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Valuing Ecosystem Services: Case Studies from Lowland England

Annex 3 - Little Ouse Headwaters project: Suffolk / Norfolk border

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NATURAL ENGLAND

Valuing Ecosystem Services: Case Studies from Lowland England

Little Ouse

Preface

This report has been commissioned by Natural England under the contract reference number of 23092.

The work aims to present how a combined ecosystem services and economic valuation approach can be used to understand the implications of different environmental conservation plans. Guidance from Defra on ecosystem services and value transfer is followed (Defra, 2007, eftec, 2010). The approach is used to assess and, where possible, value the likely changes in ecosystem services resulting from an intervention.

The information thus generated can be incorporated into decision-making or support tools such as cost benefit analysis. This information could also inform the way in which the management and conservation projects are designed to maximise the ecosystem service generation.

This is one of the six case study reports prepared to illustrate the application of the ecosystem services – economic valuation approach.

The work has benefited greatly from the ideas, knowledge, data and critique provided by numerous individuals in Natural England and other organisations. These include:

Stewart Clarke, Julian Harlow, John Hopkins, Ruth Waters and Jo-Anne Pitt.

We know that some others have provided advice or data to those who helped us and though we cannot list these people here, our sincere thanks go to them too. And our sincere apologies to anyone inadvertently omitted from the list above. Needless to say, any remaining errors are the fault of the authors alone.

Dr Robert Tinch, Adam Dutton, Laurence Mathieu (authors) and Ece Ozdemiroglu (internal reviewer).

24 November 2011

Contents

1. The Decision Context

This case study uses a value transfer methodology to assess the costs and benefits of possible changes in ecosystem services from a community-led wetland recreation and restoration project linking remnant valley fens in the headwaters of the Little Ouse River (the Little Ouse Headwaters Project).

The background to the project is a history of gradual drying out of the local fens alongside abandonment of those too wet to farm many years before or traditionally not being farmed. In the past it was used for peat production and coppicing but this ended some time ago. Other areas have been farmed. In recent times, as a result of a lowering of the water levels, a succession of very dry years, and reduced habitat management in certain areas, much of this open fen community had been lost as trees and scrub invaded, shading out the characteristic fen vegetation. Many of the rare and beautiful species that lived there were lost from the area during the second half of the 20th Century include Grass of Parnassus (*Parnassia palustris*), Marsh Helleborine (*Epipactis palustris*), Bog Bean (*Menyanthes trifoliata* and Fen Orchid (*Liparis loeselii*). Hinderclay Fen, a part of the project area, was a SSSI (Site of Specific Scientific Interest) but the designation was removed in 1983 due to drying out and lack of management. It is hoped that management reinstated by the project, together with measures taken to address groundwater abstractions, will result in the condition of the fen improving.

The aim of the project is to re-create and maintain a continuous corridor of wildlife habitat along the fenland headwaters of the Little Ouse which are located on the Suffolk/Norfolk Border. Farmland in the area is largely arable with some areas used for livestock production. The land for the project has been bought or rented from local 'Poors' Trusts and church charities. Although this land has generally not been farmed (other than some grazing) there is a potential loss in agricultural production resulting from this project. Work involves habitat regeneration through rewetting and reverting to fenland. This conservation work has potential implications not only for biodiversity, but also for recreation, agricultural land use diversification, and flood risk management.

The Little Ouse project was a demonstration project under the Waveney and Little Ouse Project which was part of the TENs (Transnational Ecological Networks). Part of the site coincides with the Waveney and Little Ouse Valley Fens Special Area of Conservation (SAC) and is marked in Figure 1 which presents the area of the Little Ouse project.

The project has a strong local involvement, originating when groups of interested residents from the Parishes of Redgrave, South Lopham, Blo'Norton, Hinderclay and Thelnetham came together in 2002 to establish a charity to conserve and enhance the environmental value of the river valley within their parishes. The charity set up to implement the project is currently run entirely by volunteers.

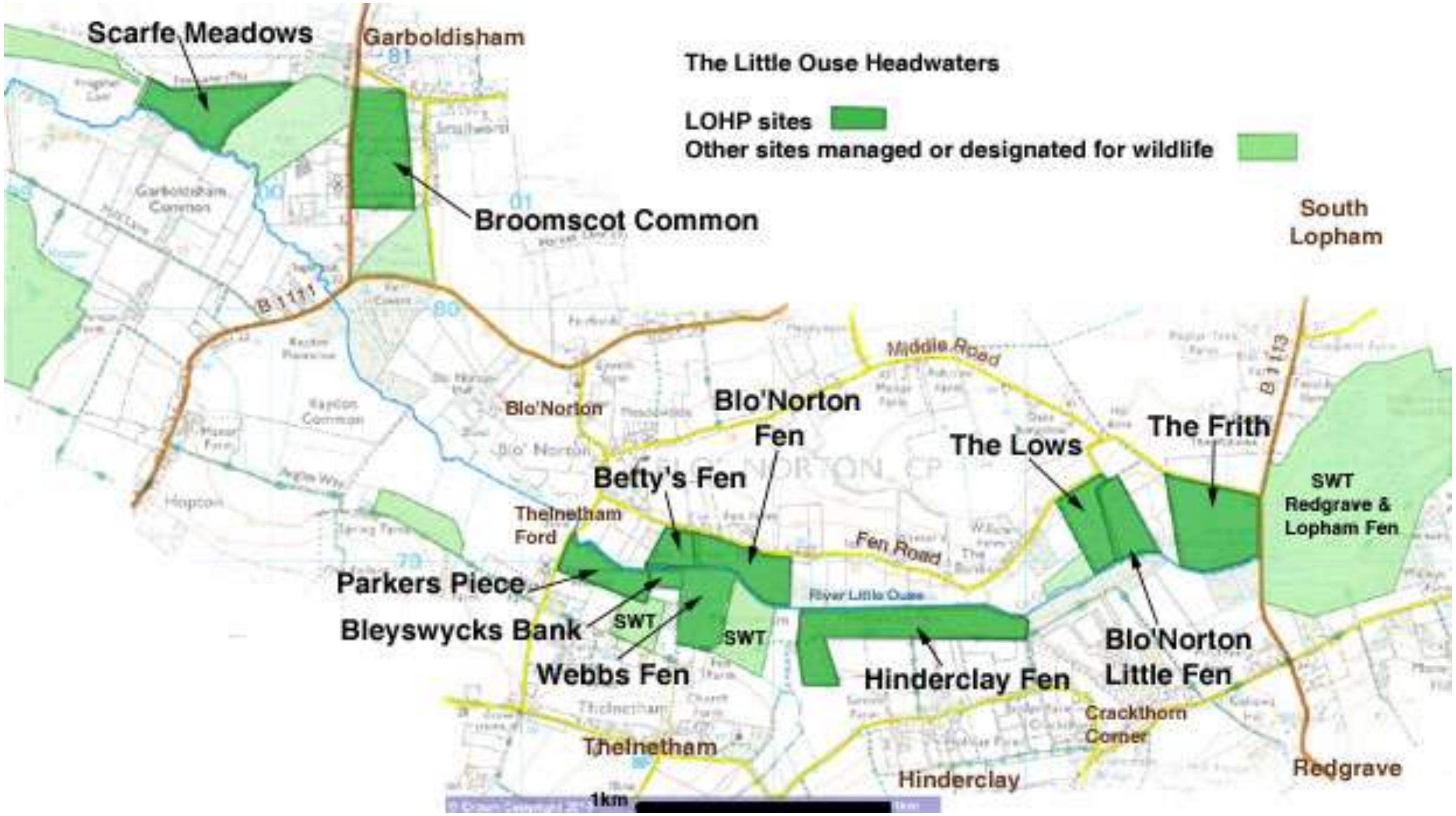

Figure 1: Map of the Little Ouse Headwaters Project (www.lohp.org.uk)

2. The Ecosystem Services and Affected Population

2.1 Ecosystem services

The project is taking place in (currently) 60ha of riparian border land. The project aims to re-create and maintain a continuous corridor of wildlife habitat along the fenland headwaters of the Little Ouse by re-wetting land and reverting to fen habitat as well as management of neglected land. There is a mixture of different baselines for this area which are described in Table 2 in Section 3. Some sites had been abandoned following historical agricultural use, others were abandoned from public use for peat extraction whilst other land which was previously grazed is now subject to different grazing regimes. The aims of the project are to be achieved through the following specific actions:

- Purchasing or renting land from landowners (mostly Poors trusts and church charities);
- Maintenance of existing wetland, wet woodland and heath;
- Clearing alder and willow;
- Grazing and mowing and fen vegetation, cutting on a 4-year cycle;
- Improve public access to the valley by the creation of new permissive footpaths and eventually cycle and bridleways;
- Excavation of new turf ponds to attract more aquatic species, in particular plant and invertebrate species associated with early succession habitats (for example, stonewort species); and
- Longer-term re-creation of some of the valley's fens, meadows and river meanders.

The potential results of project actions are listed on the website (http://www.lohp.org.uk/) as:

- Improving wildlife diversity;
- Improving water quality;
- Facilitating rural regeneration - for instance the project is now large enough to employ a co-ordinator and they hope to encourage tourism; and land-use diversification within the project area;
- Improving recreation, amenity and education value for the community;
- Improving landscape quality; and
- Reducing risks of flooding is possible but uncertain.

2.2 The affected population

The main beneficiaries of the work are likely to be local residents. There are approximately 700 households in the villages adjacent to the project. Table 1 describes the local population. There are 11 trustees of the Little Ouse Headwaters Project. The project has links to a range of local natural history and conservation groups, and works in partnership with the Norfolk and Suffolk Wildlife Trusts. Some non-use and recreation values are also likely to accrue to the wider public: in particular, enhancing the integrity of SSSI and SAC sites is a biodiversity benefit that could be of value to people across the region and at the national level.

Table 1: Household and Population numbers in the Little Ouse area (National Statistics, 2007)

Parish	**Households**	**People**
Redgrave	223	553
South Lopham	158	371
Blo' Norton	103	270
Hinderclay	121	335
Thelnetham	99	252
TOTAL	**704**	**1781**

3. Ecosystem Service Changes

Here we summarise the likely effects the Little Ouse project may have on the ecosystem services provided in the area (as reported in Section 2.1). The changes are the difference between what is provided now and will be provided in the future without the project, i.e. the baseline (Section 3.1) and what is likely to be provided when the project is implemented (Section 3.2). All quantitative information available is reported in Section 3.2 and the spider diagram at the end of that sub-section summarises the likely changes based on our analysis of the existing information.

3.1 Assessing the baseline

The baseline used for this case study is ‘business as usual’ involving continued farming on the drained land and continued degradation of the derelict sites.

Table 2 provides a qualitative description of the negative aspects associated with each site before the project intervened. It should be noted that they were not without ecological merit but these descriptions explain what the project aimed to change. These descriptions begin to highlight the limitations of a benefits transfer study in that even in these brief descriptions we see a rich variety of subtle ecological changes. Benefits transfer methods require us to make estimates based on more general interpretations of what it happening and much of this detail is lost.

Table 2: Qualitative descriptions of the sites in the baseline

SITE	AREA (where reported)	Brief description of the negative aspects of the baseline state
Bettys Fen	2.2 ha	Derelict, dried out and reverted to woodland
Blo Norton Fen	-	Dried out and reverted to scrub and trees
Broomscot Common	11.4 ha	Became of poor quality due to lack of management.
The Frith	10.7 ha	In 1940s was acid grassland and heath. Became arable and subsequently pasture, high levels of nutrients were applied leaving it dominated by nettles.
Blo Norton Little Fen	4.17ha	A lack of management led to an invasion of scrub and the lowered water table led to the loss of the open fen and the rare plants associated with it.
Hinderclay Fen	-	Wet fen, scrub, woodland, acid grassland and heathland. Once a SSSI it lost its status in 1983 as it dried out due to the deepening and straightening of the river to aid drainage for other farming sites, and impacts of public water supply borehole at Redgrave.
The Lows	4.5 ha	Improved grassland with some waterlogged lower fields where reed and reed grass were succeeding the richer fenland plant communities.
Parkers Piece & Bleyswycks Bank	5.3ha	Early arable use followed by drying out and enrichment of the pasture from free range pigs.
Scarfe Meadows	5.7 ha	Past use has left a legacy of pasture improvement and herbicide use which damaged the plant diversity.
Webbs Fen	5.7 ha	Drained in the 19th Century, converted to arable in the 20th Century. Seeded with grass in the 1990s and left unmanaged. This fen provides a linking site which will aid the areas surrounding it to provide an ecological gain greater than the sum of its parts.

3.2 Qualitative and quantitative assessment of the change

The interventions outlined in Section 2.1 will result in changes to ecosystem services, in particular food and fibre, biodiversity, climate regulation, recreation, landscape/aesthetics, knowledge/education (gathering data and teaching/guided walks), and flood regulation. There are also benefits, including health benefits, associated with volunteer work.

Food and fibre: There is no significant change in actual food production compared with the situation before the project – agricultural land was either derelict or grazed, and the grazed land is still under grazing management. Any decline in animal production is minor. Arguably, future food production potential may decline as a result of the work, but this is not thought to be significant (and the project is not irreversible: if in a future scenario it became important to use the land for intensive agricultural production that would be technically feasible).

Timber: Not relevant to the project.

Renewable energy: Not relevant to the project.

Freshwater quality: Impacts may be relatively minor. However, reduction in intensive farming will reduce fertiliser use and hence nutrient run off. The act of rewetting land may lead to further denitrification and some benefit. Taking land out of intensive production around the headwater springs and the riparian zone will have the greatest benefit.

Water flow regulation: Any impact on this service is likely to be minor. Re-wetting land could increase flood water storage capacity; there could be impacts on low-flow regulation, since water is retained and released over longer periods. However the areas involved are small. In order to estimate any impact we would need to accurately model the catchment which is beyond the scope of this case study.

Soil and erosion control: Lower stocking ratios and wetter conditions may help maintain higher vegetation cover and reduce erosion, and over time wet grassland may aid soil formation. Any impact is likely to be minor, and would require substantial work to specify which is beyond the scope of this case study.

Climate regulation: Wetting of the land will increase sequestration and reduce total emissions. Any change in animal stocking densities would also reduce emissions. However, there are no significant changes at present or planned.

Estimating sequestration levels for the soil can be achieved using evidence from Cantarello et al 2011. They report that natural grassland and pasture contains on average 124.1 tonnes of carbon per hectare (455 tonnes CO_2 per ha). Inland marsh contains 151.4 tonnes per ha (555 tonnes CO_2), but moors and heath contain 110.1 tonnes per ha (403 tonnes CO_2). Replacing 37.3 ha of grassland with heath, wet meadow and fen could therefore sequester up to 3730 tonnes of CO_2 if we consider the change to be entirely to 'marsh', but would release 1940 tonnes of CO_2 if the change is to 'heath'. Clearly these are very broad assumptions and there is a good deal of variation within each land cover class, as reported in Cantarello et al's work (2011). We can assume that the 'true' value will lie somewhere in between these values, probably a positive sequestration – there is only 4ha of heath, and the fen and wet meadow may be best characterised as 'marsh', in Cantarello et al's (2011) classes. If we assume around 2000 tonnes of CO_2 achieved over 50 years (allowing for gradual build-up of soil carbon) the yearly sequestration would be ~ 40 tonnes CO_2 per year. However this is a very rough figure and to be conservative we consider this only in the sensitivity analysis, not in the main calculations.

Air quality: Impacts on air quality are unlikely to be significant.

Recreation: Recreation improves alongside the reduced intensity of agriculture, with existing access improved and extended throughout the project sites. The area is also more attractive for walkers, increasing the recreational value, both due to the enhanced natural beauty and wildlife populations, and also through the commissioning and installation of sculptures within the fenland area.

Health is enhanced by greater recreation and also directly through the project, with up to 1000 voluntary hours each year spent on physical works. Physical activity and the social aspects of volunteering could help to improve the mental and physical health of participants. On the other hand, if this is simply displacing healthy people from participating in other 'green gym' activities, there may be little net benefit.

However, there is no quantitative information of additional recreational visits or improvements to existing visits.

Education and knowledge: Education services are enhanced through the project, which has a strong educational element. Links have been made to the local primary school and volunteers and other groups are taken on tours. Local students have used the site for research. A part time co-ordinator will be employed in future to extend this work. Two classes each year will work on projects with the Little Ouse Project to learn about the ecology of the area.

Cultural and spiritual: Cultural heritage values may also be enhanced. The project aims to return some of the land to more traditional management and so protect it as a form of cultural heritage. There are also plans to carry out oral history work in the area. This work will help promote the cultural heritage of the local area to a wider audience, enhancing the service value.

Social cohesion is enhanced through the volunteering, interaction with the local community, and increases the feeling of ownership, use and sense of place for these improved areas. This may be one of the most important aspects of this community-led project, but social cohesion is very hard to value in monetary terms. Social cohesion binds people and provides a network of support and feelings of obligation both to the stewardship of the land and one another.

However, there is not enough quantitative information to continue with value transfer for this service category.

Landscape and aesthetics: There is evidence that the public prefers land managed by low levels of grazing over intensive farming or unmanaged scrub (Willis et al. 1995). Ensuring conservation grazing alongside the clearance of some derelict land which had turned to scrub should maintain and enhance the aesthetic quality of the area.

Biodiversity/habitat: Improvement is one of the key project drivers and perhaps the most significant benefit. The baseline involves on-going loss of species from the area due to drying. Restored fen, on the other hand, supports a broad array of species, including several rare ones. Perhaps of even greater importance is the habitat re-linking and provision of a corridor connecting wider conservation interests and larger projects. A notable benefit of the project has seen the reappearance of water voles (*Arvicola terrestris*) in the Little Ouse Headwaters. The work both impacts upon the quality of the wetland fens and the riparian waterway affecting the water vole population.

Table 3 describes the impact of these works on habitat types in the area in a format which allows us to apply values from other studies. We need to remove some of the complexity and nuance in order to provide more general characterisations which fit the values we will transfer.

Table 3: Habitat changes from baseline to policy scenario

Habitat type	Area (ha)	Quality	Changes under project	Timing
Fen	24.7	From poor / derelict land or improved grassland to favourable quality habitat	This includes restored land, where significantly degraded/unmanaged habitats have been subject to conservation management. These areas were brought back to favourable condition.	Re-built between 2002 and 2010. The benefits would accrue persistently into the foreseeable future.
Species rich grassland	19			
Heath	4			
Wet Meadow	8.6			

Costs: The project has a range of financial costs, but not all of these qualify as economic costs. For example the costs of purchasing or renting land are essentially transfer payments (a cost to the project but benefit to sellers): who owns the land is secondary to what happens on it. The relevant opportunity cost associated with the project is the loss of agricultural output from the land.

Direct costs of land management, capital costs and the opportunity costs of reduced farming for this project all need to be counted. Land management costs are a mixture of professional and voluntary time and spending.

Opportunity costs can be estimated as the variable income from the area taken out of production, and do not require separate estimation since this is already accounted for in the ‘food and fibre’ provisioning service.

Figure 2 provides an overview of the relative changes in ecosystem services which we might expect from this project. This is eftec’s assessment based on the information available about the project. It compares the services provided in the ‘now’ and ‘do nothing’ baseline scenarios and in the (Little Ouse) project scenario. A scale of 0 to 5 is used where 0 means the service is not provided and 5 means the service is provided at a level optimum for the site.

The key findings from the above assessment are that:

- The most significant impacts of the work are on the biodiversity and landscape.
- The management team also believe there could be a large impact upon recreation and tourism though this is likely to be dominated by the recreation of the local people as there is no major tourism industry in the area (Jo-Anne Pitt, pers. comm. 2011).
- Knowledge will increase as they link the project to university research as well as primary school teaching in the local area.

Table 4 shows the quantitative data used for value transfer. Those services which will not change significantly due to the project or those for which we do not have sufficient data do not feature in the rest of the analysis.

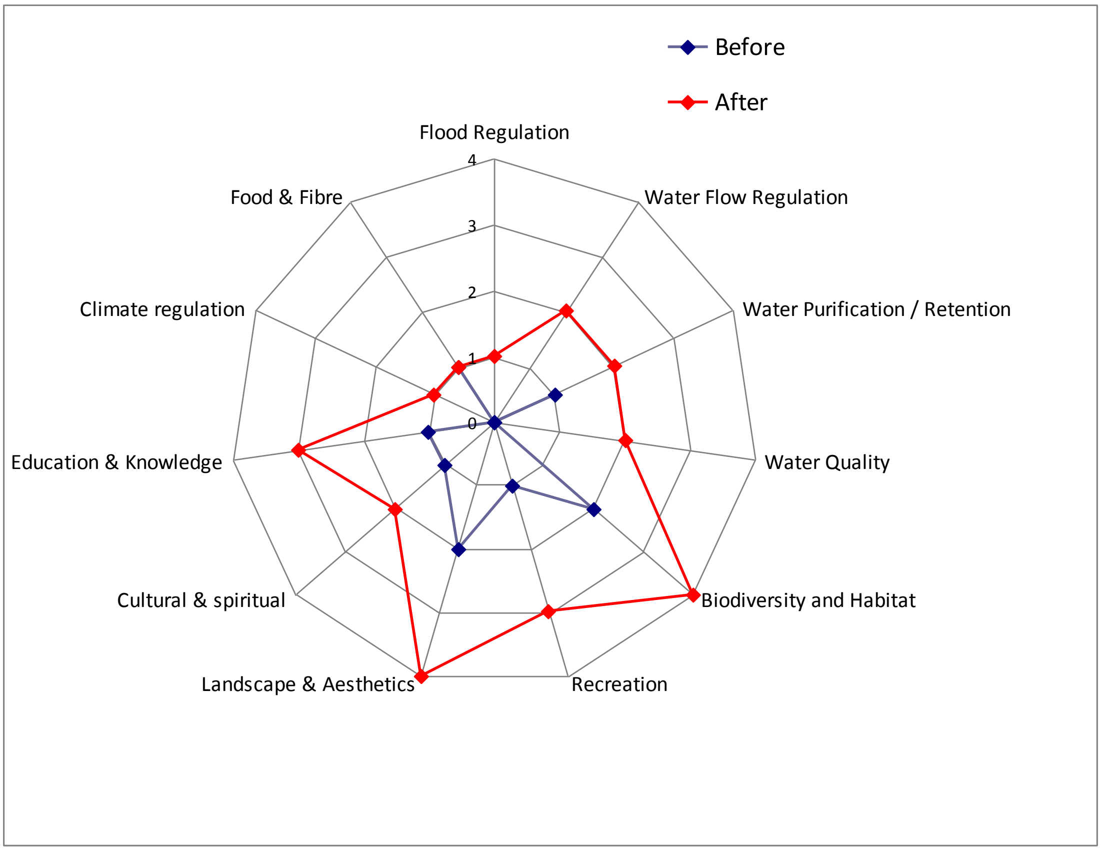

Figure 2: Ecosystem service changes in the two baselines and with the Little Ouse project (eftec's assessment)

Table 4: Key statistics of ecosystem service changes due to the Little Ouse project

Ecosystem service change	Value	Source
Climate regulation		
Carbon Sequestration with the project	Perhaps 40 tonnes/year land cover change	Land cover impacts estimated from Cantarello et al (2011) and estimated land cover changes. Uncertainty over this estimate means we consider this only in the sensitivity analysis.
Education and research		
Number of school trips	2 classes per year	Information provided by the Little Ouse Management Team.
Biodiversity / habitat		
Area of Wetland	37.3 ha	Information provided by the Little Ouse Management Team.
Length of river improved	5 km	Calculated from maps.

4. Appropriate Monetary Valuation Evidence

Here we report the process of review and selection of the unit economic value estimate that is appropriate to the case study. The value evidence includes market prices, estimated premiums where relevant and estimates of willingness to pay (WTP) or willingness to accept compensation (WTA) for non-market goods and services.

The appropriateness is determined by similarities between the context on which the estimate is based and the context of the case study. The key factors that define this context are decision making context, place, ecosystem services and population affected. The estimates also need to be robust or at least variations explainable.

Table 5 shows the unit value estimates that are selected for further analysis. The same estimates are presented in bold throughout the text.

Table 5: Unit economic value estimates used in the analysis

Ecosystem service	Value	Reference	Key reason for selection
Climate regulation			
Non-traded carbon price	£51.70 per tonne in 2010 to £268 in 2100	DECC, 2010	Standard UK carbon prices
Education and research			
Cost of an educational trip	£725/class	HLS payments and Mourato et al (2011)	This is a compromise price based on costings as there is no strong evidence for the actual value.
Biodiversity / habitat			
Wetland Value (reported mean)	£2,200/year	Brander et al. (2006)	A meta-analysis for wetland valuation (separate to riparian impacts)
Improved vole value due to improvements to river habitats	£0.48 per meter of river per year	Dutton et al. (2010)	This provides a marginal value for a metre of UK waterway in good condition.

Climate regulation: Can be valued using DECC guidance figures for carbon values. In this case, the relevant figures are those for non-traded carbon. **The mid-range values rise from £51.70 per tonne in 2010 to £268 in 2100 (DECC 2010).**

Recreation: The most common unit value of informal recreation is expressed in terms of £ per visit and estimated through individual willingness to pay by stated preference and travel cost studies. Estimates in terms of £ per visit can be applied to current and future number of visits. This assumes that the quality of each visit (and hence its value) is the same. So the Little Ouse Headwaters project would only be valued in this way if it leads to increase in the number of visits since the evidence is too coarse to pick up the value increase due to increase quality of a given visit. Alternative units used in the literature are £ per type of access, £ per household or £ per hectare.

Alternatives to WTP estimation include direct use of wage rates (opportunity cost of time) or assessment of trip expenditures, but neither of these methods results in economic value estimates.

The ChREAM travel cost study (2011) estimates an individual's willingness to pay as £5.90 per visit for an improvement across sites from medium to good quality an adult is willing to pay. Increasing quality from poor to good the adult WTP per visit is £6.80. This value is for a single payment for a visit to an improved site. However, this is for rivers in / near urban locations and hence not appropriate for this project.

Christie et al (1999) present contingent valuation evidence of the value of recreation improvements in Grampian region, ranging from £1.59 for creation of long paths to £4.24 for path maintenance. We do not have a value for the total length of paths created and so could not include these values. There were also existing rights of way as alternatives and so these values might not appropriately reflect the smaller marginal impact of the project.

Kaval (2006) presents meta-analysis drawing on studies from several countries. Results in consumer surplus per person per day include approximately £21 for hiking and £57 for general recreation. However this relates primarily to substantial all-day (or longer) trips and may not be appropriate for shorter-term casual recreation in the local area. Zandersen & Tol (2009) present meta-analysis of travel cost studies, with 26 studies in nine countries (including seven from UK), reporting consumer surplus for forest trips to range from £0.57 per trip to £97.52 per trip, with a mean of £15.06 and median of £3.94. The forest trips and the trips in the Little Ouse area are not comparable.

The Inland Waterways Day Visit Survey (British Waterways, 2008) reports £5.57 mean expenditure per day for all types of visitors. However expenditure estimates are not value estimates, and are also unlikely to be useful in the present case. Jacobs (2009) present a review of some earlier valuation studies, dating back to Willis and Garrod 1990 and 1991, summarised in Table 6. Although these results are clearly dated, there is a clear implication that local/casual visits involve lower values per visit than do visits from further afield, as might be expected.

Table 6: Estimated consumer surplus/visitor/trip

General visitors - Locals (<10 miles)	£0.02 - 0.09	Travel Cost
General visitors - Non - Locals (>10 miles)	£0.22 - £10.94	Travel Cost
Walking	£0.08 - 0.40 - 0.63	Travel Cost
Dog walking	£0.03 - 0.33	Travel Cost
Short cut takers	£0.07 - 0.360	Contingent Valuation
Cycling	£0.31	Contingent Valuation
Boating	£0.165 - 0.45	Travel Cost

(1989 prices). Sources from Willis and Garrod 1990 and 1991.

Brouwer and Bateman (2005) present contingent valuation estimates of the recreational benefits of the Norfolk Broads, estimating £363 per household per year. However flood protection and water quality benefits are thought to be included in this value. In any case, the Broads provide a major recreational resource with features and facilities not directly comparable with the Little Ouse case.

An alternative approach is to look at average values per hectare. For example Willis et al. (2003) present the average amenity value of UK woodlands as £172.77 per hectare per year. However this does not allow for the specific characteristics of the area and would not be appropriate for transfer in a detailed small-scale case.

Given uncertainty over the numbers of visitors and availability of alternatives, recreation was not included in the valuation. That does not mean that there is no recreational benefit, but simply that an estimate would be likely to be far from accurate and other ecosystem services are more readily evaluated.

Education and knowledge: In principle education services could be valued using willingness to pay methods, but for practical reasons this is difficult. An alternative proxy is to use the costs of engaging in education activities. Mourato et al. (2011) value educational trips made by schools to the London Wetland Centre and the Hanningfield Reservoir in 2009 and bird watching activities for the RSPB-organised Big School Birdwatch.

The value of educational trips is the sum of transport costs, value of teachers' time, value of student time based on the cost to government of keeping students in education and (if applicable) the cost of HLS payments to the farmers who receive education trips.

Mourato et al (2011) estimate the above (with the exception of the cost to farmers) as follows:

- Transport costs: The average cost to parents of a primary and secondary school day trip in the UK was used to value transport costs = between £7.75 and £16.18 per child per trip.
- Teachers' in-vehicle travel time: was valued using 'wage rate' – 125% of their wage (estimated at £35,000 per annum, to reflect the cost of their time and labour overheads).
- Student time: was valued at the cost to government of students in education (about £5,140 per student per year).
- Time spent travelling in the vehicle was calculated using GIS from the postcode locations of each school. The 'excess time' - time spent waiting or walking to and from school buses - was valued at 200% of in-vehicle travel time costs, following standard procedures in transport analysis.

The final values were £628 per educational trip or £19 per child for the London Wetland Centre, and £839 per educational trip or £30 per child for the Hanningfield Reservoir.

For this case study, the landowner costs can be estimated using agri-environment Higher Level Scheme payments (Natural England 2010). These come as a base payment (£500 for a minimum of 4 visits) per year and a per trip payment (£100) which is equivalent to £8.55 per child (assuming a class size of 26.3).

Thus, the value of an educational trip in this case study based on the student and school costs (£19) and farmer costs (£8.55) is **£27.55 per child per trip** or just under **£725 per class** (at a class size of 26.3).

Cultural and spiritual: eftec (2006) examined household willingness to pay for conservation of cultural heritage at the scale of English regions. For a 'large' change ('rapid decline' to 'much better conservation'), South East households were willing to pay £15.79 (11.47-20.64) per household per year. While this is evidence of value, it is difficult to transfer to an intervention at a specific small site.

eftec (2006) also report WTP per household per year for increases in field margins and for protection of hedgerows from losses. In Cambridgeshire, estimates were from £13.95 to £20.20 per household per year for field margins, while in Hereford, £12.94 to £31.57 per household per year for hedgerow protection.

Social capital is recognised to be a vital resource for a community. It has been suggested that measures of social capital be included with environmental and market based economic metrics for national accounts. However, despite its importance, the technical challenges to measuring the value of social cohesion mean that it is not valued monetarily.

Biodiversity / habitat & Landscape & Aesthetic: The ELF study gives an average value of £155 (133-176) per household per year, based on the avoidance of a 10% reduction in abundance of wetlands (Ooglethorpe 2005). Christie et al (2006) present choice experiments for improvements from "continued decline" to various options for biodiversity. Results shown here are for Cambridgeshire as per household yearly tax increases for 5 years:

- For general outcomes:
    - Stop decline in rare, familiar species: £39.47
    - Stop decline rare and common farm species: £103.51
    - Slow decline in rare species: -£51.68
    - Reverse decline in rare species: £127.47
    - Restore habitat: £38.09
    - Create new habitat: £67.93
    - Recover ecosystem services used by humans: £59.37
    - Recover all ecosystem services: £46.73
- For specific policies
    - Agri-environment schemes: £82.23
    - Habitat creation scheme: £60.86
    - Avoid development loss: £50.15
    - Three schemes above pooled: £65.18

This shows quite a diversity of values, and also illogical valuations in some cases – for example, "all services" valued less than just services used by humans. There is evidence too of embedding problems with the value for all schemes pooled being less than that for the agri-environment scheme alone. Although it is difficult to draw on these rather general results for application to the specific case of the Little Ouse, the results might be used to derive a total estimate for the WTP of local populations for biodiversity conservation in agricultural landscapes, and some proportion of this could be counted for the Little Ouse project.

Dutton et al (2010) used a study by White (1997) which reported household WTP as a one off payment of £8.82 for water vole population increases of 25-50%, as a result of biodiversity action plans. The way the questionnaire is worded means that it is likely this value is appropriate for measuring the value of riparian habitats in good condition, rather than voles specifically. Dutton et al (2010) translated these values into per metre of river values for water vole habitats weight-able by the ability of the habitat to support the population. The valuation specifically concerns the biodiversity impact and given the nature of water voles respondents would have to go to some length to spot one. As such this is a non-use value largely un-linked to other values for aesthetics or recreation. The estimated value is £12 per metre of suitable habitat as a one off payment for an immediate improvement.

Brander et al (2006) present a meta-analysis of wetland valuation studies, estimating an average value for UK wetlands of £2,232 per ha per year, approximately double the European average. Inland marshes were estimated at £3,716 per ha per year, for

Europe, almost four times the average for all wetlands estimated by the same authors. It is not possible to say precisely what the value for UK inland marshes would be just on the basis of these figures, but it would be greater. Other studies include the Brander et al (2006) meta-analysis of wetland valuations which includes a value function that can be used to estimate diminishing values based on areas. For example the value per ha of grazing marsh is estimated at approximately £390/ha at 50ha, but falls to £260/ha at 250ha. Woodward and Wui (2001) used a meta-analysis of wetland valuation studies to estimate total annual wetland values from all different services per acre. Values for general habitat provision are around £700 per ha, with a range of £200-£2200 per hectare; values for wetlands with particular use for birdwatching are much higher, around £2800/ha with a range of £1200 to £6400.

These meta-analyses of wetlands include a range of services and not only biodiversity impacts. Where we choose to list these as value transfer impacts is therefore a matter of judgement, bearing in mind the need to avoid double counting. The Brander value is useful because it is based on a meta-analysis taking into account a larger set of estimates and factors than an individual site study. It is also in terms of £ per hectare per year which is readily useable in value transfer.

We used the vole value because it is an example of a value designed for use in instances of small environmental changes. It is particularly effective when we are able to estimate the suitability of the surrounding area as vole habitat. In this case, given that the project is part of a wider project along the river we assume that each new metre is part of a fully viable population and so worth the flat £12/metre. The benefits to the rivers are separate from those for the wetland and so are valued separately. Clearly the two are ecologically linked but we lack a value which considers this symbiosis.

Costs: The land management costs are based upon direct payments for contractors provided by the project in the initial years. These are presented in Table 7.

Table 7: Costs of Contractors Reported by Project Managers

Year	Cost
2003/04	£20,161
2004/05	£22,417
2005/06	£80,221
2006/07	£41,172
2007/08	£14,595
2008/09	£39,432
2009/10	£44,051

We can also derive estimates for the cost of volunteer hours, based on hourly pay rates. The UK Office of National Statistics found that in 2010 the median income per hour was £12.50 (National Statistics, 2010). Other rates could be justified using official values for considering volunteer work as in-kind contributions for funding purposes – for example the Heritage Lottery Fund has set three levels for costing volunteer time: unskilled tasks at up to £50 per day; skilled tasks at up to £150 per day; professional tasks at up to £350 (HLF 2009). We use £12.50 per hour as a reasonable approximate average, matching median income and falling between the ‘unskilled’ and ‘skilled’ figures from HLF. However volunteer hours do not necessarily represent a cost, due to the benefit of volunteering. This is discussed further under ‘sensitivity analysis’.

5. Monetary Value of Ecosystem Service Changes

Having selected (or assumed) the appropriate unit value estimate, here we aggregate this to the affected ecosystem service and/or population. In many cases, this is a simple multiplication of the unit of change (from Section 3) and the unit economic value (from Section 4).

Table 8 summarises the results and the rest of this section explains the process behind these. The unit estimates from different years are converted to 2010 £ using the Retail Price Index and Consumer Price Index (Note the Consumer Price Index only began in 1996).

Climate regulation: In the sensitivity analysis, we consider direct impacts from land-cover change.

Education and knowledge: Two classes of children are expected to take a trip each year. This will only begin this year and is assumed to continue into the future. The average class size for primary schools in the UK was multiplied by an estimate for the cost of taking a child on a trip to estimate the value of the educational work.

The HLS scheme gives a base payment of £500 per year, plus £100 per trip (Natural England 2010), generally based on 4 trips per year, making £225 per trip on average. With 26.3 children per class, the estimated £19 per trip per child cost gives £500 per trip for school costs and £725 per trip (or £27.55 per child) when the HLS costs are added.

Table 8: Summary of Values for Likely Ecosystem Service Changes

Ecosystem service	Environmental Change	Economic Value	Net value £/Year
Climate regulation			
Carbon sequestration with the project	100 tonnes/year from agricultural intensity changes	Yearly carbon price as in DECC (2010) guidance	£5,170 per year, increasing over time
Education and research			
Cost of an educational trip	2 classes/year	£725/class	£1,450
Biodiversity / habitat			
Wetland Value (reported mean)	37.3 ha	~£2,200/year	~£74,800
Vole habitat value	5km	£0.48 per m per year	£2,400

Landscape and aesthetics / Cultural and spiritual / Biodiversity/habitat: There are overlaps between the valuation estimates for cultural heritage and biodiversity, as well as overlaps with recreation and landscape values, where biodiversity and habitat feed in to these values. Even if the ecosystem service *concepts* are quite clear, actual value estimates will generally combine elements of more than one. Therefore great care is needed to avoid double counting.

In this study, biodiversity values were derived by first converting the present value (into infinity) of a metre of vole habitat into a yearly value (Dutton et al., 2010). Once converted into a yearly value this could be multiplied by the total length of waterway effected and then discounted and valued over 10, 50 and 100 years. It is assumed that water vole habitat would remain intact with an extant population of voles over these periods. The mean yearly per hectare value for wetlands (Brander et al, 2006) was multiplied by the total area of wetlands created to date.

Costs: Contractor costs and voluntary hours were provided to us by the project co-ordinators. We treat the contractor costs as costs of the project but do not include the voluntary hours, since volunteers derive benefits from volunteering: this is discussed further in the sensitivity analysis. The voluntary management work will need to continue into the future at an unknown rate.

6. Aggregation

The benefits identified above can be summed over time to give a comparison of the baseline (do nothing) and the project scenario (Table 9). The values are estimated on a year-by-year basis over 10, 50 and 100 years, discounted at the HM Treasury Green Book (2003) rate declining over time: 3.5% for years 1-30; 3.0% for years 31-75; and 2.5% for years 76-125.

Table 9: Aggregate values for ecosystem services affected

Ecosystem Service	**Present Value**			**Notes**
	10 years	**50 years**	**100 years**	
Education	£1,000	£24,000	£34,000	This includes only the two trips from Primary school classes. These trips start well into the project and so the value over the first ten years is low.
Landscape & aesthetics / biodiversity/habitat	£644,000	£1,890,000	£2,420,000	These values are based on the riparian habitat only and do not yet consider the fields Brander (2006) mean values are used (US$2800 - 2006) and does not include the species rich grassland.
Cost (Contractors)	-£262,000	-£262,000	-£262,000	Costs to date
NET PRESENT VALUE	£383,000	£1,652,000	£2,192,000	

The large upfront costs for the restoration of the sites mean that the first 10 years are less profitable. Over 50 and 100 years, the project yields very significant benefits. This is an evolving project and new land is likely to be brought in to the project, and as this happens the efficiency of the projects spending will be increased along with the net benefits as the landscape is defragmented. However, considering the project as it is now we show in Section 7 that the project may not pass a cost benefit test if we were to use a median value for wetland recreation rather than the mean used in this example.

7. Sensitivity Analysis

This project is likely to expand in the coming years and some work could be done to estimate the impact of probable expansions. As the site expands it is likely to benefit from some scale efficiencies and benefits are likely to rise considerably.

Total numbers of visitors are uncertain and volunteer hours are not systematically measured. The recreational values of this site will be positive and are not reflected in the above calculations.

Volunteer hours are an interesting feature. In some senses they are a necessary cost, but given freely they are clearly demonstrate a 'willingness to pay' (in time) for the activity and its results. If we assume that people volunteer up to the point at which their marginal benefit of volunteering equals their marginal benefits from alternative activities (that is, we assume a clearing 'market') this would suggest that there could be significant 'volunteer surplus' to estimate. On the other hand, there may be opportunity costs associated with this specific use of volunteer time – perhaps, had they not been involved in the Little Ouse project, they would have been giving their time to other socially beneficial projects. So the net impact is difficult to judge. Despite this it is useful to detail voluntary hours in the project as it gives a broader picture of the commitment to the project.

If we assume that there are approximately 800 hours of volunteer work carried out each year then the in-kind contribution of volunteers could be estimated at approximately £93,000 over 10 years, £255,000 over 50 years and £323,000 over 100 years. However as noted above this can not be treated as a true cost – there will be opportunity costs, since there is displacement from other activities (whether volunteering or recreational), but the choice to volunteer for this project suggests that the benefits to the individuals exceed their opportunity costs. There may also be additional health benefits associated with the 'green gym' nature of some of the work, that may or may not be taken into account by the volunteers.

The likely changes in carbon contained in the soil and vegetation are not included in the main estimates because of the uncertainties regarding the calculation. The change could be of the order of 40 tonnes per year over 50 years, with a corresponding present value of £18,600 over 10 years, and £93,200 over 50 years.

We use a meta-analysis to provide an overall value for the landscape changes in terms of the remaining value of the wetland. Brander et al., (2006) present a median value per hectare per year of US$150 (2006 prices). It is arguable that the median is the more appropriate value to choose for this case study. Whilst it is common to use the mean, its high value relative to the median presents a clear skew towards high value areas. As such the median is a more representative conservative value for a smaller (less significant) wetlands. However, the mean is the more common value used and we have continued in this fashion.

The median is the equivalent of roughly £107/ha/year today. The project has restored approximately 37 hectares of wetland. This would provide a benefit of around £4000 per year. This median value yields estimate yields benefits of £55,000 over 10 years, £260,000 over 50 years. However the mean values were used of US$2,200/ha/year and so these figures were significantly higher with present values of £0.6 million (10 years), £1.8 million (50 years) and up to £2.3 million over 100 years.

The median value would mean that the project no longer passed a short-term (10 years) cost benefit test in this analysis. However, over 50 years the median value is about the same as the cost of the works, so the project would approximately brea even over this horizon. There are likely to be significant losses of efficiency in carrying out work over relatively small areas and the possibility that this project does not pass strict tests cannot be ruled out. However, there are two issues of note: firstly we cannot be certain whether the mean or the median values is more relevant here and secondly there are many benefits in this project which cannot be valued. The social capital value of the project is particularly difficult to measure and is likely to be large.

Finally, flood risk and water quality may be significant benefits from this work. However they cannot be estimated without appropriate reports from natural scientists.

8. Conclusions

This small scale project presents a range of challenges to value transfer analysis as it is difficult to quantify the service changes. More specifically to this case study, there are projects which provide high social capital values which do not easily fit within this framework.

It is hard to estimate the marginal impact which this site has on the wider projects along the Little Ouse. Fragmentation is a key obstacle to UK biodiversity protection and small areas of conservation can be worth more than the sum of their parts when carried out in relation to other areas.

We should also consider for a moment the choice of a mean over a median value for wetland values. The decision has had a very significant impact upon the valuation provided. It is usual for studies to use a mean value, but where the mean value is skewed by some particularly high value examples it may be more reasonable to use the median. Household income is a good example: If we took a household at random and, knowing nothing more about it but the number of adults (akin to the area of wetland in our valuation), then an estimate of household income based on the mean would more often than not be an overestimate. Instead, if we use the mean as an estimate 50% of the time we would guess too high and 50% too low. When aggregating across a population the mean is reasonable but when guessing for an individual the median may be more accurate. The best response however is to present both values as we do in Section 7.

Valuing social cohesion is difficult and it is almost impossible to judge the benefits of local community projects such as this one in economic terms. However the interaction between neighbours and the ownership of this project are likely to have significant welfare benefits for the community.

There are significant challenges to valuing small scale changes in ecosystem provision such as in this project. Non – linearity in ecological systems can mean that changes over a small area can have either large impacts (where they for instance link up existing habitats) or very small impacts where they are isolated. For a case study of this scale, the analysis is restricted to linear assumptions regarding the impact of the project which may significantly over or underestimate impacts.

However significant benefits are gained from education and willingness to give up time for the project. These impacts are less affected by ecological non-linearities and are largely driven by the existence of the project rather than its environmental successes. This project is the impressive and selfless result of the actions of a number of individuals with key environmental and administrative skills. The UK has many professional and non-professional wildlife enthusiasts who are already providing their time for the benefit of our environment. The future of projects such as the Little Ouse brings up issues regarding economies of scale, the best use of resources and potential clashes with the myriad of government and non-government agencies. However their benefits lie in their ability to work more organically with local landowners and achieve community buy in and it is a shame that these benefits cannot be directly valued.

Summary

The Little Ouse headwaters project is headed by a group of local volunteers as a community project. It is based on the Norfolk Suffolk border along the River Ouse and around a few small villages to the South East of Thetford. The group have bought derelict land and farm land and recreated fens.

The scale and format of this project in isolation presents two major challenges to value transfer. The first is that small changes in land use can have starkly variable impacts upon the ecosystem services produced. A small addition of habitat in the correct place can help to link up two stranded populations and so have an overall impact which is greater than the sum of its parts. Alternatively a stranded piece of newly created habitat disconnected from any larger meta-population may have very little value. Being able to firstly identify such a difference in ecosystem service provision and then actually alter values to account for them may be impossible for value transfer methods. Therefore it is particularly important that sensitivity is considered for major values in this context

The second challenge is that the value of this work to the community that creates it is likely to be greater than if it were provided from outside. Social cohesion is recognised to be of importance to development as well as wider wellbeing but it is hard and perhaps impossible to value in monetary terms. As such any estimates provided for the ecosystem service benefits will be an incomplete estimate of the value of this work to the community.

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