRM spending and the provision of amenity/ recreation benefits is not well understood; however it is likely that the estimated costs for providing the benefits valued here have been underestimated.

[54] Note this figure includes unpowered boating visits whereas the previously stated 69,000 person boat days relates to powered boats only.

[55] It is thought that a decrease in funding on rural rivers would have less of an impact on angling than other waterway categories as there is no potential for dewatering (as is the case for canals) and there is less likely to be a problem with rubbish/anti-social behaviour than urban rivers. The reduction in boat traffic may result in benefits to fish populations; however this is not accounted for in any predicted increase in angling under Scenario 1.

The application of these assumptions across a 15 year appraisal period has resulted in the benefit estimates shown in Table 19. Overall, Scenario 1 is estimated to result in a 16% loss in benefits; whereas Scenario 2 is estimated to result in a 17% increase. The benefits arising at this case study site do not deviate as much from the baseline in comparison to other case studies because angling visits comprise the largest proportion of benefit values these visits are not assumed to decrease under Scenario 1 or increase under Scenario 2. Also, unlike many of the other case study sites, boating visits comprise a larger proportion of the benefit values than towpath/ pathway visits. As noted in Table 6, boating visits are not assumed to increase between the Baseline and Scenario 2 as much as pathway visits.

The key benefits valued under the baseline (recreational use and amenity as captured by property premiums) come in at approximately £4M per year, thus greatly exceeding the maintenance and capital expenditure. Although the amount spent on flood defence annually is not known, it is clear that the benefits delivered by the Ancholme are much larger than the costs incurred to maintain the river in its current state.

Table 19 Case Study 9 – River Ancholme – Results (£'000, EAV)

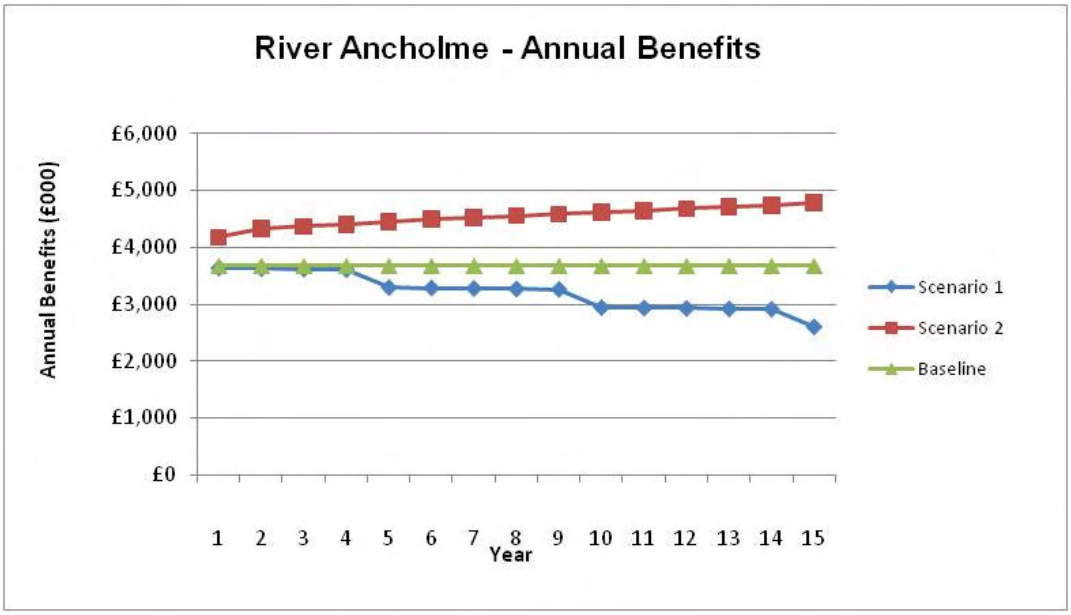
Benefit	Baseline	Scenario 1	Scenario 2
Property premium	£45	£13	£71
Boating*	£954	£588	£1,187
Towpath visits**	£442	£234	£852
Angling	£2,417	£2,417	£2,417
Flood protection / alleviation	£35	£35	£35
Sum Value	**£3,894**	**£3,287**	**£4,562**
Percentage change over baseline	**-**	**-16%**	**17%**

**Boating visits include powered and unpowered boats.*
***Towpath visits include walkers, cyclists and other casual users (picnics, photographers etc).*
Note: See Appendix A for details of how these values have been estimated.

Figure 19 presents the undiscounted benefits arising in each year for those benefit categories valued.

Because the benefit values are largely comprised of angling visits, Scenario 1 and 2 trends do not deviate greatly from baseline levels. The decline in benefits in Scenario 1 over years 1-15 is staged, driven by reductions in boating visits in years 5, 10 and 15 followed by intermediate periods of stability. In Scenario 2 the benefits increase in a near linear fashion over years 1-15, driven by boating visits which increase by 2.5% year on year.

Figure 19 River Ancholme - Annual benefits (undiscounted)



4.11 Case Study 10 – River Great Ouse

The River Great Ouse is approximately 140 miles long, the fourth longest river in the UK. The upper reaches flow through an attractive rural environment, past several historical sites and towns. The lower reaches pass through the characteristic Fenland landscape, past the famous Ely Cathedral. There is a 150 mile footpath known as the Ouse Valley Way which follows the river from its source near Brackley in Northamptonshire to its mouth in The Wash near King's Lynn. This case study considers a 17 mile (28km) long section of the lower reach – from just outside St. Ives to the confluence with the River Cam (see Figure 20).

This case study stretch is classed as category 3 – River/ Rural. No data on boat density were available; however according to the report *An Economic Valuation of the River Great Ouse* (Halcrow, 2010), approximately 70% of the unpowered and powered boats in the East of England are registered on the River Great Ouse. In 2010, this amounted to 3,763 private powered and unpowered boats, plus an additional 20 day hire and 24 week hire boats. Taking the average number of cruising visits per boat per year and the average number of persons participating in cruising visits, it is estimated that 72,000[56] boating visits (i.e. person boat days) take place on Great Ouse annually.

There are 1,166 private moorings on the river, with an occupancy rate of 99%. This suggests that increased funding could go towards additional moorings in order to generate immediate benefits. The Halcrow (2010) report, also notes that there is potential to increase the value of visitor boating activity as well as spend per head on day and week hire boating on the Great Ouse.

The Great Ouse is also noted for its recreation and tourism benefits, specifically boating, bird watching and walking. Angling is cited as one of the largest economic value generators for water based recreation, with 25,733 angling licenses issued in the East of England region attributed to the Great Ouse. An estimated 62,500 visits angling visits occur each year on the case study stretch. The Halcrow (2010) report estimates that there are 5,000 informal visits each year per mile of navigable

[56] Note this figure includes powered and unpowered boating visits.

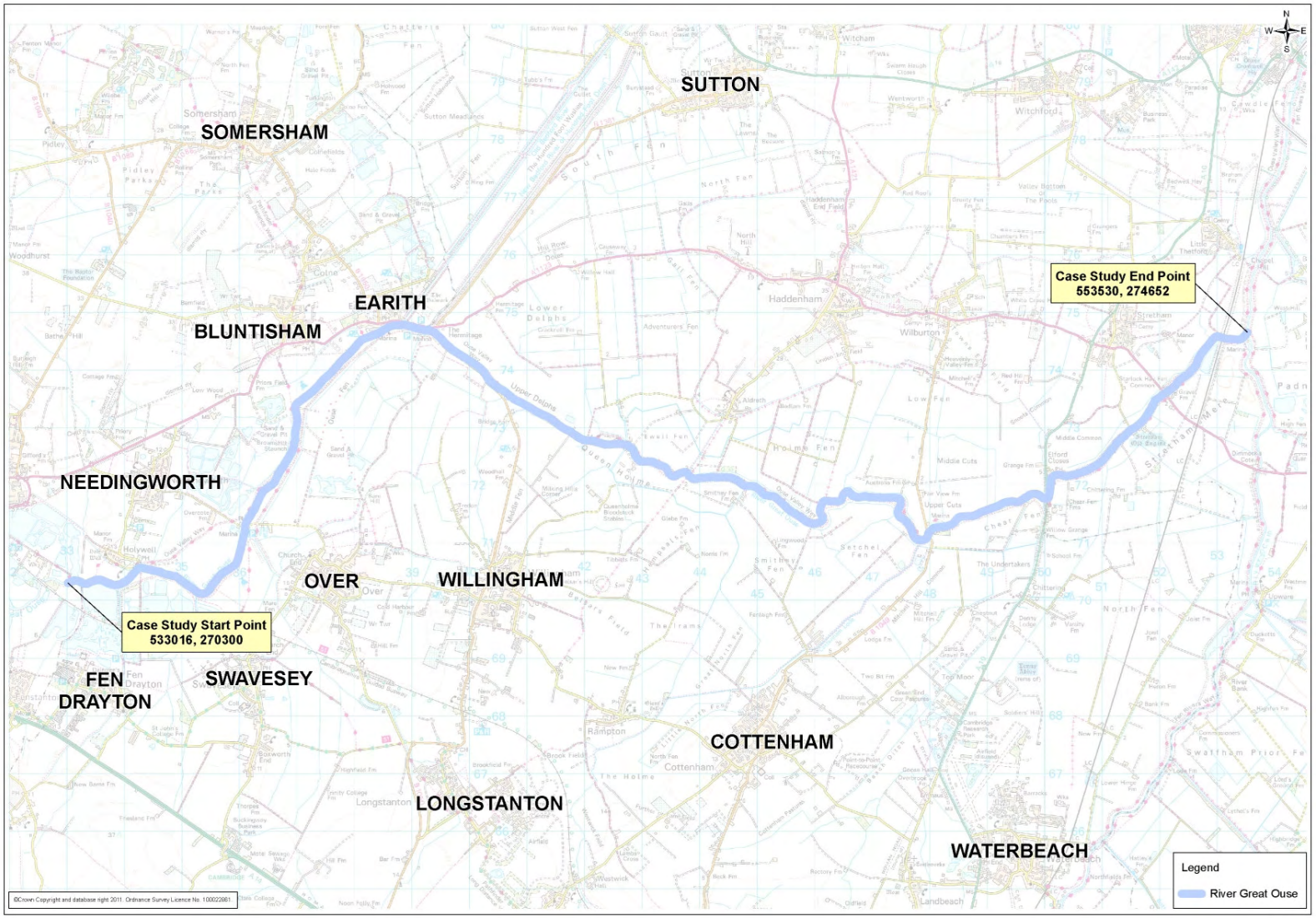
waterway[57], which equates to 85,000 pathway visits per year on this section of the Great Ouse.

According to the report Valuing Ecosystem Services in the East of England (2009)[58] there is potential for wetland around the Ouse Washes to be extended and connected to other wetland sites at Great Fen and Wicken Fen. The Ouse Washes are listed as 'highly significant' in terms of ecosystem services, providing water regulation benefits through winter storage as well as flood protection benefits to areas downstream. However these aspects are outside the scope of this case study; therefore such benefits are not considered further.

[57] The report refers to a recent study which uses a benchmark figure of 10,000 informal visits per mile per annum of navigable waterway, but suggests that this assumption is likely to be more appropriate in dense urban areas with commercial attractions. Instead, the report adopts a figure of 5,000 per mile per annum derived from consultation with local clubs and community groups.

[58] Glaves, P., Egan, D., Harrison, K. and Robinson, R. (2009) Valuing Ecosystem Services in the East of England, East of England Environment Forum, East of England Regional Assembly and Government Office East England.

Figure 20 River Great Ouse – Case study stretch



Maintenance spending on the River Great Ouse annually equates to around £430k. In addition, approximately £400k is spent annually on capital works. This does not include any spend on flood defence and is purely navigation-related spending. When apportioned by length to the case study stretch, this equates to about £97k in maintenance spending and about £90k in capital works annually.

Under Scenario 1, boating visits are predicted to decrease from 72,000 per year to 43,000 per year (averaged over 15 years), resulting in a reduction in benefits from £978k to £602k in EAV. Pathway visits are expected to decrease from 85,000 to 65,000 per year on average, resulting in a reduction in benefits from £627k to £332k in EAV.

Angling visits are not expected to decline under Scenario 1[59], but remain at approximately 62,500 per year, valued at £1.68M in EAV.

The change in property premium assumed for Scenario 1 is equivalent to a loss of 3.5% of the value for those properties within 50 m of the river (from +5% premium to +1.5%). For the 15 properties within this distance of the Great Ouse, this equates to a loss of approximately £14k in annual benefits (EAV).

Scenario 2 predicts that boat movements will increase by 2.5% per annum and pathway visitors will increase by 18% per annum over years 1-2, by 2% over years 3-6, before stabilising over years 7-15. This results in an increase from 72,000 to 88,000 boating visits per year and from 85,000 to 125,000 pathway visits per year, averaged over the 15 years. The benefit values associated with this increased recreational usage are £1.23M in EAV (a 26% increase over baseline) for boating and £1.21M in EAV (a 93% increase over baseline) for pathway visits.

Angling is not expected to increase under Scenario 2 and remain at baseline levels throughout the 15 year appraisal period.

The property premium under Scenario 2 is assumed to increase the value of properties within 50m of the river by 3% (from +5% to +8% premium above average prices), which equates to of £31k in EAV, a growth of £11k in annual benefits.

The application of these assumptions across a 15 year appraisal period has resulted in the benefit estimates as shown in Table 20. Overall, Scenario 1 is estimated to result in a 21% loss in benefits; whereas Scenario 2 is estimated to result in a 26% increase. Both boating and pathway visits contribute almost equally to the respective reduction and increase in benefits. As with the Ancholme, the benefit values do not deviate significantly from the baseline because angling visits comprise a large proportion of the benefits and this category of recreation is assumed not to change under either scenario. The table also shows that the annual benefits valued under the baseline far outweigh the annual spend on the navigation.

[59] It is thought that a decrease in funding on rural rivers would have less of an impact on angling than other waterway categories as there is no potential for dewatering (as is the case for canals) and there is less likely to be a problem with rubbish/anti-social behaviour than urban rivers. The reduction in boat traffic may result in benefits to fish populations; however this is not accounted for in any predicted increase in angling under Scenario 1.

Table 20 Case Study 10 – River Great Ouse – Results (£'000, EAV)

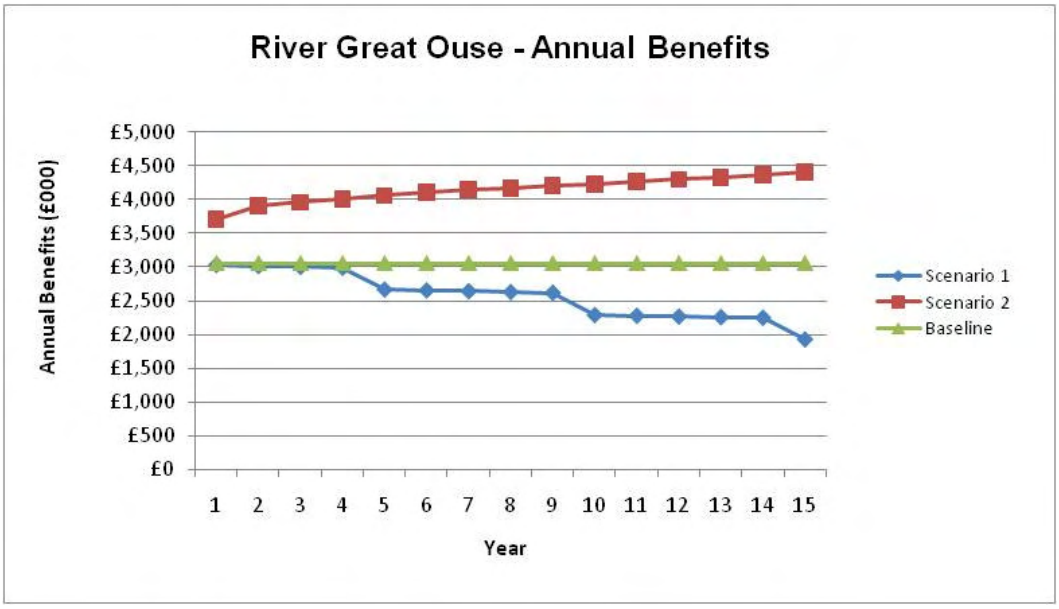
Benefit	Baseline	Scenario 1	Scenario 2
Property premium	£20	£6	£31
Boating*	£978	£602	£1,232
Towpath visits**	£627	£332	£1,207
Angling	£1,677	£1,677	£1,677
Sum Value	**£3,301**	**£2,616**	**£4,147**
Percentage change over baseline	**-**	**-21%**	**26%**

** Includes powered and unpowered boats*
***All visits include walkers, cyclists and other casual users (picnics, photographers etc).*
Note: See Appendix B for details of how these values have been estimated.

Figure 21 presents the undiscounted benefits arising in each year for those benefit categories valued.

Because the benefit values are dominated by angling visits, Scenarios 1 and 2 do not deviate greatly from the baseline when compared to other case study sites. The staged decrease in boating visits under Scenario 1, with reductions occurring in years 5, 10 and 15, is more prominent here than on other case study sites which are driven by a linear decrease in pathway visits. Scenario 2 benefits increase more steadily than other case study sites which are again dominated by a rapid increase in pathway visits over years 1-6.

Figure 21 River Great Ouse – Annual benefits (undiscounted)



4.12 Case Study 11 – River Medway

The River Medway flows from Ashdown Forest in Sussex into the Thames Estuary at Sheerness through 70 miles of chalk downs, alluvial plains and sandstone uplands. The catchment area of the River Medway is one of the largest in the south of England, extending over 930 square miles, with an extensive network of tributaries and streams feeding into the main river.

The Medway was opened to navigation over 250 years ago and was mainly used to transport goods and people. Today a range of commercial and recreational

activities take place along the river. The Medway offers beautiful views of the countryside, and the opportunity to visit historical buildings and locks. As such, it attracts a number of recreational uses including canoeing, angling and boating as well as cycling and walking. It is understood that a lot of work has recently gone into improving the river to facilitate the development of these activities.

Tours, events and festivals are also organised around the river, the most prominent being the annual Maidstone River Festival which is held every July. The festival attracts between 25,000 and 30,000 visitors a year. A number of marinas and riverside pubs are located along the stretch, primarily towards the downstream end (Allington Lock [60]).

A detailed assessment was carried out during Phase II of this research programme (Jacobs 2010) on the 19 mile (approx 31km) non-tidal section from Tonbridge to Allington Lock below Maidstone, known as the 'Medway Navigation' (see Figure 22). This case study analysis is based on information previously gathered; however the data have been split in order to assess the benefits on the urban and rural stretches of the Medway separately.

The disaggregation of user data into urban versus rural visitors was carried out by assessing the population of settlements along the case study section as a guide. Where local population exceeds 10,000, the settlement is considered urban; where the recorded population is less than 10,000, the settlement is characterised as rural.

Most of the settlements located along the case study section (i.e. Allington, East Farleigh, West Farleigh, Wateringbury, Nettlestead, Yalding, and East Peckham) were found to be rural. The urban sections of the river pass through Maidstone and Tonbridge.

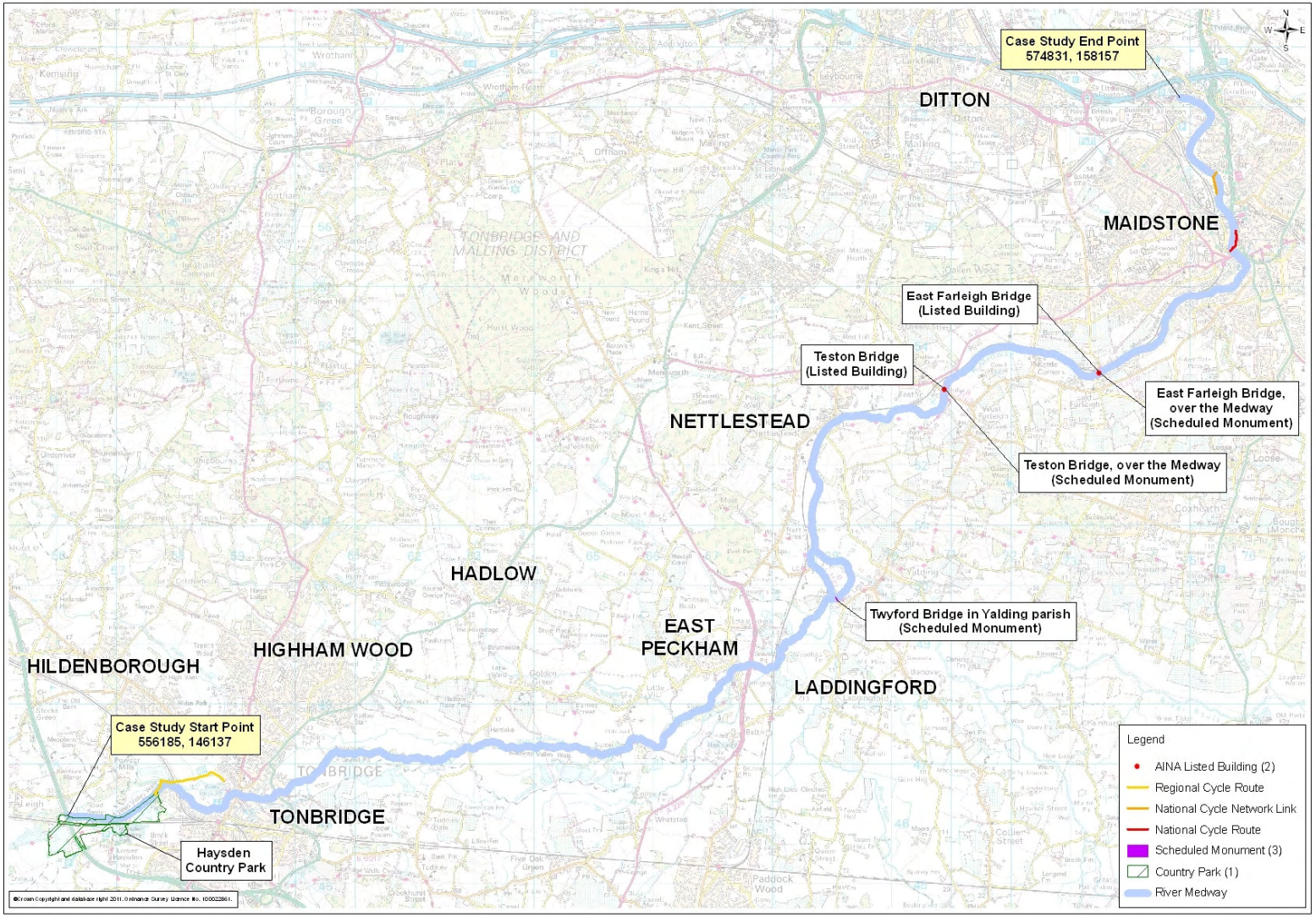
User data originate from the Environment Agency report 'Pilot Medway Visitor Survey Year 1 and 2 Report (September 2007 – August 2009)'. In this study, visitor totals are extrapolated from 3 honeypot sites along the Medway: Allington Lock, Yalding Sluice and Tonbridge Town Lock. Based on the classification of urban vs. rural, it was assumed that visitor data from Allington Lock and Yalding sluice reflected visits to the rural stretch, and visitors data to Tonbridge reflected visits to the urban stretch of the case study section.

An attempt was made to source recent visitor data. However, owing to a range of factors including works being carried out in the area which required the closure of parts of the river, data collected after September 2009 were not considered to portray an accurate picture (EA, personal comment.). Subsequently, the visitor data used here is the average of relevant observations of the two preceding years (2007 & 2008).

Further details on the underlying assumptions and observations arising from the two stretches are outlined below.

[60] Information in this section is heavily referenced from Inland Waterways Phase II report.

Figure 22 River Medway – Case study stretch



(1) River Medway – Urban

The benefit estimates on the urban stretch of the Medway Navigation are based on the recorded visitor numbers at Tonbridge. It should be noted that Allington which is classed as a rural area is situated close to Maidstone which is a large urban centre. Consequently, the benefits allocated to the urban stretch may be underestimated although the total benefits for the urban and rural stretch combined should provide an accurate reflection.

The urban stretch of the Medway is classified as category 4 – River/ Urban. No information on boat density was available; however according to the user data supplied by the Environment Agency there are approximately 500 powered boating visits and 1,900 unpowered boating visits per year on this stretch, making it a low density waterway.

There are approximately 63,000 pathway visits per year on this section of the Medway[61]. In addition, there is an annual 3 day festival each year in Maidstone (the Maidstone Festival), which is strongly linked with the River Medway. The festival attracts approximately 25,000 visitors each year – of which the majority (approximately 90%) are assumed to be day visitors and the remainder are overnight visitors.

The volunteering benefit associated with the Medway Navigation was estimated in the Phase 2 report (Jacob 2010) to be approximately £16k per year. It has not been possible to establish a split between the urban and rural stretches; therefore the benefit has been allocated equally.

Specific observations under the three scenarios are outlined below.

Baseline: Benefits under the baseline were assumed to remain unchanged over the 15 year period.

Under Scenario 1, boating visits are predicted to decrease from 2,400 per year to 1,400 per year (averaged over 15 years), resulting in a reduction in benefits from £19k to £11k in EAV. Pathway visits are expected to decrease from 63,000 to 29,000 per year on average, resulting in a reduction in benefits from £723k to £376k in EAV.

The number of visitors to the Medway Festival is assumed to remain unaffected; the rationale being that funding for the festival is unlikely to be tied directly to funding for the maintenance of the Medway Navigation. However, it may be argued that visitors to the Festival may wish to combine their visit with other activities on the waterway and may be less inclined to do so under Scenario 1. This is captured by reduced WTP values for festival visits. Festival day and overnight visits have been assigned the same WTP values as day and overnight pathway visits; under Scenario 1 the consumer surplus value is assumed to drop to zero, reducing the total WTP for each visit.

Angling visits are expected to decline at the same rate as general pathway visits (see Table 5), from approximately 400 per year to 200 per year, on average.

[61] Excluding the Maidstone festival, there are an estimated 258,000 visits on the combined rural and urban case study stretch, equating to approximately 8,500 per km per year. This is much lower than most data for BW waterways which range from 9,000 – 821,000 per km per year. It is thought that towpath/ pathway visits on non-BW waterways have been underestimated, particularly in urban locations.

The change in property premium assumed for Scenario 1 is equivalent to a loss of 10% of the value for those properties within 25 m of the waterway (from +5% above average prices to -5% below average prices). For the 36 properties within this distance of the Medway (urban stretch), this equates to a loss of approximately £70k in annual benefits (EAV).

Scenario 2 predicts that boat movements will increase by 2.5% per annum and towpath/ pathway visitors will increase by 30% per annum over years 1-2, by 2% over years 3-6, before stabilising over years 7-15. This results in an increase from 2,400 to 2,900 boating visits per year and from 63,000 to 107,000 towpath visits per year, averaged over the 15 years.

The number of visitors to the Medway Festival is assumed to remain unchanged, for the same reasons as stated under Scenario 1; however WTP for festival visits is expected to increase in line with WTP for day/ overnight pathway visits. This can be attributed to the environmental and amenity improvements that could be realised as a result of increased funding.

The benefit values associated with this increased recreational usage are £27k in EAV (a 39% increase over baseline) for boating and £1.23M in EAV (a 71% increase over baseline) for pathway visits.

Angling is not expected to increase under Scenario 2 and remain at baseline levels throughout the 15 year appraisal period.

The property premium under Scenario 2 is assumed to increase the value of properties within 25m of the river by 3% (from +5% to +8% premium above average prices), which equates to of £56k in EAV, a growth of £21k in annual benefits.

The total EAV over the 15 year appraisal period for each of the Scenarios described above is shown in Table 21. Overall, Scenario 1 is estimated to result in a 54% loss in benefits; whereas Scenario 2 is estimated to result in a 68% increase. The majority of this change is driven by pathway visits, as both boating and angling activity is minimal at this case study site.

Table 21 Case Study 11a - Medway Urban – Results (£000, EAV)

Benefit	Baseline	Scenario 1	Scenario 2
Property premium	£35	-£35	£56
Boating*	£19	£11	£27
Towpath visits**	£723	£376	£1,234
Angling	£11	£6	£11
Volunteering	£8	£8	£8
Sum Value	**£796**	**£366**	**£1,335**
Percentage change over baseline	**-**	**-54%**	**68%**

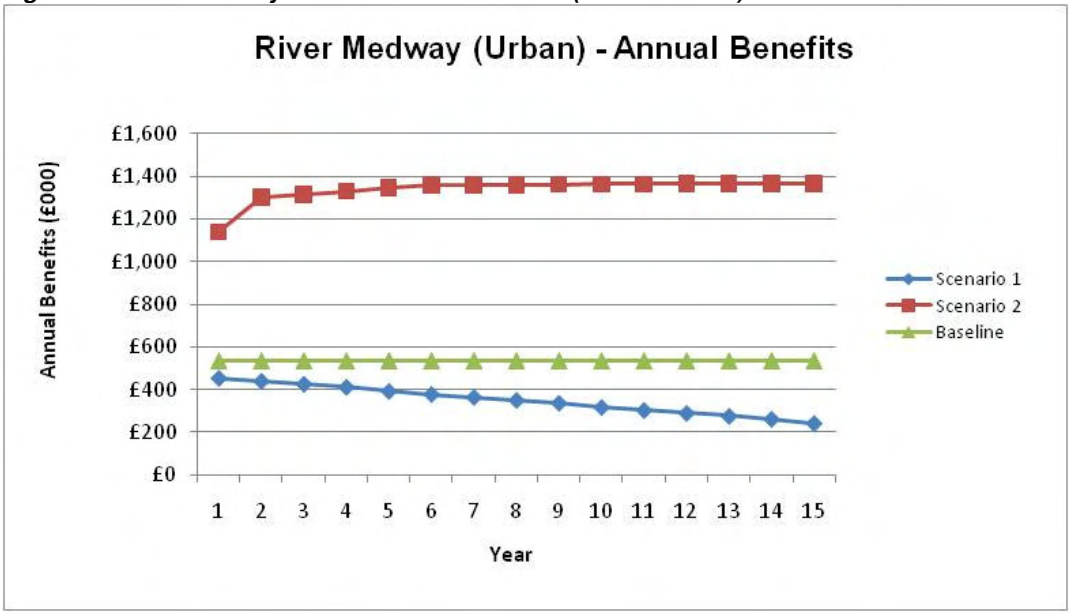
** Includes powered and unpowered boats*
***All visits include walkers, cyclists and other casual users (picnics, photographers etc).*
Note: See Appendix B for details of how these values have been estimated.

Figure 23 presents the undiscounted benefits arising in each year for those benefit categories valued.

The decline in benefits over years 1-15 in Scenario 1 is approximately linear; whereas in Scenario 2 the benefits increase sharply over the first six years. This is

especially pronounced in urban locations such as this case study stretch as the average growth rate for towpath visits is doubled over years 1-3. The large gap in benefits emerging even from year 1 is also driven by pathway visits, which includes general pathway visits (local, day and overnight), cycling, walking/rambling, running/jogging, as well as visits to the Medway festival. Both the number of visitors and the consumer surplus value (a component of total WTP) are assumed to increase from year 1.

Figure 23 River Medway Urban – Annual benefits (undiscounted)



(2) River Medway – Rural

As described above, benefit estimates on the rural stretch of the Medway Navigation are based on the recorded visitor numbers at Allington and Yalding.

This stretch is classified as category 3 – River/ Rural. No information on boat density was available; however according to the user data supplied by the Environment Agency there are approximately 9,200 powered boating visits and 11,200 unpowered boating visits per year on this stretch, making it a low density waterway.

There are approximately 192,000 towpath/ pathway visits per year on the rural section Medway[62], including approximately 16,000 cycling visits and 38,000 running/ jogging visits. There are also approximately 2,500 angling visits per year.

The volunteering benefit associated with the Medway Navigation was estimated in the Phase 2 report (Jacob 2010) to be approximately £16k per year. It has not been possible to establish a split between the urban and rural stretches; therefore the benefit has been allocated equally.

Specific observations for the rural stretch are outlined below.

[62] Excluding the Maidstone festival, there are an estimated 258,000 visits on the combined rural and urban case study stretch, equating to approximately 8,500 per km per year. This is much lower than most data for BW waterways which range from 9,000 – 821,000 per km per year. It is thought that towpath/ pathway visits on non-BW waterways have been underestimated, particularly in urban locations.

Baseline: Baseline benefits calculated for 2010 are assumed to remain unchanged during the 15 year appraisal period.

Under Scenario 1, boating visits are predicted to decrease from 20,400 per year to 12,200 per year (averaged over 15 years), resulting in a reduction in benefits from £252k to £155k in EAV. Pathway visits are expected to decrease from 192,000 to 146,000 per year on average, resulting in a reduction in benefits from £906k to £554k in EAV[63].

Angling visits are not expected to decline under Scenario 1[64], but remain at approximately 2,500 per year, valued at £67k in EAV.

The change in property premium assumed for Scenario 1 is equivalent to a loss of 3.5% of the value for those properties within 50 m of the river (from +5% premium to +1.5%). For the 321 properties within this distance of the rural stretch of the Medway, this equates to a loss of approximately £209k in annual benefits (EAV).

Scenario 2 predicts that boat movements will increase by 2.5% per annum and towpath/ pathway visitors will increase by 18% per annum over years 1-2, by 2% over years 3-6, before stabilising over years 7-15. This results in an increase from 20,400 to 25,000 boating visits per year and from 192,000 to 281,000 towpath visits per year, averaged over the 15 years. The benefit values associated with this increased recreational usage are £360k in EAV (a 42% increase over baseline) for boating and £1.93M in EAV (a 113% increase over baseline) for towpath visits.

Angling is not expected to increase under Scenario 2 and remain at baseline levels throughout the 15 year appraisal period.

The property premium under Scenario 2 is assumed to increase the value of properties within 50m of the river by 3% (from +5% to +8% premium above average prices), which equates to of £478k in EAV, a growth of £179k in annual benefits.

Table 22 below presents the benefit values under each scenario. Overall, Scenario 1 is estimated to result in a 43% reduction in benefits; whereas Scenario 2 is estimated to result in an 86% increase. For Scenario 1, both the reduction in property premium and loss of pathway visits contribute to the change in benefits. For Scenario 2 again, the increase in benefits is largely attributable to the additional pathway visits and the increase in property premium.

Under the baseline, approximately £400k is spent annually on operations on the Medway (including the urban and rural stretch) and £100k is spent on dredging in order to maintain the navigation. In addition, £10M has been spent on capital works over the past 5 years; however, capital spend is expected to drop in future years to around £500k per year. Considering only the benefit categories valued here, it can be seen that combined benefits for the urban and rural stretches of the Medway are estimated to be larger than the costs of providing them.

[63] The decline in pathway visits is not expected to be as dramatic for the rural stretch of the Medway as urban locations may be perceived as unsightly or unsafe due to lack of maintenance whereas rural locations may be perceived as more natural and therefore less off-putting.

[64] It is thought that a decrease in funding on rural rivers would have less of an impact on angling than other waterway categories as there is no potential for dewatering (as is the case for canals) and there is less likely to be a problem with rubbish/anti-social behaviour than urban rivers. The reduction in boat traffic may result in benefits to fish populations; however this is not accounted for in any predicted increase in angling under Scenario 1.

Table 22 Case Study 11b - Medway Rural – Results (£000, EAV)

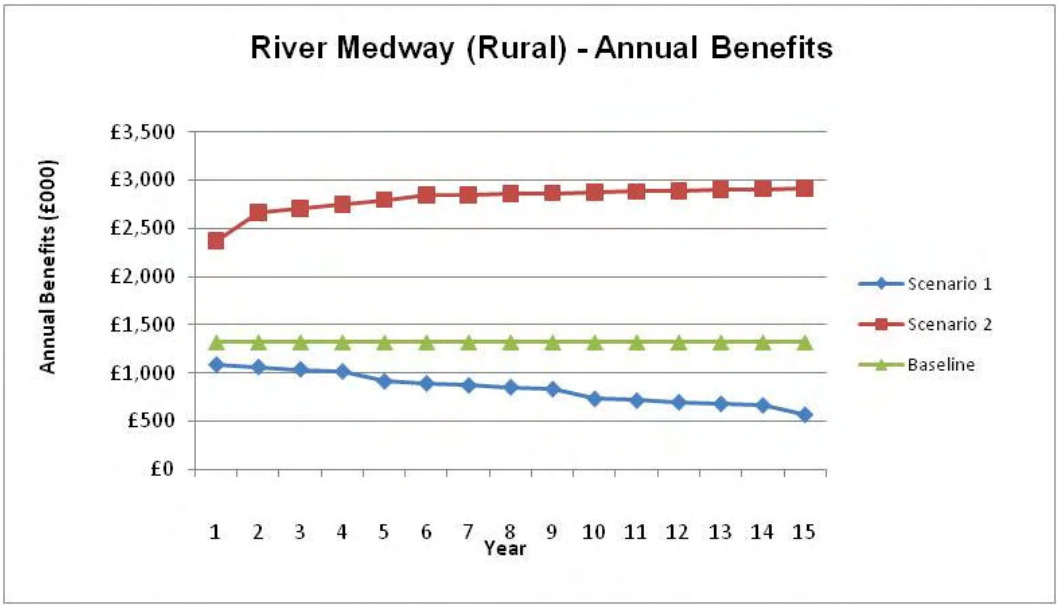
Benefit	Baseline	Scenario 1	Scenario 2
Property premium	£299	£90	£478
Boating*	£252	£155	£360
Towpath visits**	£906	£554	£1,933
Angling	£67	£67	£67
Volunteering	£8	£8	£8
Sum Value	**£1,532**	**£873**	**£2,846**
Percentage change over baseline	**-**	**-43%**	**86%**

**Includes powered and unpowered boats.*
***All visits include walkers, cyclists and other casual users (picnics, photographers etc).*
Note: See Appendix A for details of how these values have been estimated.

Figure 24 presents the undiscounted benefits arising in each year for those benefit categories valued.

The split between Scenario 1 and the Baseline is more evident than in previous case studies as the property premium contributes a larger overall proportion of the benefit values, and these are assumed to decrease immediately (a step change in year 1)[65] as opposed to the gradual decrease in benefits assumed for recreational use.

Figure 24 River Medway Rural – Annual benefits (undiscounted)



4.13 Case Study 12 – River Wey

The River Wey, a tributary of the Thames, is one of the oldest navigable rivers in the UK, opening to barge traffic in 1653. At its opening, it was only navigable for 15 ½ miles linking Guildford to Weybridge and then London. It wasn't until 1764 that the Godalming Navigation opened, adding a further 4 miles of navigable waterway upriver from Guildford. Construction of the navigation meant that agricultural goods

[65] It is not that property values are assumed to instantly drop; rather this relates to how the premium has been annualised. It is assumed that the property premium benefit is realised at the point of sale, and that properties are sold on average once every 10 years; therefore the premium is annualised over 10 years.

produced in the fertile Wey Valley could be transported to London and the Channel ports.

Meandering through a green corridor between the urban areas of Godalming, Guildford, Woking, Byfleet, Addlestone and Weybridge, the Wey currently provides a key recreational resource. Visitors can spot kingfishers, water vole, or make a refreshment stop in one of the many pubs along the way. The navigation was recently voted by the public as one of the Seven Man Made Wonders constructed prior to the 20th century.

The navigable section, which is currently managed by the National Trust, is the subject of this case study (see Figure 25 for a schematic). This 32km stretch is classified as category 4b – River/ Urban/ Medium boat density.

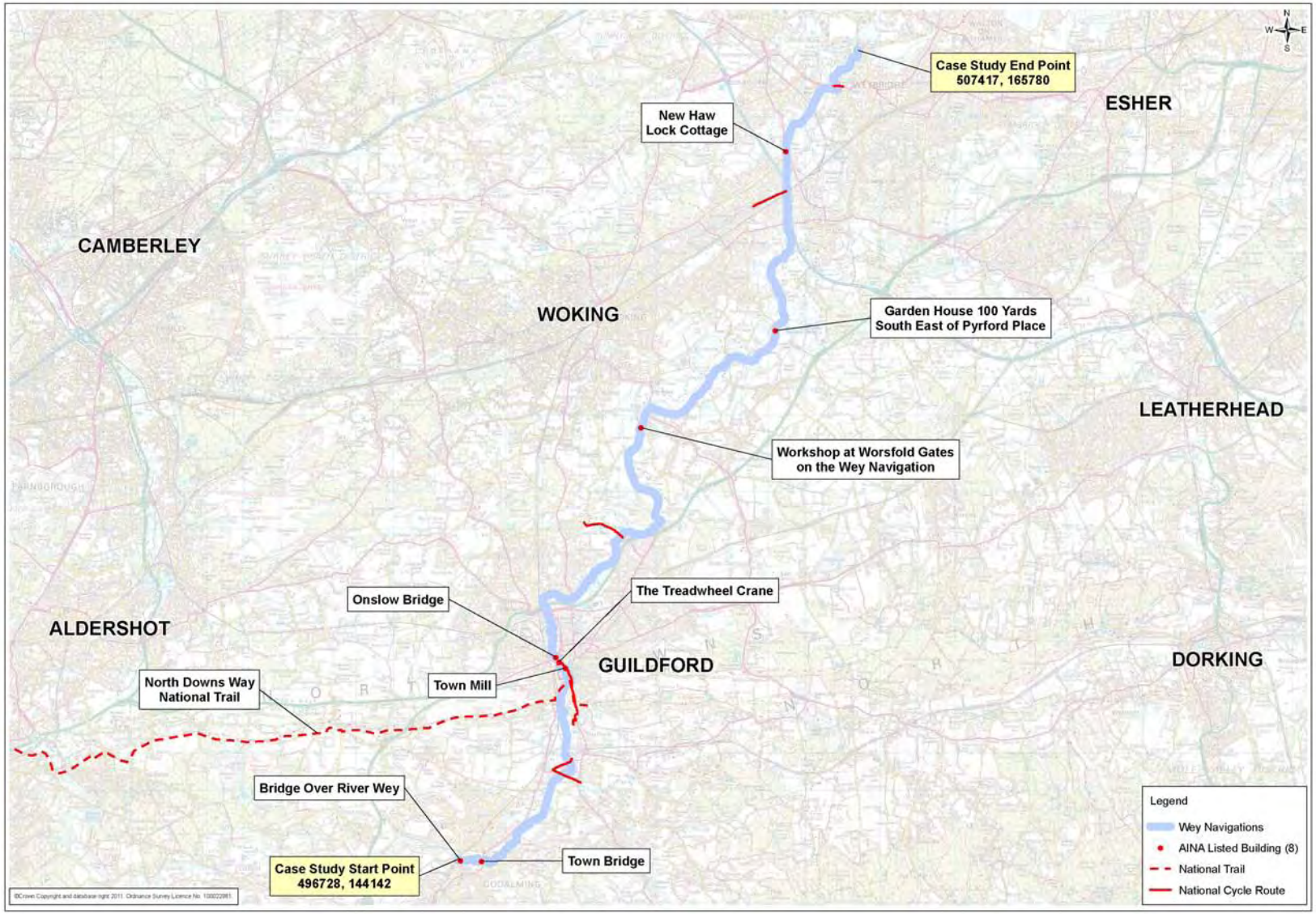
The baseline data used to undertake this assessment come from the AINA Craft Survey (2008) on the River Wey. According to this report, there are 638 powered boats registered on the river[66] (including private and hire boats) as well as 547 unpowered craft. Applying assumptions as to the number of visits per boat per year and the number or people participating in each visit, it is estimated that approximately 205,000 person boat days take place on the River Wey each year under the current baseline.

There is a pathway which follows the banks of the river along its entire length from Godalming to the junction with the Thames, passing Guildford town centre. Pathway data for the Thames region suggest that ~15,000 visits take place each year per km of pathway[67]. This equates to 500,000 visits annually for the River Wey – this is assumed to include angling and cycling visits however the breakdown by recreation type is not known.

[66] This includes visitor powered boats registered on the River Wey; however this is thought to be an underestimate of visiting craft from the Thames in particular.

[67] This is much lower than most data for BW waterways which range from 9,000 – 821,000 per km per year. It is thought that towpath/ pathway visits on non-BW waterways have been underestimated, particularly in urban locations.

Figure 25 River Wey – Case study stretch



Under the baseline scenario, it is assumed that recreational use remains stable throughout the 15 year appraisal period.

Annual expenditure on operational costs to deliver these baseline benefits is approximately £1M on the Wey. Between £100k and £500k is also spent on capital expenditure annually. It is assumed that these estimates relate to the navigable stretch considered here.

Under Scenario 1, boating visits are predicted to decrease from 205,000 per year to 123,000 per year (averaged over 15 years), resulting in a reduction in benefits from £2.74M to £1.69M in EAV. Pathway visits are expected to decrease from 500,000 to 260,000 per year on average, resulting in a reduction in benefits from £3.69M to £8.56M in EAV.

In urban locations, the property premium is assumed to drop from +5% above average prices to -5% below average prices (a net loss of 10%) for properties within 25m of the river. For the 111 properties within this distance of the Lee Navigation case study stretch, this equates to a loss of approximately £448k in annual benefits (EAV).

Scenario 2 predicts that boat movements will increase by 2.5% per annum and towpath/ pathway visitors will increase by 30% per annum over years 1-2, by 2% over years 3-6, before stabilising over years 7-15. This results in an increase from 205,000 to 252,000 boating visits per year and from 500,000 to 885,000 towpath visits per year, averaged over the 15 years. The benefit values associated with this increased recreational usage are £3.50M in EAV (a 28% increase over baseline) for boating and £8.56M in EAV (a 132% increase over baseline) for towpath visits.

The property premium under Scenario 2 is assumed to increase the value of properties within 25m of the river by 3% (from +5% to +8% premium above average prices), which equates to of £359k in EAV, a growth of £134k in annual benefits.

Note that angling benefits have not been valued for this case study. There are at least 10 angling associations operating on the River Wey and Wey Navigations[68]; however data on the number of angling visits taking place on the river each year were not readily available. Given that angling visits do not comprise a large proportion of the benefits across most of the case studies, this gap is not thought to significantly affect the overall trends.

Table 23 below presents the benefit values under each scenario. Overall, Scenario 1 is estimated to result in a 57% loss in benefits; whereas Scenario 2 is estimated to result in a 87% increase. For Scenario 1, the change is driven approximately equally by the reduction in boating and pathway activity. For Scenario 2, the increase in benefits is driven by the large growth in towpath visits over years 1-2 (attributed to the urban setting) combined with lower WTP values. It is also evident that the estimated costs incurred under the baseline are far outweighed by the value of the key benefits captured here.

[68] http://www.weyriver.co.uk/theriver/use_website.htm

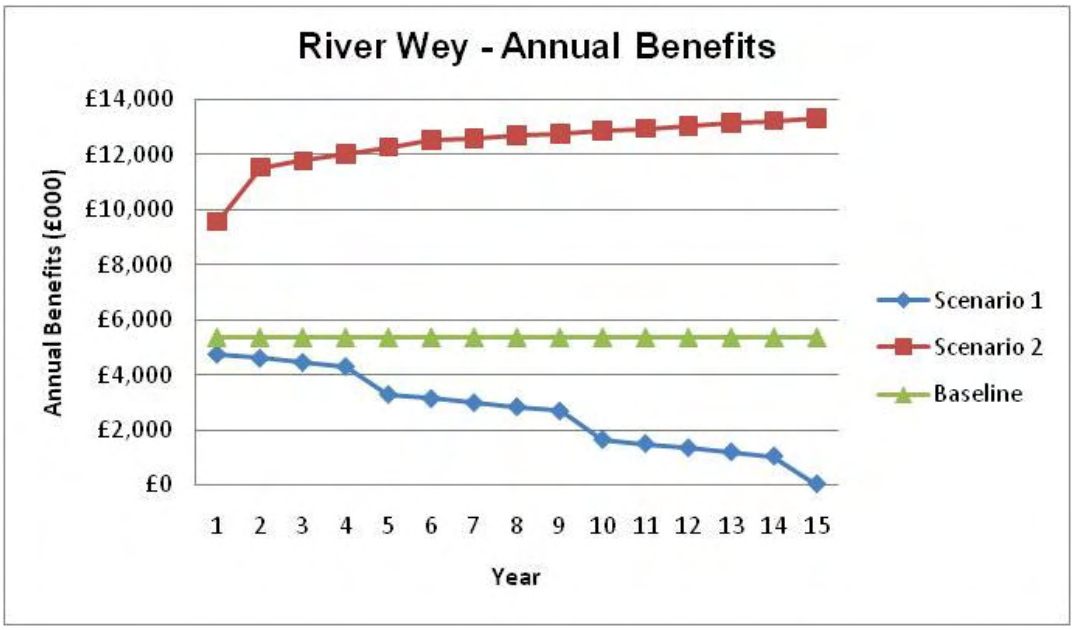
Table 23 Case Study 12 - River Wey – Results (£000, EAV)

Benefit	Baseline	Scenario 1	Scenario 2
Property premium	£224	-£224	£359
Boating*	£2,744	£1,688	£3,504
Towpath visits**	£3,687	£1,399	£8,562
Angling	-	-	-
Sum Value	**£6,655**	**£2,863**	**£12,425**
Percentage change over baseline	**-**	**-57%**	**87%**

**Includes powered and unpowered boats.*
***All visits include walkers, cyclists and other casual users (picnics, photographers etc).*
Note: See Appendix A for details of how these values have been estimated.

Figure 26 presents the undiscounted benefits arising in each year for those benefit categories valued.

Figure 26 River Wey – Annual benefits (undiscounted)



4.14 Case Study 13 – River Lee Navigation

The River Lee, known as 'London's second river' runs from Leagrave in Luton, through Herefordshire to London. The river is more often called the River Lea, although both spellings are currently used. From Hertford to London (a distance of 28 miles), the river is canalised and is commonly referred to as the Lee Navigation.

The Lea Valley was for years the industrial centre of London – where everything from buses, to chemicals to guns were once (and in some cases still are) manufactured. In the latter part of the 20th century the area became known as the UK's 'silicon valley' with many electronics companies setting up factories in the area. It is also the future site of the London 2012 Olympic Games.

The Lee was once an important transport route for grain grown in Hertfordshire, although navigation of its southern-most tidal reaches known as Bow Creek has always proved difficult. The first Act to improve the navigation was granted in 1425 and since then, a series of improvements have been made, including the first pound lock in England which was constructed at Waltham Abbey in 1577.

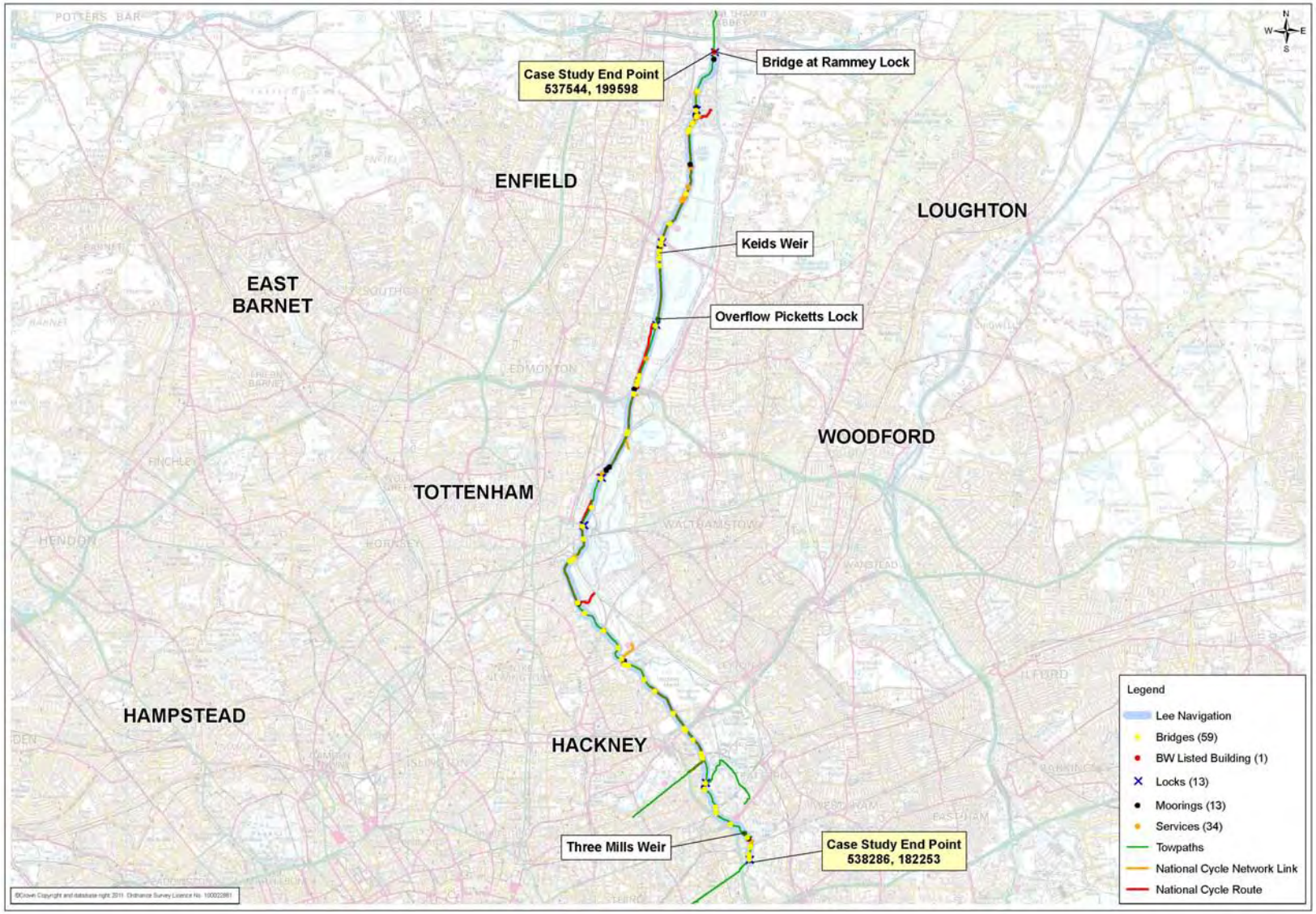
In 1948 the navigation was nationalised and control was passed to the British Transport Commission. When the commission was abolished in 1962, control was passed to the British Waterways Board (which is now British Waterways). Commercial traffic all but ceased by the 1980s and the river is now primarily used for recreation.

South of Stratford there are two routes to the River Thames. Boats can travel through the tidal Bow Creek before passing a tidal barrier onto the main river at Trinity Buoy Wharf. Most small boats prefer the easier route known as the Limehouse Cut. This new stretch of canal, which originally had its own lock to the River Thames, was constructed in 1770. In 1969 the cut was redirected into the Regents Canal Dock (also called Limehouse Dock). From here boats can access the Thames via a single lock.

This case study considers a 14 mile (22 km) stretch from Limehouse to the junction with the M25 (see Figure 27). The Lee Navigation is generally classed as category 4b – River/ Urban/ Medium boat density. However according to British Waterways data on boat movements, there are approximately 2,600 boat movements per year on the section from Limehouse to the M25, making this stretch a low density waterway. These boat movements are estimated to generate 12,300 boating visits (person boat days) per year.

Data on towpath / pathway and angling visits are based on the 1996 IWDVS, which is considered to be reflective of current use levels. According to this data there are approximately 1.14M pathway visits per year on this stretch as well as 40,000 angling visits and 12,000 unpowered boating visits.

Figure 27: River Lee – Case study stretch



Under the baseline, the level of recreational use is expected to remain constant over the 15 year appraisal period.

Under Scenario 1, boating visits are predicted to decrease from 24,300 per year to 14,600 per year (averaged over 15 years), resulting in a reduction in benefits from £216k to £130k in EAV. Towpath / pathway visits are expected to decrease from 1.14M to 593,000 per year on average, resulting in a reduction in benefits from £8.09M to £3.16M in EAV.

Angling visits are expected to decline at the same rate as general towpath visits (see Table 5), from approximately 40,000 per year to 20,800 per year, on average.

The change in property premium assumed for Scenario 1 is equivalent to a loss of 10% of the value for those properties within 25 m of the waterway (from +5% above average prices to -5% below average prices). For the 285 properties within this distance of the River Lee case study stretch, this equates to a loss of approximately £895k in annual benefits (EAV).

Scenario 2 predicts that boat movements will increase by 2.5% per annum and towpath/ pathway visitors will increase by 30% per annum over years 1-2, by 2% over years 3-6, before stabilising over years 7-15. This results in an increase from 24,300 to 29,800 boating visits per year and from 1.14M to 2.02M towpath visits per year, averaged over the 15 years. The benefit values associated with this increased recreational usage are £130k in EAV (a 34% increase over baseline) for boating and £18.45M in EAV (a 128% increase over baseline) for towpath visits.

Angling is not expected to increase under Scenario 2 and remain at baseline levels throughout the 15 year appraisal period.

The property premium under Scenario 2 is assumed to increase the value of properties within 25m of the river by 3% (from +5% to +8% premium above average prices), which equates to of £716k in EAV, a growth of £269k in annual benefits.

The application of these assumptions across a 15 year appraisal period has resulted in the benefit estimates as shown in Table 24. Overall, the application of Scenario 1 could result in a 65% reduction in the benefits which are realised at this site. Scenario 2, as modelled, is expected to result in a 109% increase in benefits above the current baseline.

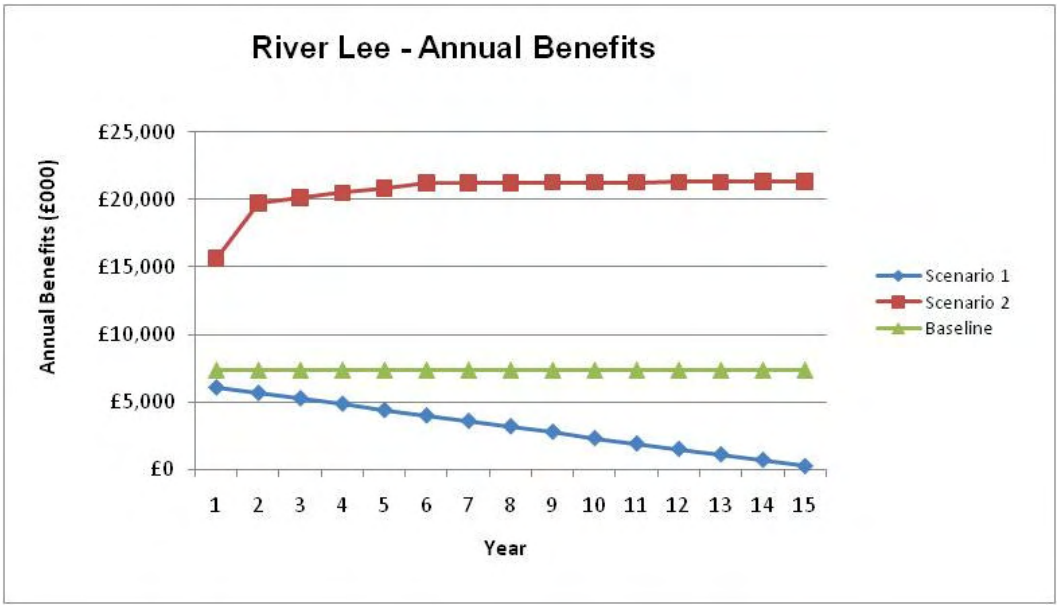
Table 24: Case Study 13 – River Lee Navigation – Results (£'000, EAV)

Benefit	Baseline	Scenario 1	Scenario 2
Property premium	£448	-£448	£716
Boating*	£216	£130	£268
Towpath visits**	£8,096	£3,160	£18,446
Angling	£1,073	£599	£1,073
Sum Value	**£9,833**	**£3,441**	**£20,504**
Percentage change over baseline	**-**	**-65%**	**109%**

**Includes powered and unpowered boats.*
***All visits include walkers, cyclists and other casual users (picnics, photographers etc).*
Note: See Appendix A for details of how these values have been estimated.

Figure 28 presents the undiscounted benefits arising in each year for those benefit categories valued.

Figure 28 River Lee Navigation – Annual benefits (undiscounted)



4.15 Case Study 14 – River Severn Navigation

For centuries the Severn has been an important waterway in Europe. It was once navigable, although with great difficulty, as far as Welshpool and many historical remnants including Roman remains, battlefield sites, castles and abbeys can be found along the banks of the river.

From the end of the 17th century to the railway age in the mid 1800s, the Severn was a major commercial waterway, transporting iron and coal from the Midlands to the Bristol Channel and thereby playing a vital role in the Industrial Revolution. The riverside towns of Stourport, Worcester, Upton, Tewkesbury and Gloucester were once important inland ports. Now activity in these towns and on the river is mainly associated with leisure and tourism.

The section from Stourport in Worcestershire to Sharpness in Gloucestershire, a distance of 50 nautical miles (93 km) is known as the Severn Navigation. This section, complete with 5 automated locks, is popular with narrow boats and motor cruisers. The section north of Stourport is navigable; however this section has little traffic other than small pleasure boats and unpowered craft. South of Gloucester the Severn is treacherous and un-navigable. Boats must bypass this section by using the Gloucester and Sharpness Canal. From Sharpness to Bristol is the Severn Estuary which, although navigable, is generally not recommended for inland waterway craft.

This case study considers the 12 km section on the Severn Navigation through Worcester – from Hawford to Kempsey (see Figure 29). The Severn Navigation is generally classed as category 4a – River/ Urban/ High boat density. According to British Waterways data, there are approximately 7,500 boat movements per year on the section from Hawford to Diglis and 5,500 on the section from Diglis to Kempsey. These boat movements are estimated to generate 17,800 boating visits (person boat days) per year.

In addition, there are approximately 459,000 towpath visits per year on this stretch as well as 4,000 angling visits and 25,000 unpowered boating visits. These data are

taken from the 1996 IWDVS, which is considered to be reflective of current use levels.

This level of recreational use is expected to remain constant over the next 15 years under the baseline scenario.

Under Scenario 1, boating visits are predicted to decrease from 42,800 per year to 25,700 per year (averaged over 15 years), resulting in a reduction in benefits from £407k to £246k in EAV. Towpath visits are expected to decrease from 459,000 to 239,000 per year on average, resulting in a reduction in benefits from £3.35M to £1.28M in EAV.

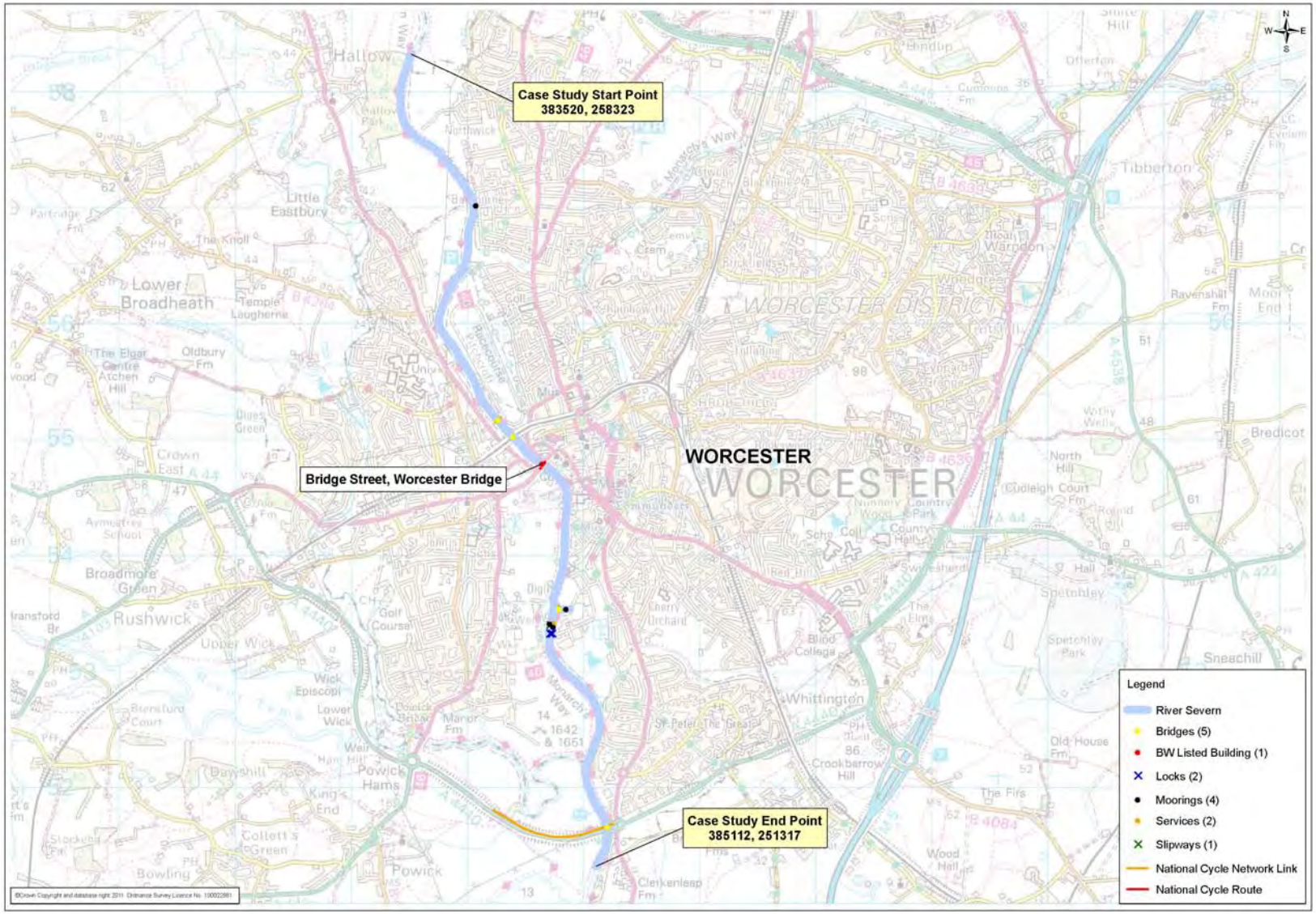
Angling visits are expected to decline at the same rate as general towpath visits (see Table 5), from approximately 4,000 per year to 2,000 per year, on average.

There are no residential properties within 25m of this section of the Severn Navigation. Therefore the change in amenity value (as reflected by property premiums) cannot be accounted for in this case study.

Scenario 2 predicts that boat movements will increase by 2.5% per annum and towpath/ pathway visitors will increase by 30% per annum over years 1-2, by 2% over years 3-6, before stabilising over years 7-15. This results in an increase from 42,800 to 52,400 boating visits per year and from 459,000 to 813,000 towpath visits per year, averaged over the 15 years. The benefit values associated with this increased recreational usage are £542k in EAV (a 33% increase over baseline) for boating and £7.73M in EAV (a 131% increase over baseline) for towpath visits.

Angling is not expected to increase under Scenario 2 and remain at baseline levels throughout the 15 year appraisal period.

Figure 29: Severn Navigation – Case study stretch



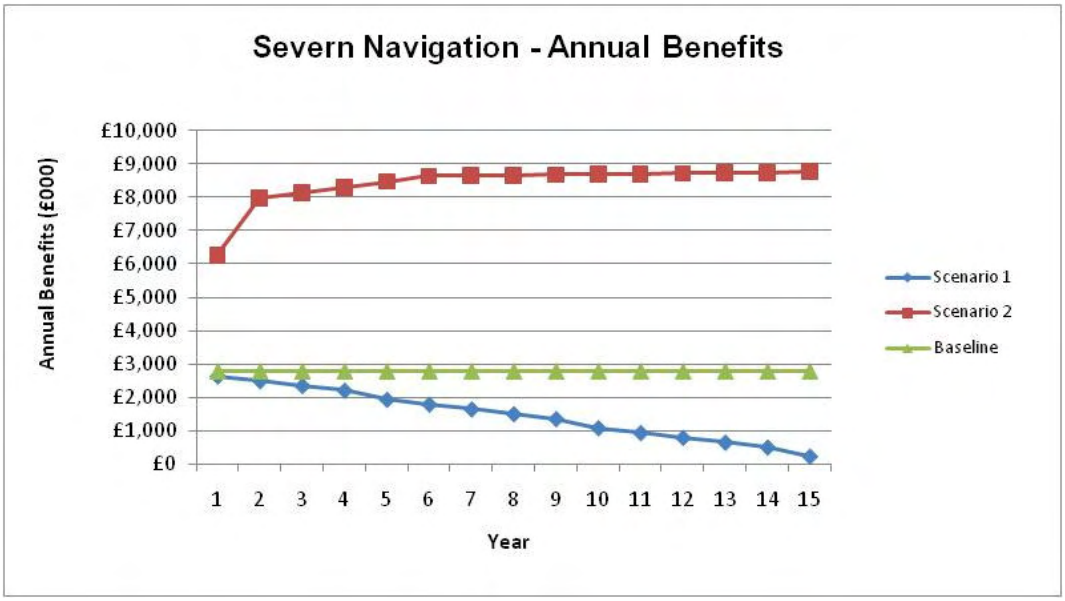
The application of these assumptions across a 15 year appraisal period has resulted in the benefit estimates as shown in Table 25. Overall, the application of Scenario 1 could result in a 59% reduction in the benefits which are realised at this site. Scenario 2, as modelled, is expected to result in a 117% increase in benefits above those currently realised under the baseline.

Table 25 Case Study 14 – Severn Navigation – Results (£000, EAV)

Benefit	Baseline	Scenario 1	Scenario 2
Property premium	£0	£0	£0
Boating	£407	£246	£542
Towpath visits	£3,347	£1,281	£7,732
Angling	£107	£60	£107
Sum Value	**£3,861**	**£1,586**	**£8,381**
Percentage change over baseline	**-**	**-59%**	**117%**

Figure 30 presents the undiscounted benefits arising in each year for those benefit categories valued.

Figure 30 Severn Navigation – Annual benefits (undiscounted)



4.16 Summary results

Looking across the results of the case studies, there is significant variation in the total value of benefits (as shown in Table 26). This difference may be partially attributed to the length of case study stretch analysed; therefore it may be more informative to compare the benefit values arising per kilometre of waterway (see Table 27 for this comparison).

Table 26 Summary results (£M, EAV)

Case Study site/ Category	Baseline	Scenario 1	Scenario 2
Kennet and Avon (1b)	19.4	8.7	35.5
Caldon (1b)	4.0	1.8	7.5
Lancaster (1c)	6.3	2.4	11.7
Pocklington (1c)	2.8	1.2	5.3
Leeds and Liverpool Canal (1b)	21.2	9.0	39.9
Coventry (2a)	9.3	3.1	20.3
Rochdale (2c)	30.3	10.3	69.0
Basingstoke (2c)	11.9	3.8	26.4
River Ancholme (3)	3.9	3.3	4.6
River Great Ouse (3)	3.3	2.6	4.1
River Medway (urban) (4)	0.8	0.4	1.3
River Medway (rural) (3)	1.5	0.9	2.8
River Wey (4b)	6.7	2.9	12.4
Lee Navigation (4b)	9.8	3.4	20.5
River Severn Navigation (4a)	3.9	1.6	8.4

Generally, the increase in benefits in Scenario 2 is greater than the loss in benefits under Scenario 1. This can be attributed primarily to two factors. Firstly, the majority of the growth in towpath/ pathway visits under Scenario 2 occurs over years 1-2, driving the large increase in benefits in year 1 and increasing the EAVs over the 15 year period. Scenario 1 on the other hand is assumed to cause a steady linear decline in towpath/ pathway visits; therefore the reduction in benefits when expressed in EAV is not as great. Second, the WTP values for *local* towpath/ pathway visits increase proportionally more under Scenario 2 than they decrease under Scenario 1[69]. As noted throughout, the benefit values across the majority of the case studies are driven by towpath visits, of which ~75%[70] are assumed to be local visits. Both the growth in towpath/ pathway visits and WTP values have been subject to sensitivity testing at the aggregate level (see Section 5) for these reasons.

This variation across case studies may be attributed to the following observations:

- The change in property premiums is greater for Scenario 1 (-10% to -3.5% reduction on baseline) compared to Scenario 2 (+3% over baseline). Therefore, where there are a large number of properties within close proximity to the waterway, there is a tendency for Scenario 1 to be driven by a large reduction in property values.
- In general, towpath visits tend to be the main contributing factor to the percentage change across scenarios. This is especially true for Scenario 2 in urban locations, where a higher growth rate is applied over the first 2 years.
- It is also clear that the locations where towpath/ pathway visits are estimated based on British Waterways data have much higher benefits than non-British Waterways waterways and that all of the other benefit categories are dwarfed by towpath/ pathway benefits.
- Sites with a high proportion of benefits derived from angling visits experience a smaller percentage increase/decrease as angling visits are assumed not to vary across scenarios.

[69] For all other categories of recreation, the CS component of WTP decreases proportionally more under Scenario 1 than they increase under Scenario 2.
[70] Towpath visits include general visits, which are assumed to be comprised of a 78:20:2 split between local/ day/ overnight visits, as well as cycling visits.

- Despite applying the same unit values and growth assumptions across the categories (see Table 5 and Table 6), there are variations within categories of benefits. For example, boating activity may comprise private and hired, powered and unpowered boats. There are different unit values associated with these activities, for example the unit value for powered boating visits is greater than for unpowered boating visits. Therefore, for a case study site with a higher proportion of unpowered boats (associated with a smaller unit value), a reduced number of boating visits has a lesser impact on the overall percentage change.
- Similarly, for towpath visits, different types of visits are assigned different unit values. As a rule, the same percentage split between local/day/overnight visits has been applied across all case studies. However for example, case study 11a (River Medway – urban stretch), visits to the annual Medway festival are categorised as day visits (91%) or overnight visits (9%) only. This increases the overall contribution made by towpath visits as day and overnight visits are assigned a higher unit value than local visits.

Table 27 shows a comparison of the benefits per km of waterway across all case study sites. Note these values include only those benefit categories which have been valued at every site (i.e. boating visits, towpath visits, angling visits and property premiums), to allow for comparison. Under the baseline, the estimated unit benefit values range from £109k EAV per km per year to £730k EAV per km per year. Figure 31 charts variance across categories and scenarios. In general, canals tend to generate higher benefit values per km than rivers; however this is thought to be partially attributable to variances between navigation authorities in the way data are collected and reported[71].

For both canals and rivers, the study sites which demonstrate the highest percentage change between the baseline and Scenarios 1 and 2 are those in urban locations. Again this is driven by towpath visits which are assumed to decrease/ increase at a greater rate than for rural waterways (see Tables 5 and 6),

The study sites which demonstrate the smallest percentage change between the baseline and Scenarios 1 and 2 are those which are dominated by angling visits and have relatively few general towpath visits (e.g. the River Ancholme and River Great Ouse). These sites in particular may be sensitive to the assumption that angling visits remain constant for both Scenario 1 and 2 on rural river locations.

There does not appear to be a clear correlation between boat density and the value of key benefits delivered per km. This is likely to be site specific, as most of the case studies demonstrate a tendency for towpath visits to dominate – thus the quality of the towpath and facilities in place as well as the number of substitute sites available are likely to play a bigger part in attracting towpath visitors than the number of boats on the waterway.

According to British Waterways, urban waterways (i.e. those in larger cities) tend to have lower boat densities than rural locations. For towpath/ pathway use the opposite is often the case – with higher usage in urban locations due to higher population catchment densities. However, urban towpath/ pathway use can be quite variable, depending on the quality of the waterway environment, and is concentrated at specific nodes or destinations. In rural areas towpaths/ pathways may attract

[71] Seven of the eight canal case study sites are managed by BW which tends to report higher usage figures; whereas two of the seven river case study sites are BW waterways.

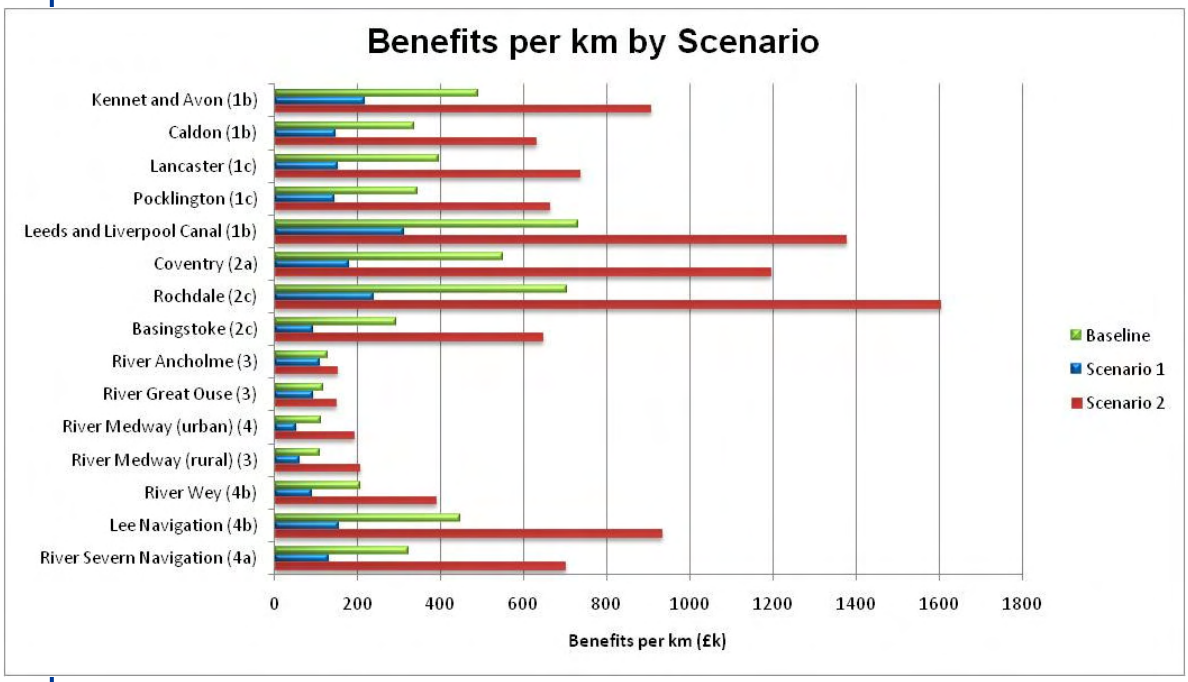
relatively fewer people; however many rural stretches also include small towns and villages[72] which can raise the number of visits substantially.

Overall, the pattern of use (and corresponding benefits generated) appears to be much more variable than a simple urban / rural split would suggest.

Table 27 Benefits per km per case study, by scenario (£000, EAV)

Case Study site/ Category	Baseline	Scenario 1	Scenario 2
Kennet and Avon (1b)	491	217	903
Caldon (1b)	337	147	629
Lancaster (1c)	396	153	734
Pocklington (1c)	346	145	662
Leeds and Liverpool Canal (1b)	730	311	1,375
Coventry (2a)	549	191	1,195
Rochdale (2c)	705	240	1,604
Basingstoke (2c)	292	93	644
River Ancholme (3)	129	108	151
River Great Ouse (3)	118	93	148
River Medway (urban) (4)	113	51	190
River Medway (rural) (3)	109	62	203
River Wey (4b)	208	89	388
Lee Navigation (4b)	447	156	932
River Severn Navigation (4a)	322	132	698

Figure 31 Benefits per km, by scenario



[72] In this study, settlements with populations less than 10,000 are classed as rural.

5 Aggregation

5.1 Objectives

The project aim is to apply a benefits transfer based valuation framework produced in the earlier phase of the research programme to evaluate the key social, economic and environmental benefits that the inland waterways deliver in England and Wales, against a two policy scenarios (e.g. reduced or increased funding). In order to achieve this, the benefit values estimated through the case studies are aggregated, by category, to provide an estimate of the marginal value of the key benefits for each policy scenario considered.

While under the case studies the total values for each scenario are presented, under the aggregation the **marginal change from the baseline** is presented in order to better inform discussions around policy decisions[73].

5.2 Key Issues

The completion of the aggregation task has thrown up a number of issues, both practical and theoretical. These are discussed in brief here with an explanation of how they have been addressed within the aggregation exercise.

Aggregation is completed by **category of waterway**. As case studies have not been completed for all categories of waterway due to data availability, consideration has been given as to how to aggregate benefits for missing categories. Where gaps have been identified, the benefits estimated for other similar categories have been applied. Where more than one case study has been completed per category, the benefit values have been averaged. See Table 28 for further explanation.

Table 28 Derivation of benefit estimates per category using case study results

Category	Case study benefits applied	Notes
1 – Canal/ Rural/ Unknown boat density	Average of Lancaster (1c) and Pocklington (1c)	Where no boat density information is available, waterways have been assigned the same benefit values as category c – low boat density.
1a – Canal/ Rural/ High boat density	Kennet & Avon (1b)	The Kennet & Avon canal has the highest number of boat movements of all the category 1 case studies.
1b – Canal/ Rural/ Medium boat density	Average of Kennet & Avon (1b), Caldon (1b) and Leeds & Liverpool (1b)	-
1c – Canal/ Rural/ Low boat density	Average of Lancaster (1c) and Pocklington (1c)	-
2 – Canal/ Urban/ Unknown boat density	Average of Rochdale (2c) and Basingstoke (2c)	Where no boat density information is available, waterways have been assigned the same benefit values as category c – low boat density.
2a – Canal/ Urban/ High boat density	Coventry (2a)	-
2b – Canal/ Urban/ Medium boat density	Average of Coventry (2a), Rochdale (2c) and Basingstoke (2c)	-

[73] While the information presented in this study is relevant to the new funding models under consideration, it was not within the original scope of the project to directly inform any of the decisions currently being made as part of that process.

2c – Canal/ Urban / Low boat density	Average of Rochdale (2c) and Basingstoke (2c)	-
3 – River/ Rural/ Unknown boat density	Average of Ancholme (3), Great Ouse (3), and Medway rural (3)	-
3a – River/ Rural/ High boat density	Great Ouse (3)	The River Great Ouse has the highest number of boating visits of all the category 3 case studies.
3b – River/ Rural/ Medium boat density	Ancholme (3)	The number of boating visits on the Ancholme is higher than the Medway rural, but lower than the Great Ouse.
3c – River/ Rural/ Low boat density	Medway rural (3)	The Medway rural has the lowest number of boating visits of all the category 3 case studies.
4 – River/ Urban/ Unknown boat density	River Lee (4b)	Where no boat density information is available, waterways have been assigned the same benefit values as category c – low boat density.
4a – River/ Urban/ High boat density	Severn Navigation (4a)	
4b – River/ Urban/ Medium boat density	Average of Wey (4b), Lee (4b) and Severn (4a)	-
4c – River/ Urban/ Low boat density	River Lee (4b)	The River Lee has the lowest number of boat movements of all the category 4 case studies.

Prior to aggregation, it is important to look at the **nature of the case study site** again in the context of all other waterways in the same category of waterway.

The overriding consideration for aggregation, especially in cases of marginal change assessments, is whether it is appropriate to assume that the value estimated for one location is applicable to the preferences of people in another, and whether it is legitimate to apply a site specific value more generally without taking into consideration the characteristics of individual sites and substitute sites.

The case study sites were selected on the basis that, broadly speaking, all waterways within that category provide similar benefits and therefore that the same transfer values can be applied. However, for the aggregation there are some instances where the profile of a case study site cannot be directly transferred across all waterways within that category.

For instance, not all waterways have towpaths/ pathways adjacent and so it cannot be assumed that the towpath benefits can be simply aggregated over the length of the waterways within each category. Also, not all waterways within each category are fully navigable. The GIS database has therefore been used to verify the appropriate length over which to aggregate £/km values for each of the benefit categories.

In the case of towpath/ pathway, benefits have only been allocated to those waterways with an adjacent towpath/ pathway[74]. Data on the lengths of towpath/ pathways were only available for British Waterways waterways; therefore to calculate the aggregate towpath benefits for non-British Waterways waterways, it was assumed that the same proportion of non-British Waterways waterways have a

[74] It is assumed that all polylines in the BW towpaths dataset are associated with a waterway. Of these polylines, 93% are within 50m of a waterway. This is considered a reasonable distance offset to account for variations arising in digitising quality.

towpath/ pathway adjacent[75]. This is thought to be an over-estimate as it is likely that British Waterways waterways have more towpaths/ pathways than non-British Waterways waterways; however the extent to which this might be overestimated is not known.

Angling benefits were also aggregated over the length of waterways with an adjacent towpath/ pathway.

With regard to boat density classification, where the GIS database is missing data, it has been assumed that boat density is low (see Table 28). Where it is known to be zero in the GIS dataset; these lengths are not included in the aggregation exercise.

Non use values are benefits perceived by individuals that are not associated with the actual use of, or even an option to use, the waterway (or its services). Non use values are therefore a 'special case' in that they are not dependent upon any particular ecosystem service as such, but simply upon the existence of species, habitats, landscapes, or social and cultural heritage. Therefore identifying how a change in policy scenario would impact on the provision of these values is not straightforward.

While non-use values are considered important, it was not possible to include them at a case study level (see Section 3.3). However, a high-level assessment has been undertaken in order to provide an indication of the potential change in non-use values associated with the policy scenarios. The approach applied to estimating a national non-use value is discussed further in Section 5.3.

As noted in Section 4, the Treasury Green Book requires that consideration is given to the impact of **distributional variations** across the population with regard to their impact on benefits (and costs). An example of distributional weighting analysis is presented in Section 4.8 – the Rochdale Canal case study. At the national level, it cannot simply be assumed that distributional impacts will 'average out' across the country. This is because the weighting function is non-linear.

It was not considered appropriate to carry out a distributional weighting exercise for each study and to feed these results into the aggregation as the demographic nature of the area/ visitors is very location specific and would not be applicable across every waterway in that category.

Rather than apply the possibly flawed 'bottom up' approach described above, the implications of a 'top down' approach were considered. However, a number of factors were found to limit the feasibility of applying distributional weights in this case:

- While information is known about the average deprivation of each of the waterway sites, it would be incorrect to assume that all visitors to a waterway come from the area immediately adjacent (thereby sharing the same deprivation indices);
- The complexity of the data makes the application of a weighting very difficult, for example each 1km stretch may pass through more than one LSOA;
- It is questionable as to the value such an analysis would provide, given the large number of assumptions which already underlie the analysis; and

[75] According to the BW towpath dataset, 56% of all BW waterways by length are within 50m of a towpath. This is considered a reasonable distance to offset variances in digitising quality (see previous foot note). This same proportion by length has therefore been applied to all non-BW waterways.

- Consideration was given to maintaining consistency with the National Ecosystem Assessment (NEA) which does not include this distributional impact analysis, except in one case-study example.

It was therefore concluded that only a qualitative description of the deprivation status of the waterways would be provided to allow for a greater understanding of the aggregation results. See Section 5.4 for this discussion.

As noted throughout the case study analyses, no adjustments for displacement were made at the case study level. However, it is critical that the **issue of displacement** is reconsidered at the aggregate level in order to understand how the additional visits to waterways under Scenario 2 or lost visits to waterways under Scenario 1 contribute to real national welfare gains or losses. It is unrealistic to assume that all additional visits under Scenario 2 estimated at a case study level would be new visits to the waterway network when aggregated to the national level. Similarly, it is important to consider the loss in visits under Scenario 1 at the national level and whether these would simply be transferred to another location.

For the purpose of this assessment, it is has been assumed that because the degradation under Scenario 1 would occur across the whole of the waterway network, the reduction in recreational visits estimated at the case study level can be aggregated without adjustment. It is likely to be the case that some, possibly a high number, of these visits would not be lost to the nation as people would simply visit other substitute outdoor sites (woods, beaches etc); however they are still assumed to be lost to the waterways. The aggregate change presented in Section 5.4 therefore reflects the benefits lost from waterways nationally.

With regard to Scenario 2, it cannot be assumed that all of the additional visits will be new visits to the waterways and thus to the nation. Many visits will simply be the result of people visiting a different waterway as a result of the improvements. Therefore, the aggregated towpath/ pathway benefits have been reduced by 80% based on the assumption that 20% of the modelled increase in visitor numbers are new visits[76], thus providing a real change in welfare at the national level.

The application of these different assumptions to the two policy scenarios results in the aggregate benefit assessment suggesting there is more to be lost under Scenario 1 at the aggregate level than there is to be gained under Scenario 2. This is in contrast to the picture presented at the case study level where the percentage loss in benefits under Scenario 1 is smaller than the percentage gain in benefits which could be realised under Scenario 2. This is further discussed within the sensitivity analysis presented in Section 5.6.

No adjustment has been made to boating visits. It has been assumed that all additional boating visits are in fact new as there is capacity on the waterways to accommodate this. This assumption is reliant on the continuing injection of investment to facilitate this growth.

5.3 Approach and Methods

The aggregation of benefits from the case study level to the national waterways category level has been completed using a variety of approaches depending on the

[76] This assumption was also applied in the Rochdale and Huddersfield Narrow Canals Restoration - Economic Evaluation (Jacobs 2010) which in turn is based on the review of a range of economic impact assessment where displacement is considered. It is also consistent with a BW 'rule of thumb' assumption for displacement.

type of benefit. Analysis of the GIS database forms the basis of the approach in all cases.

The approach and methods for each benefit category is discussed in turn below.

Property Premium (proxy value for amenity benefits)
The following steps were undertaken

- The National Receptor Database (NRD) data were filtered to include only residential property within 50m of a rural waterway and 25m of an urban waterway;
- Each property was associate with the closest waterway and the government region it was in, using a spatial join in the GIS database;
- Each property was then attributed an average market value, based on the government region and property type, using a table join in the GIS database;
- The total value of all properties within each waterway category was then extracted from the GIS database using a query function;
- The value of the benefits under each scenario was then calculated by multiplying the scenario assumptions (e.g. -10% to +8% of average property prices) by the total property value by category; and
- The loss/gain in property value is only realised upon the sale of the property; therefore the change in premium has been converted to EAV by assuming that properties are sold on average once every ten years, or 1.5 times throughout the 15 year appraisal period.

Boating trips

- The value of the boating benefits generated at the case study level were converted to a £/km/yr value by dividing the EAV for boating benefits by the length of each case study stretch ;
- This value was assigned to the waterway categories based on the category each case study falls into. Where more than one case study was undertaken for a single category, the average value per km was applied;
- The length of navigable waterway within each category in England and Wales was then calculated; and
- The value (£/km/yr) was then multiplied by the number of kilometres of navigable waterway within each category.

Towpaths and angling visits

- The value of the towpath and angling benefits were generated for each scenario, by category, from the £/km/yr estimated through the case study analysis;
- The length of waterway with towpaths / pathways was then generated by category, including only those waterways within 50m of a towpath;
- The value (£/km/yr) was then multiplied by the number of kilometres of towpath within each category; and
- For towpath visits only, this value was then adjusted by scenario to reflect displacement effects (as described above), the availability of substitute sites and what can be considered to be truly additional visits to the waterways under each scenario.

Non-use values

- It is assumed that the non-use values estimated for the continued maintenance of canals for boating, heritage and towpaths as presented in the benefits transfer framework are suitable for use here. Therefore, the transfer values are only considered appropriate for application under

Scenario 1, the loss of benefits associated with the discontinuation of maintenance of the canals. No non-use valuation has been undertaken for Scenario 2.

- These values are aggregated over the total households in the England and Wales only.
- These results are presented separately below for transparency.

5.4 Aggregation Results

5.4.1 Marginal results

The results have been aggregated based on the approach outlined above. Presented in Table 29 below are the *marginal changes* estimated for each scenario. The annual potential loss in benefits (EAV) for a given waterway category under Scenario 1 is shown in the column titled 'Scenario 1'. The annual potential gain in benefits (EAV) is then shown in the 'Scenario 2' column. The sum values show that the value of the marginal change under both scenarios is significant. This table also shows the value of the marginal loss and gain per kilometre per category for each scenario considered.

Table 29 Aggregated results - marginal change from baseline- (£'000)

Category		Category Details	Scenario 1	*£k/km*	Scenario 2	*£k/km*
1	a	**Canal** / **Rural** / High Boat Density	-96,308	*-283*	31,287	*92*
	b	Canal / Rural / Medium Boat Density	-161,336	*-307*	53,052	*101*
	c	Canal / Rural / Low Boat Density	-72,613	*-181*	23,279	*58*
	-	Canal / Rural / Unknown Boat Density	-4,757	*-67*	1,578	*22*
		Category sub-total	*-335,014*		*109,196*	
2	a	**Canal** / **Urban** / High Boat Density	-47,492	*-333*	20,110	*140*
	b	Canal / Urban / Medium Boat Density	-144,705	*-290*	60,031	*120*
	c	Canal / Urban / Low Boat Density	-169,915	*-271*	69,656	*111*
		Canal / Urban / Unknown Boat Density	-17,404	*-153*	6,532	*57*
		Category sub-total	*-379,815*		*156,329*	
3	a	**River** / **Rural** / High Boat Density	-130	*-19*	74	*11*
	b	River / Rural / Medium Boat Density	-1,750	*-18*	931	*10*
	c	River / Rural / Low Boat Density	-7,267	*-27*	4,532	*17*
		River / Rural / Unknown Boat Density	-8,218	*-11*	6,635	*9*
		Category sub-total	*-17,364*		*12,172*	
4	a	**River** / **Urban** / High Boat Density	-1,825	*-24*	1,188	*16*
	b	River / Urban / Medium Boat Density	-14,765	*-128*	6,265	*54*
	c	River / Urban / Low Boat Density	-29,194	*-129*	11,273	*50*
		River / Urban / Unknown Boat Density	-11,917	*-28*	4,696	*11*
		Category sub-total	*-57,701*		*23,421*	
		Sum	**-789,894**		**301,118**	

This table shows that at a national level, a reduction in funding is likely to result in a significant annual loss in benefits – in the region of £800M annually. This represents a loss over the baseline of 62%, on average. It should be noted that this relates only to the key benefits considered here and that in reality, benefits would also be lost from a number of other benefit categories.

Similarly, significant gains in benefits arise from the increase in funding assumed under Scenario 2; however these are proportionally smaller than the loss in annual

benefits under Scenario 1 – primarily due to the assumption that only 20% of towpath/ pathway visits are additional at the aggregate level. The £300M in additional benefits estimated under Scenario 2 represents a gain over the baseline of 24%, on average.

In considering the total marginal change by benefit type, it is clear that under both scenarios towpath/ pathway visits are driving the results. As shown in Figure 32 these benefits represent 84% of the marginal change, with the loss in property premiums being the next most significant benefit category. Figure 33 shows a similar picture with almost of the marginal gain in benefits expected under Scenario 2 being attributed to towpath visits (83%).

Figure 32 Scenario 1 - Marginal change benefits split by benefit type

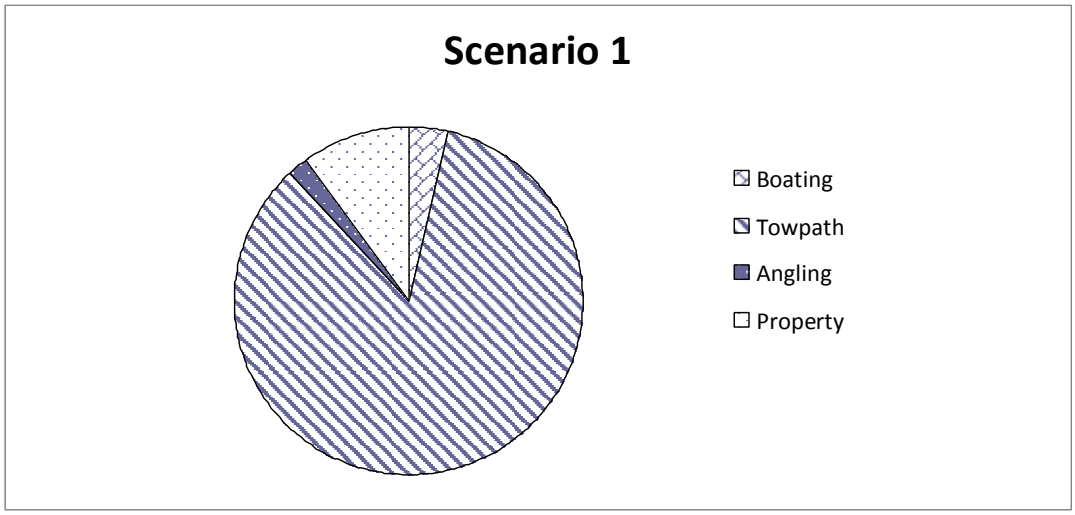
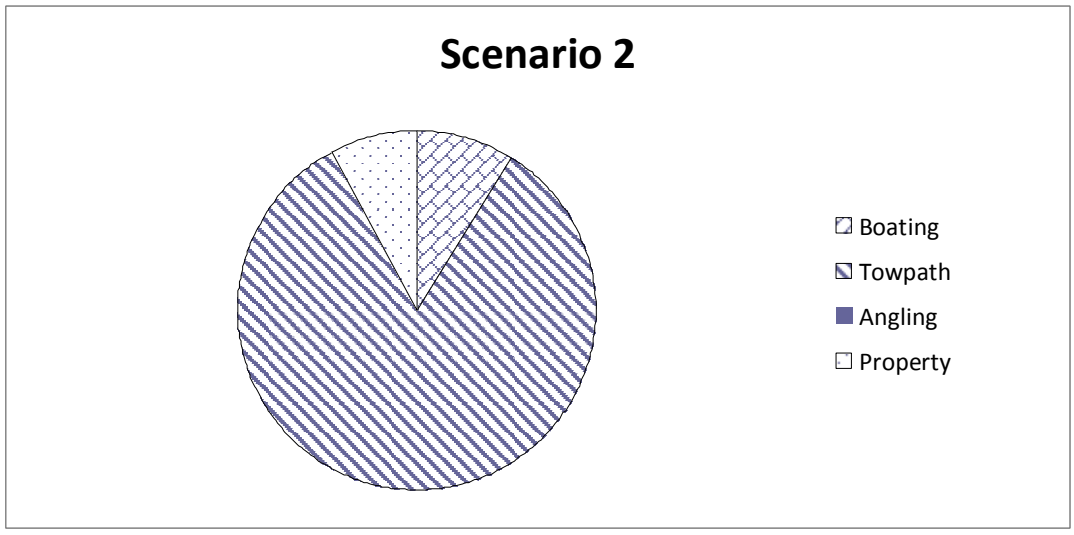


Figure 33 Scenario 2 - Marginal change benefits split by benefit type



5.4.2 Non use values

Under Scenario 1, it could be assumed that in addition to the losses in use values (boating, towpaths etc) the non use values held by the wider population would also be lost. The Phase 1 guidance report cites values of between £0.75 (median) and £5.55 (mean) per household per year (1995 prices) for the continued maintenance of the network for boating, heritage and towpaths.

When uplifted to 2010 prices and aggregated over the 21.7M households in England and Wales, it is estimated that the possible loss in non-use benefits under Scenario 1 is between £24M and £180M per year.
This is likely to be an underestimate of the loss of non-use values for two main reasons. Firstly, the primary study asked respondents their WTP for the continued maintenance of one waterway close to their homes[77]. It is likely that WTP per household for continued maintenance across all waterways would be higher – perhaps much higher. Secondly, the WTP values have been aggregated only across households in England and Wales; however it is likely that some residents of Scotland and Northern Ireland and perhaps outside the UK would attribute non-use values to the waterways.

It has not been possible to estimate the change in non-use values associated with the increased funding assumed under Scenario 2. This is due to lack of primary valuation studies which consider WTP for improvements to waterways and also due to the nature of waterway characteristics giving rise to non-use values. As noted in Table 2, non-use values are generally associated with heritage and environment aspects, including biodiversity. These categories of benefits have not been quantified as part of this assessment as the link between funding and the provision of these benefits is not well understood.

5.4.3 Distributional impact assessment

As discussed in Section 5.2, a qualitative assessment of the deprivation status of the waterway locations at the national level has been undertaken. This assessment could be used to inform distributional impact assessment and to provide insight into the relative importance of some of the waterway categories – for example, where the marginal change in benefits across two sites/ categories is similar, or where operational and capital expenditure needs to be prioritised.

Since the benefit categories that have been valued appear to greatly outweigh the costs presented, it is not thought that the application of distributional weighting would alter the overall picture presented here or ultimately the number of socially beneficial projects; however it might alter the ranking of projects and/or help in deciding which projects are implemented in any programme subject to a budget constraint.

In order to produce this qualitative assessment, the following GIS analysis was undertaken:

- A copy of the original waterways GIS file of 1km sections was edited to merge adjacent sections of waterway based on common name and category;
- Merged sections were buffered by 1,000m to create a polygon feature class;
- This was intersected with LSOA polygons to which IMD (Index of Multiple Deprivation) information had already been joined;
- This generated 27,000 combinations of matches between waterway sections (of unique name and cat) and LSOAs within 1,000m;
- The data were then analysed in MS Excel to generate frequency counts of results by bands of IMD overall rank;
- With 32,482 LSOAs in England with an IMD result, the lowest rank of 1 is allocated to the most deprived LSOA and the least deprived LSOA is ranked 32482;

[77] Refer to the guidance (Jacobs, 2010) for a review of the primary valuation study (Adamowicz, 1995).

- Frequency counts for 10% bands of IMD rank were generated by counting results for each category where IMD overall rank was 0-3248 (0-10%), 3248-6496 (10-20%) etc.
- These data were displayed on frequency charts to illustrate the distribution of IMD rank results for each different category of waterway.

Due to the difference in IMD reporting for England and Wales, the process was undertaken independently for each nation. The Overall Rank IMD for Wales ranges from 1 to 1896, defining frequency count bands of 1-190 (0-10%), 190-379 (10-20%) etc. The results are not directly comparable, but general trends between category and deprivation may be observed. However due to the low frequency of navigable waterways and associated LSOAs in Wales, the analysis may not provide a large enough sample to generate any meaningful statistics.

Figures 34 to 37 show the frequency of waterways falling into each deprivation index band in England. In general, urban waterways (categories 2 and 4) show higher levels of deprivation which is to be expected. In England, the category with the highest occurrence of very deprived LSOAs (0-10% deprivation band) is category 2c – Canal/ Urban/ Low density waterways. In contrast, rural rivers (all category 3 waterways) show the lowest deprivation levels. The picture in Wales is less clear as the frequency of waterways show a more even spread over the deprivation index bands; however this is thought to be due to a small sampling size (a small number of navigable waterways in Wales). See Appendix H for charts showing the frequency of IMD rank for England and Wales, broken down by sub-category.

Figure 34 IMD rank – all Canal/ Rural waterways in England

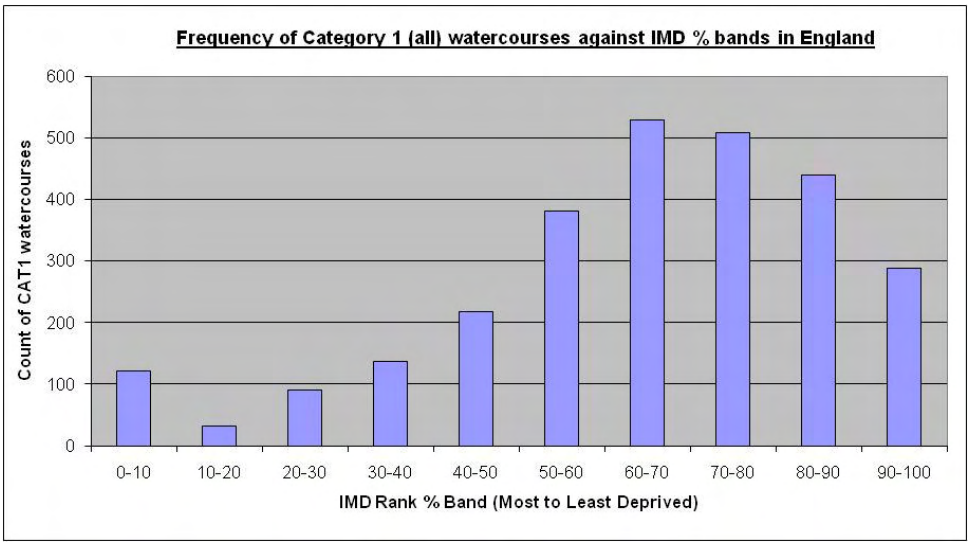


Figure 35: IMD rank – all Canal/ Urban waterways in England

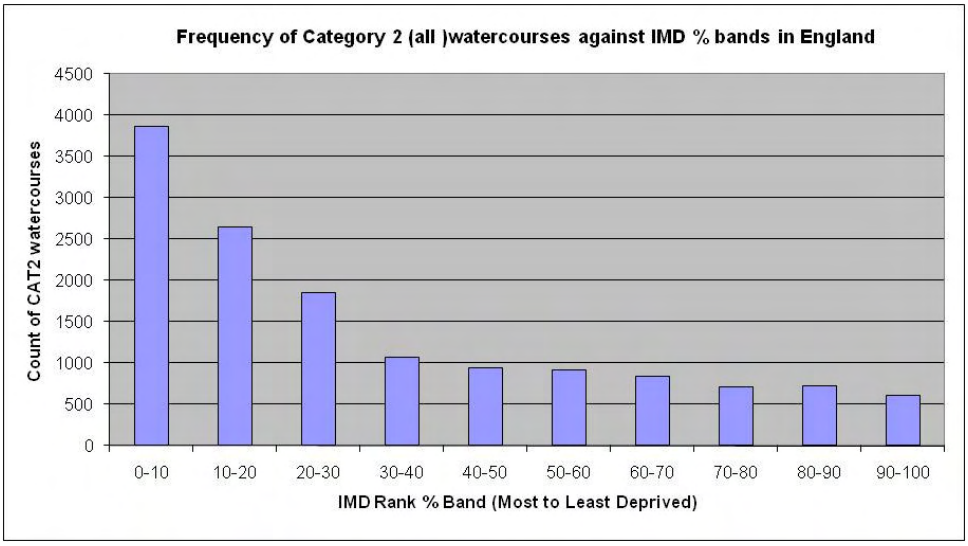


Figure 36: IMD rank – all River/ Rural waterways in England

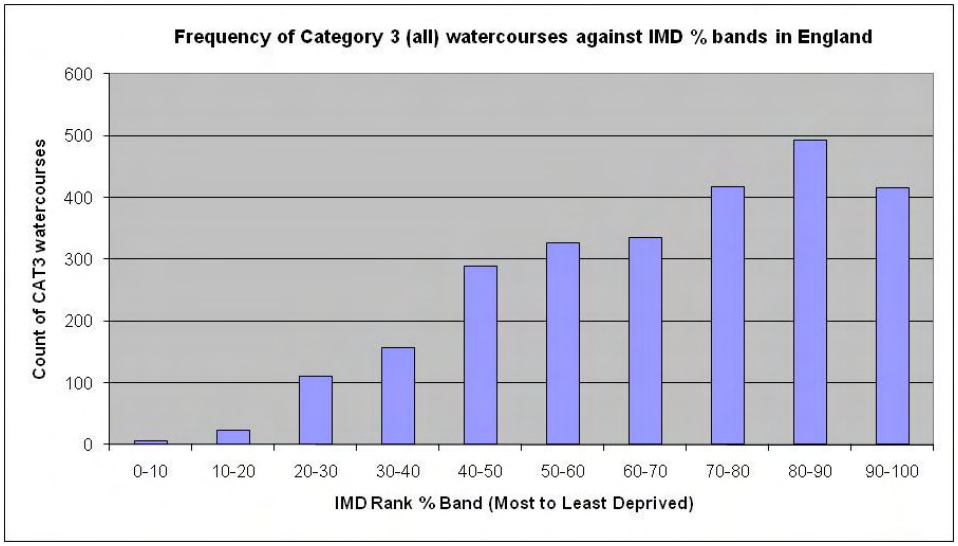
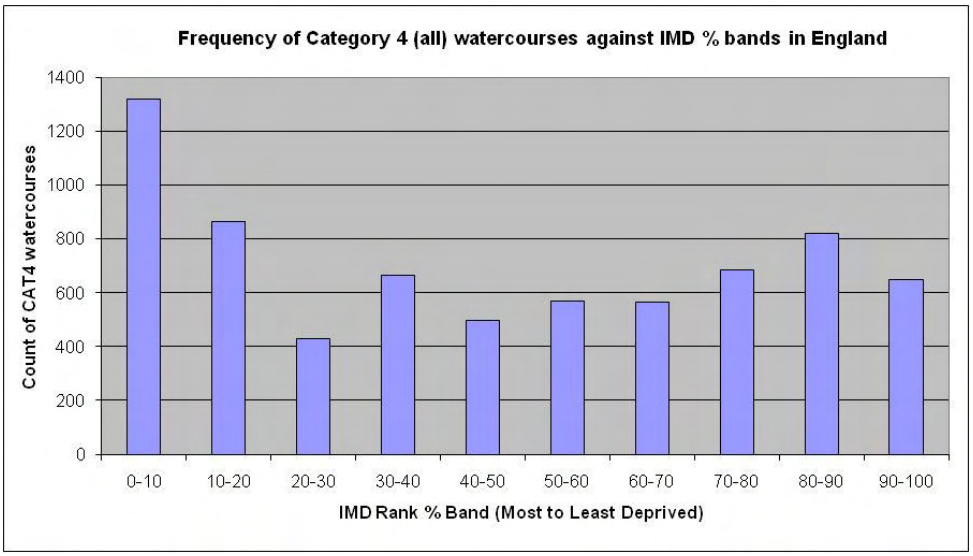


Figure 37: IMD Rank – all River/ Urban waterways in England



5.5 Scenario Cost Discussion

It has proven very difficult to gather any appropriate data to allow the policy scenarios considered here to be costed in financial terms.

At a case study level, costing data are only available for a few sites and is therefore not suitable for use in any aggregation exercise. The data gathered at a case study level are also very site specific, and generally excludes any expenditure on flood risk management activity. While it is thought that the majority of recreation and amenity benefits are derived from spending on navigation, there is likely to be some relationship between these benefits and FRM spending as well; however this relationship is not well understood.

The only data available at a national level are those presented in British Waterways annual accounts. These show that in England and Wales, British Waterways spent £120M on capital and operation in 2010/11. These costs cover maintenance, customer services, and staff costs of £96M (operational expenditure) and £24M on major infrastructure works and canal dredging (capital expenditure). Table 30 shows this breakdown.

Table 30 British Waterways annual operational and capital expenditure (£M)

Category	2009/10	2010/11	Average
Waterway maintenance & customer service	£60.5	£58.1	£59.3
National & waterway teams	£38.8	£38.0	£38.4
Capital – major infrastructure works	£27.6	£20.4	£24.0
Capital – canal dredging	£3.9	£4.2	£4.1

If it is assumed that these costs are representative of the costs incurred on non-British Waterways waterways, they can be used to paint a picture of the baseline costs across the network. Using the average spend over the two years presented above, operation costs for British Waterways are equivalent to about £32k per km of waterway and capital expenditure, about £9k per km.

If you apply these estimates to the whole length of the network in England and Wales (5,000km), the operational costs are estimated to be £159M, while the capital costs are about £46M per year.

The question is, assuming that these values appropriately represent the costs of providing the baseline benefits provided by the network (which are significantly greater), how might these costs change under the policy scenarios considered here?

It is clear that under Scenario 1, all expenditure on the waterways would not be saved as under a 'remainder' status the waterways are likely to still require significant spending. Even if as much as 80% of the costs were saved[78], resulting in a savings of £127M in operational costs and £36M in capital costs, the loss in benefits would far outweigh any direct financial savings made.

[78] According to BW, it is very unlikely that 80% of the costs would be saved – particularly with regard to canals. For many waterways a drainage function would have to be maintained, or alternative measures would have to be put in place. Also, there would be other statutory constraints related to public safety, maintaining the environment & heritage, etc.

It is harder to estimate the potential additional costs which might be incurred to achieve the benefits estimated under Scenario 2. However, it can be seen the annual costs (operational and capital) would have to increase by about 150% before they would outweigh the estimated benefits which could be provided under this scenario.

5.6 Sensitivity Analysis

The most significant assumptions influencing the difference between the outcomes under the two scenarios are:

- the percentage growth applied to towpath/ pathway visits under Scenario 2;
- the change in WTP values between the baseline and Scenarios 1 and 2; and
- the displacement adjustment applied to additional towpath/pathway visits under Scenario 2 to reflect real national gains.

Sensitivity testing was therefore undertaken by individually adjusting these three assumptions.

As shown in Table 6, towpath/ pathway visits in urban locations were assumed to increase by 30% per year over years 1-2 and 2% per year over years 3-6, a total compound growth from year 1 to year 6 of 83%. Similarly, visits in rural locations were assumed to increase by 18% per year over years 1-2 and 2% per year over years 3-6, a total compound growth from year 1 to year 6 of 51%. A sensitivity test was carried out whereby the annual growth rate in the first 2 years was halved, resulting in a total compound growth of 43% and 28% for urban and rural categories, respectively. This change in assumption would reduce the growth in benefits under Scenario 2 from £301M to £215M (see Table 32).

As shown in Table 3, the WTP values are assumed to decrease under Scenario 1 and increase under Scenario 2 (the CS element only, expenditure is assumed to remain the same). A sensitivity test has been undertaken whereby the CS under Scenario 1 is assumed to decrease; however to the lower-bound estimate presented in the guidance as oppose to zero. For Scenario 2 sensitivity testing, the CS is assumed to remain at baseline values (i.e. total WTP per recreational visit under baseline and Scenario 2 is the same).

Table 31 presents these revised WTP values. These changes would effectively close some of the gap between Scenario 1 and 2, reducing the loss in benefits under Scenario 1 from -£790M to -£766M and reducing the gain in benefits under Scenario 2 from £301M to £186M.

Table 31: Unit WTP values used for sensitivity testing

Recreation type	WTP Component	Baseline (£/visit)	Scenario 1 (£/visit)	Scenario 2 (£/visit)	Reference
Private boats (powered)	Expenditure	12.84			GHK (2004)
Hire boats (powered)	Expenditure	30.64			Mid range value from Jacobs Gibb (2001) and GHK (2004)
Unpowered boats	Expenditure	3.62	3.62	3.62	IWDVS (2008)
Boating (all)	CS	0.57	0.31 (0.00)	0.57 (0.84)	Baseline & Scenario 2 – mid and range from Willis and Garrod (1990); Scenario 1 – low range estimate.
Towpath/ pathway visits – Local	Expenditure	3.53			Value for walking/ rambling from IWDVS (2008)
	CS	0.75	0.15 (0.00)	0.75 (3.12)	Baseline & Scenario 2 – mid range from Willis & Garrod (1991). Scenario 1 – low range estimate.
Towpath/ pathway visits – Day	Expenditure	4.87			Mid range value for day visitors from Ecotec (2006) and Glaves (2007)
	CS	8.08	0.41 (0.00)	8.08 (10.47)	Baseline & Scenario 2– mid range value for non-local visits from Willis & Garrod (1991). Scenario 1 – low range estimate
Towpath/ pathway visits – Overnight	Expenditure	64.20			Ecotec (2006)
	CS	8.08	0.41 (0.00)	8.08 (10.47)	Same assumptions as per day visits.
Cycling	Expenditure	4.61			IWDVS (2008)
	CS	0.58	0.32 (0.00)	0.58 (0.85)	Baseline & Scenario 2 – value from Willis & Garrod (1990). Scenario 1 decrease from baseline calculated from boating CS.
Angling – Coarse Canal	WTP	19.97			Spurgeon et al. (2001)
Angling – Coarse River	WTP	26.83			

Note: ( ) indicates the original values used in the analysis.

If it were assumed under Scenario 1, that not all of the losses estimated at the case study level would be realised at the national level, the loses under this scenario would be significantly reduced.

If the same assumptions as applied under Scenario 2 were applied to Scenario 1 (20% are true national losses), then the sum value of the marginal losses under this scenario would be reduced from -£790M annually to -£256M annually. This

represents a loss of 20% over the baseline and is in the same region as the expected gains under Scenario 2. This sensitivity analysis also demonstrates that the picture presented by the case study analysis - where the potential gains under Scenario 2 is greater than the potential losses under Scenario 1 - would be maintained at the aggregate level if the displacement assumption was applied equally to both policy scenarios.

Even if this were the case, the potential maximum financial savings which might be realised under Scenario 1 (£163M/yr) are still far outweighed by the expected loss in benefits. It is therefore considered that the message coming from this analysis - that the potential losses under Scenario 1 far outweigh any potential financial savings which might be realised - is not sensitive to the key assumptions made within the analysis.

Under Scenario 2, if it were assumed that 50% of the estimated additional towpath/ pathway visits were truly new visits to the waterway network and thus real welfare gains, the benefits under this scenario would rise to £677M (EAV) (see Table 32).

Table 32 Summary of sensitivity testing – marginal change in benefits (£M)

Sensitivity test	Scenario 1	Scenario 2
Original analysis	-£790	£301
Reduced towpath/ pathway growth	-	£215
Changes to unit WTP values (CS component)	-£766	£186
Displacement adjustment for Scenario 1 towpath/ pathway visits (20% real loss)	-£256	-
Displacement adjustment for Scenario 2 towpath/ pathway visits (50% real additional)	-	£677

As shown in Figure 32 and Figure 33, towpath visits dominate the values estimated under both Scenario 1 and Scenario 2. Therefore any sensitivity analysis undertaken on the other benefit categories is not going to significantly impact on the overall results presented above.

6 Key Messages and Conclusions

The key messages and conclusions coming out of this analysis are:

- The benefits currently provided by navigable waterways, both at the case study level and the national level, are clearly significant. The baseline benefits have been found to range between £109k per kilometre per year to £730k per kilometre per year. In general, the categories covering canals showed higher baseline values for the key benefits than river categories showed.

- The Scenario 1 assessment shows that benefits can be easily lost through inaction or poor maintenance, resulting in degradation of the waterways and associated assets. Based on a range of assumptions, between £256M and £790M could be lost annually should Scenario 1 be realised.

- The assessment also shows that significant value could be realised under Scenario 2. These benefits could be described as the potential additional value of the waterways to the nation if investment happened. Again, based on a range of assumptions, this could be between £186M and £677M annually. The best estimate is £300M per year[79].

- The majority of these gains or losses in benefits are driven by towpath/pathway visits. The analysis shows that over 80% of the possible loss or gain in benefits would come from informal use of the towpaths along canals and pathways along rivers. It is therefore clear that in order to maximise the benefits which could be realised by investment, this is a key area to focus on.

- In addition to the welfare losses estimated for use related benefits (boating, towpaths etc) of approximately £790M a year, Scenario 1 could result in further losses related to non-use benefits. These are estimated to be in the region of between £24M and £180M per year. This range highlights the potential for fundraising by the new charity, illustrating the importance that people could place on maintaining the waterway network for heritage and environmental reasons. Per kilometre this equates to a potential loss between £5k and £35k per year across all waterways.

- The waterways are diverse in nature and limiting the categorisation to 4 main categories was difficult. However the analysis shows that in terms of the count of waterways in each category, the largest number of reaches fall into the Rural River Category (Category 3) (~35%), whereas all other categories have a broadly similar number of reaches (~21% - 23%). However by length, Categories 1 and 2 (urban and rural canals) contain the greatest proportion of all waterways (~29% and ~30% respectively), with Category 3 having ~24% and Category 4 (urban rivers) ~18%.

[79] Defra's 'Impact Assessment for moving inland waterways into a new charity in England and Wales (March 2011) estimated annual benefits in the region of £40M - £150M for the scenarios depicting grant funding options (these also show large cost-benefit ratios). The figure for increased benefits estimated here (£301M) is thought to be larger due to variations in WTP unit values applied, as well as the time-lag incorporated in the Impact Assessment. It is also important to note that the scenarios and methodology depicted in the two analyses were derived independently and are not intended to be identical.

- The losses projected under Scenario 1 are greatest in categories 1 and 2 for canals (£251k and £274k per km per year respectively), and significantly lower within categories 3 and 4 for rivers (£16k and £68k per km per year). This is as a result of the difference in the expected implications of Scenario 1 to canals and rivers and also due to the estimated current and projected use levels on canals and rivers. This is true also for the potential gains which could be realised by Scenario 2.

- Therefore the loss of benefits under Scenario 1 would be expected to hit urban canals (category 2 waterways) worst, with ~70% of the baseline benefits being lost. Rural rivers are expected to be impacted least by this scenario, with 46% of the baseline benefits lost.

- On a per kilometre basis, Scenario 1 could result in an average loss in benefits of £263k per year for categories 1 and 2 (canals), and result in an average gain in benefits of £98k per year under Scenario 2. These estimates would fall to £38k and £18k respectively for category 3 and 4 waterways.

- In England, the waterway category with the highest incidence of deprivation (passing through or adjacent to the greatest number of LSOAs with IMD rank <10%) is category 2 – urban canals (specifically 2c – urban canals with low boat density). Conversely, category 3 (rural rivers) showed the lowest levels of deprivation. The count of navigable waterways in Wales is too low to detect a clear pattern in waterway category and average deprivation levels.

- There remain significant limitations in terms of data availability. Data limitations exist relating to the current costs of maintaining the network and therefore the ability to predict the cost of implementing Scenario 2 was limited. GIS data were gathered from a range of sources; however the datasets are skewed by very detailed British Waterways information and very little data to cover other waterways.

- The development of the policy scenarios, and the implications of these on the benefit categories reviewed, is heavily dependent on expert judgement as little concrete evidence could be drawn upon to support assumptions made. This applies to the review and analysis presented on the expected marginal change in funding costs also.

- While it has been very difficult to relate the assumptions under each scenario to real funding changes, it can be seen from a simple review of the current expenditure by British Waterways, that the possible savings in funding which might be realised under Scenario 1 are likely to be far outweighed by the loss in benefits which would result. This conclusion is not sensitive to any of the key assumptions made in the analysis. In relation to Scenario 2, waterway funding would have to increase by around 150% before it would be in the same order as the expected benefits of this scenario.