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Valuing Ecosystem Services: Case Studies from Lowland England

Annex 5 - Dearne Valley Green Heart: Yorkshire

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Valuing Ecosystem Services: Case Studies from Lowland England

Dearne Valley Green Heart

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:

Heather Rennie, Stewart Clarke, Julian Harlow, John Hopkins Ruth Waters, Stuart Jenkinson, Pete Wall and Joanne Wehrle.

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

The Dearne Valley, which follows the River Dearne, is located in South Yorkshire between the towns of Barnsley, Rotherham and Doncaster. The wider project area covers 20 square miles of the valley and hinterland; the core 'Green Heart' local scale project area is 1270ha of valley / river corridor, within a wider watershed / settlement pattern context (Figure 1).

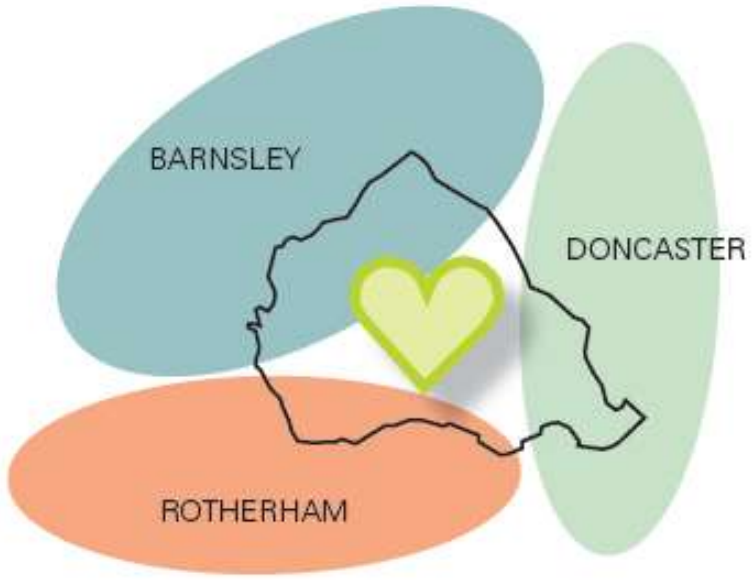

Figure 1: Location of Dearne Valley (Dearne Valley Green Heart - DVGH - website)

The valley is wide with gently sloping sides and very few steep gradients. It is a semi-rural landscape with farming being the main land use in the valley bottom. Small former mining towns, remaining from what was once the centre of the local mining industry supporting a large local community, are situated on the valley sides. The old collieries have closed, tips have been restored and subsidence has created wetlands near rivers. At present, much of the valley is managed as nature reserves and public green spaces. Regeneration includes projects undertaken by the Forestry Commission at Wombwell Woods, Cudworth Common and Thurnscoe community woodland.

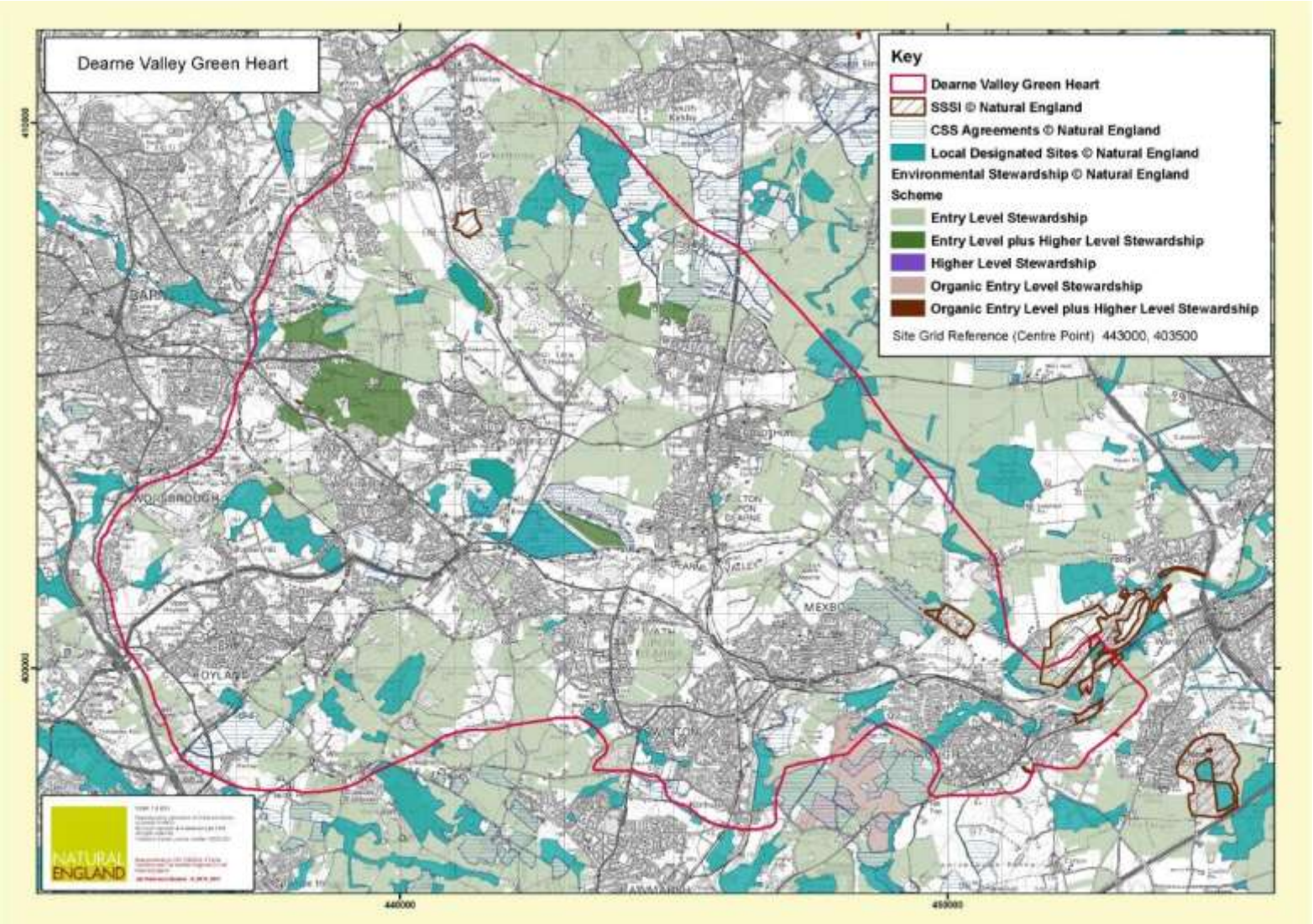

Figure 2: Location of Dearne Valley showing designated sites and areas under different agri-environment schemes (9 March 2011)

The valley is considered a model for large scale environmental regeneration. The valley floor contains a series of wetland, washland and marshland sites that are home to many species of birds and wildlife. Ancient woodlands are scattered across the valley, many woodlands being publicly accessible with networks of footpaths, cycle and bridle trails. Reclaimed colliery sites have been restored to create community green spaces and the valley includes many heritage features in strong historical settings, such as Worsbrough Mill, a 17th century working water powered corn mill but the Dearne Valley Green Heart (DVGH) project has no work related to these sites. The surrounding area is well served by motorways and the Dearne Valley Parkway links with these and facilitates vehicle access (though it is a barrier to pedestrians).

The area has high tourist potential, but this is largely unrealised outside a few major attractions. The DVGH project is a large, *coordinated* restoration project to restore habitat and enhance the ecosystem services of the local environment. Ownership of the land in the project area is a mixture of public open space, RSPB, Forestry Commission, Yorkshire Wildlife Trust, Garganey Trust, Environment Agency, and private landowners and households. A partnership project to redevelop post-industrial sites, recreating and enhancing green spaces is being implemented.

2. The Ecosystem Services and Affected Population

The situation in the area before the project includes diffuse and peripheral public green spaces, and corridors bisecting the area cutting green spaces off on either side with no links. Paths are muddy and unattractive, and access points such as stations are uninviting. There is a general lack of signage and interpretation, and developments often screen reserves from passers. Gun and motorbike culture in the area create noise and a sense of insecurity, as well as damaging paths, habitats and wildlife.

The area features a wide range of increasingly mature habitats, close to people and access routes, in some cases with adequate introduction and interpretation (Old Moor and Broomhill Flash). There is innovative riverside and wetland restoration, and the area provides significant water flow regulation / flood protection services.

The DVGH project identified potential to address various problems facing the area by investing in better access, image, and identity for the area. There is scope to increase cycling significantly, and to solve the problems caused by an incomplete footpath network, often dominated by busy roads. Barriers and furniture (for example, benches) can enhance visitor experiences while discouraging off-roading.

2.1 Ecosystem services

A number of objectives have been identified, including creating a critical mass of users, improving access, improving the quality of green places to go, and connecting to all communities. Several themed and strategic walking and cycling routes have been identified. Specific project proposals include a number of access improvements, upgrading surfaces in order to help users negotiating slopes; for example.

Recreation: A range of changes were made to improve access for recreation. The most easy to estimate a value for has been the increase in cycling routes. Other changes are less tangible and so more difficult to measure. For instance workshops were held to gain access to waterways and a fleet of hire bikes were bought for the Old Moor site. A strategic document was produced to develop access and branding of the Dearne Valley to raise awareness of the river corridor. Some murals were also created on the Trans Pennine route. This type of work is clearly of importance and will lead to greater change in the future. Value transfer work, however, relies upon specific physical changes which have been measured – unless there is a previous study that valued the sufficiently similar intangible changes.

Education and research: Education packs were created for schools, and a band was commissioned to produce a multi-media music focused presentation on the Dearne Valley outdoors. Work has also been carried out with arts groups and encouraging media studies A-Level student to produce products based around the Dearne Valley outdoors.

Landscape and aesthetics: The project aimed to make the infrastructure in the area more user friendly such as through the artwork in a graffiti afflicted underpass (Figure 3).

Figure 3: Dearne Valley Art Work (DVGH 2011)

Biodiversity / habitats: Eel and fish passes have been created and 50,000 elvers were released into wetlands at RSPB Old Moor reserve which was created before the DVGH project. The project plans to create another reserve just over half the size of Old Moor. Further description of Old Moor is provided in Box 1 (and in Section 2.2) to help base estimation of some of the benefit of DVGH on the existing information about Old Moor.

Box 1: Old Moor RSPB Reserve

The RSPB took over the lease of the 104 ha reserve at Old Moor with the core conservation objective of creating wetlands within a series of flood storage washlands along the River Dearne. By managing habitats, the RSPB wanted to create a broad spectrum of wetland communities across the valley that will accommodate all year round wildlife without reducing the sites' value for flood defence.

The RSPB also wanted to create a new kind of reserve that would attract not only bird watchers, but also the wider public by providing an inspiring visitor's centre, meeting rooms, and a classroom. The objective was to generate sufficient income from its three core business elements of retail, catering and conferencing to support the full running costs of the site. In addition, the RSPB wanted the reserve to be an excellent amenity for all the communities who live in the region and contribute to the local economy. The project aimed to increase visitors to the site from 12,000 to 50,000 per year.

The RSPB is managing a range of key Biodiversity Action Plan (BAP) habitats including open water, marsh, reedbeds and grassland that are attracting a range of important BAP species including Bittern, Lapwing, Garganey and Water Vole. The area is vital for the survival of a number of BAP species of birds and other wildlife.

The reserve has adopted a local sourcing policy which aims at increasing the long-term viability of some businesses in the area (For example, Silvapower, a local company, that sources local sustainable timber, supplies wood chips that are produced to specification for the boiler at the reserve. The wood chips are stored and delivered by a local farmer).

Source: Rotherham et al (2006)

2.2 Affected population

DVGH project provides habitats (open water, marsh, reedbeds and grassland) for BAP species of birds and other wildlife. These birds and wildlife are enjoyed by bird and wildlife watchers in the area and regionally.

There were 96,000 visitors to Old Moor in 2010 (Yorkshire Post 2011). Visitor activity includes walking, cycling, bird and wildlife watching and angling. A rambling group (The Dearne Valley ramblers group, 85 members) and an angling club (The Hoyle Mill Angling Club) operate in this area. Additionally, RSPB have 18,000 members in the South Yorkshire region, which includes the Dearne Valley Green Heart area (Rotherham et al. 2006).

The flood defence and water regulation services from Dearne Valley riparian habitats are provided to homes and businesses who are affected by the downstream flood risk of the Dearne River. While the DVGH does not provide water regulation services directly, care must be taken in its design not to damage existing flood defences.

At Old Moor the glass fronted classroom has provided nearly 4,000 school children per year from 80 schools with the opportunity to learn about conservation and the environment. There are nine field teachers employed by the centre (RSPB 2009).

In 2001, the population of the Dearne Valley urban area was 207,726 (includes Barnsley and other smaller towns and villages) (2001 census). South Yorkshire has a population of 1.29 million (in 2007). Table 1 summarises these figures.

Table 1: Local resident and visitor population estimates

Area	**Population**	**Household***	Note
South Yorkshire	*1,290,000*	537,500	1
Dearne Valley urban area	*207,726*	56552	2
RSPB members in South Yorkshire	18,000	7500	3
Rambling group	85	-	4
School children visiting Old Moor	4,000	-	5
Number of visitors for 2009	350,000	-	6
*Estimated based upon an average household size of 2.4 [7]			

1 – Statistics, (2007); 2 – Census 2001; 3 – Rotherham et al (2006); 4 – www.dearnevalleyramblers.org.uk; 5 RSPB (2009); 6 – Yorkshire Post (2010); 7 – National Statistics, 2007.

3. Ecosystem Service Changes

Here we summarise the likely effects the DVGH project may have on the ecosystem services provided in the area. 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 choice of a baseline could be a business as usual scenario in which the pre-project management continues. This could mean ongoing investments in restoration, conservation, flood management and so on, but with no coordinated and strategic approach to optimising the wider benefits from these areas.

Alternatively, we could go back a step further and consider a baseline of 'no public investments in regeneration' – in effect a scenario in which the post-mining landscape and those living in and using it were left to manage alone. This would perhaps be less useful, however, because the change in which we are really interested is not from 'do nothing' to 'coordinated project' but rather from 'piecemeal projects' to 'coordinated projects'. On the other hand, choosing the more realistic baseline may make it harder to detect the additional ecosystem service changes. We have tried to consider only the impacts of the DVGH project itself – this means we do not try to reflect all of the work carried out in this area, but only the added value of co-ordinating the efforts of groups carrying out their own projects.

In summary, the effects of the DVGH project of coordinated investments to enhance the provision of services and better realise the potential of the area are estimated against the baseline of ‘business as usual’ in which the valley evolves with no coordinated approach to access, recreation, flood risk management, biodiversity and cultural heritage conservation and other key services and features.

3.2 Qualitative and quantitative assessment of the change

Food and fibre: Some farmland has been taken out of production (20 ha) or had production moved to less intensive practices (40 ha) hence the decline in food and fibre as part of the project. Adwick Washland currently has 60 ha of arable farmland. On this site 20 ha of wetland will be created and the remainder will be grassland (though the reports are unclear). The site will be grazed by highland cattle. Income per hectare will drop as income from cattle per hectare is lower than arable and also likely to be at low conservation grazing levels. Moving to livestock will also reduce the total food calories produced per hectare as the practice will be less intensive and cattle moves a trophic level up from arable.

Timber: There are coppicing activities in the broader project but nothing linked directly to the DVGH project.

Renewable energy: The Adwick washlands may be given a new small hydropower plant along with a fish and eel escape. The development of the hydropower plant is by no means certain nor, to our knowledge, are the plans yet developed. In addition, since the net benefit estimate would require the knowledge of man-made capital investment (which is not known), this service is not analysed any further.

Fresh water quality: Wet grasslands filter the water that passes through them as well as reducing the fertilisers required by the grasses and so nitrogen loads. Quantitative estimates of water quality impacts would require a thorough scientific assessment which is not available in this study. Any benefits produced would be very location specific and hence difficult to assess even if we dealt with the challenging scientific issues.

Water flow regulation: The DVGH project is aiming to increase the biodiversity potential of three washland sites. Ensuring that the ditches and ground is wet year round reduces the total capacity of these sites to hold floodwaters. However the work is designed to have no net impact on flood defence. In Adwick washlands, removal of top soil will increase flood storage capacity (as well as removing nutrients), mitigating the impacts of wetting the land and leading to a small net increase in flood water storage capacity on the site of 1,200 m^2. Quantitative estimates of the subsequent flood defence impacts would require a thorough scientific assessment which is not available in this study.

Soil and erosion control: Wetter conditions may help maintain higher vegetation cover and reduce erosion, and over time wet grassland may aid soil formation. These impacts are not likely to be very significant, and would require further detailed analysis to specify.

Climate regulation: The DVGH project will reduce the intensity of farming in the area. Conservation grazing practices emit less than a quarter of the GHG (greenhouse gas) equivalents than winter wheat (Williams 2006). Williams (2006) suggests that winter wheat production produced 4.35 tonnes of CO_2 equivalent per ha per year but the conservation grazing 2.12 tonnes per ha per year. This leads to a net emissions reduction of 140 tonnes per year.

The practices will also convert grasslands and arable land to wetland. Wetlands have more than double the GHG storage capacity of pasture. Harlington washland will be converted to a broadleaved copse: in time, this will increase the carbon content of the soil and vegetation by approximately 149 tonnes (546 tonnes of CO_2 equivalent) per hectare, compared to grassland (Cantarello, Newton, & Hill, 2011).

The impact of land use change on carbon sequestration is based upon estimates from Cantarello et al (2011). Table 2 presents the areas covered by each land type, the total change anticipated under the project, and the approximate sequestration per year, assuming the changes occur over 50 years.

Table 2: Land Cover Created by the DVGH project

Landcover Type	Area covered (ha)		Soil and vegetaion carbon: tonnes CO_2 equiv. /ha	Total CO_2 equivalent (baseline)	Total CO_2 equivalent (project)
	Baseline	With Project			
Broadleaved copse	0	4	546	0	2,184
Wetland	0	20	555	0	11,100
Pasture	6	42	455	2,730	19,110
Arable	60	0	243	14,580	0
TOTAL approximate value:				17,310	32,394
Approximate change per year over 50 years:					300/year

We assume the changes occur over 50 years: this is approximate, and there may in fact be more rapid sequestration to start with, and ongoing sequestration after that; but a 50 year horizon is a reasonable assumption allowing for the gradual accumulation of soil carbon. In the case of the copse, where a large part of the change is in above-ground biomass, a 100 year horizon would be more realistic, but that applies only to a small area, and a small proportion of the change overall, so the approximation is acceptable. It should be noted that the 300 tonne per year estimate is very approximate, and in particular that the assumption that the baseline is best characterised by Cantarello et al's (2011) 'non-irrigated arable' category may be incorrect since the pre-project area is washland periodically used for flood storage (a use which will continue) and this could influence the soil carbon levels. So this figure may be best viewed as an upper bound on the carbon changes.

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

Recreation: Recreation improves alongside the installation of a path network, horse trails and over 700m of traffic-free cycleways. The area is also more attractive for walkers, increasing the recreational value, due to the enhanced natural beauty and wildlife populations. At Old Moor a cycle hire scheme was introduced along with guided cycle tours to increase cycling at the site. 8% of visitors travel to Old Moor via the cycle track (RSPB, nd). Some new cycle track was built at Bolton upon Dearne but only 700 metres. The plan (DVGHP 2011) references extra planned work including a diversion at Harlington Washlands and extra cycle track at the Bolton cycleway. This track was not quantified but by examining the areas on Google Maps we estimated the total length of cycle track likely to be created. We assume the DVGH will lead to significant improvement in a cycle path of 3 km: a modest total length, but with a large population of potential users.

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 will help to improve the mental and physical health of participants.

The DVGH project has also embarked on a set of community engagement projects. Successful community engagement can multiply the total benefits of any change as local people increase their use of the local environment.

Anglers are a significant stakeholder in the UK natural environment. Eel and fish passes created by DVGH are likely to improve fish population numbers and so the fishing experience. However we do not have detailed estimates of the impact which this work might have on fish populations nor the marginal impact this might have on angling experiences. As such, angling benefits will not be included separately in our final estimates.

Education and knowledge: Education services are enhanced through the project, which has a strong educational element. The restoration of habitats will provide learning opportunities for local students, and information will be distributed to motivate and enable local populations to access the natural parts of Dearne Valley, with encouragement to be involved with caring and managing the local environment.

Specific projects include hiring Being 747 (a theatrical education group) to create a multi-media show for schools to teach them about the wildlife in the Dearne Valley. The Goldthorpe Art club was involved in creating artwork based on the area. A-level media studies students were engaged to base their projects upon the Dearne Valley's natural areas.

Cultural and spiritual: Cultural heritage values may also be enhanced by the DVGH. The project will relate the restoration of environmental and biodiversity interests to retain and restore remaining heritage. The Adwick washlands contain a WWII anti-aircraft gun which is a scheduled ancient monument and archaeological surveys suggest the site is of low to moderate interest. Development of the site will be carried out so as not to damage this cultural heritage but there will be little added value.

Landscape and aesthetics: The transformation of the post-industrial landscape to a remediated, diverse landscape for wildlife and nature is highly significant. The area demonstrates the effectiveness of innovative re-engineering, habitat creation and landscape management techniques. The aesthetic appeal of Dearne Valley Green Heart will be enhanced by the project, with more traditional, high quality environmental landscapes and increased wildlife presence. Improved condition of the River Dearne contributes to this.

Adwick washland is the most significant area of change driven by the project: 1.65 ha of reedbed, 16.97 ha of wet grassland, 0.88 ha of open water and 0.58 ha of fen will be created here over a 66 ha area (JBA Consulting 2010).

Biodiversity/habitat: The River Dearne in the DVGH area exhibits a variety of habitats from open water, through fen, carr and marshland, to hedgerows, remnant ancient woodland, and newly planted woodland. The broader project seeks to replant woodland with ash, field maple, durmast oak, wych elm, sessile oak, sycamore, small-leaved lime, hornbeam, hazel, hawthorn, spindle, guilder rose, dogwood, clematis and black bryony, and shrub vegetation including wayfaring tree, privet, clematis and calcicolous herbs. Within the DVGH core project, a small area (estimated to be 4ha) of broadleaved copse is being created.

The project has produced over 200 metres of wet ditches which are being colonised by water voles and other riparian mammals such as otters. More ditches will be created at

Adwick washlands. As noted above, 20 ha of wetlands will be created at the Adwick site (JBA Consulting 2010).

The project is also working to protect eel populations. Three eel passes have been created and more are planned. The European eel is listed as Critically Endangered on the IUCN Red List, is a UKBAP Priority Species, and a "species of principal importance for the purpose of conserving of biodiversity" under the Natural Environment and Rural Communities Act 2006.[1] 50,000 elvers were released into the Old Moor wetlands.

Figure 4 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 ''business as usual (no project)' baseline and in the (DVGH) 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 and is optimal for the site.

The key findings from the above assessment are that the larger gains are in landscape and aesthetics, biodiversity/habitat and recreation services. These services are also the key aims of the project. The gain in renewable energy is driven by a potential hydropower plant. But this is not included in the analysis as explained above.

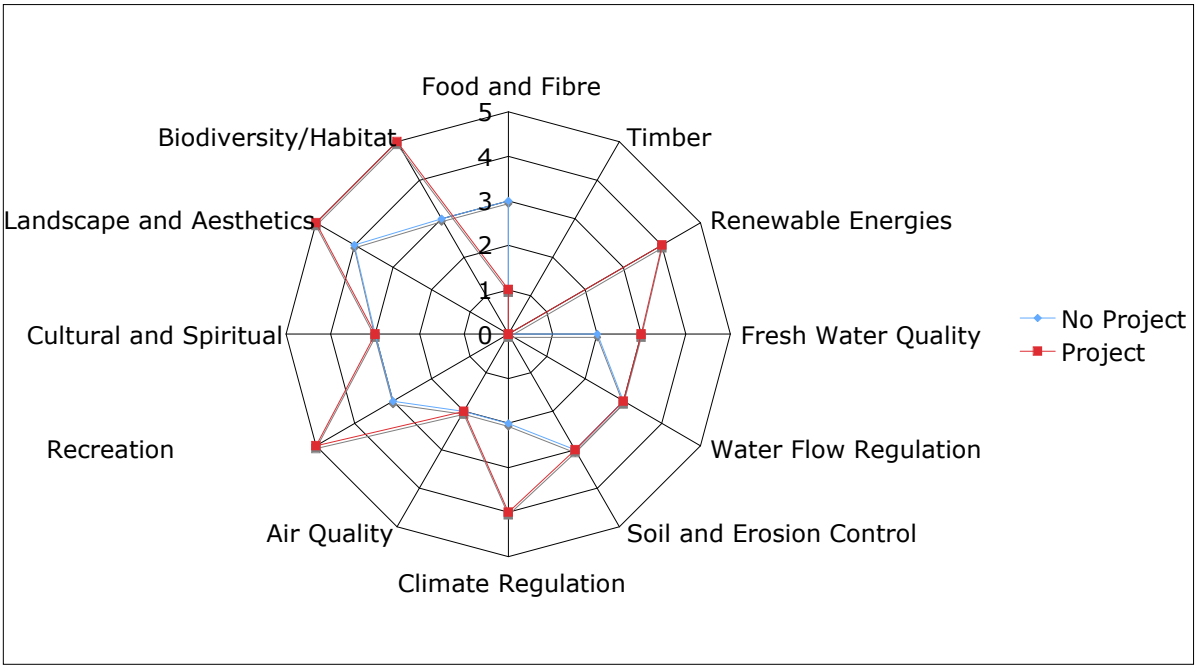

Figure 4: Representation of ecosystem service impacts at Dearne Valley (eftec's assessment)

[1] http://www.naturalengland.org.uk/ourwork/marine/protectandmanage/mpa/mcz/features/species/europeaneel.aspx

Table 3 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.

Table 3: Key statistics of ecosystem service changes due to the DVGH project

Ecosystem service change	**Value**	**Source**
Food and fibre		
Arable land lost	60 ha	Estimated by eftec for the case study
Conservation grazing replacing most arable (beef)	57 ha (including grazable wetland)	Estimated by eftec from maps for Adwick
Climate regulation		
Carbon Sequestration with the project	300 tonnes/year over the first 50 years of the project.; 140 tonnes/year from change in agriculture	Estimated from Cantarello (2011) and estimated land cover changes (Table 2), and from Williams (2006)
Recreation		
Improved cycle paths	3 km	eftec estimate based on the DVGH information provided
Landscape and aesthetics		
Most significant area is from Adwick Washlands	66 ha	JBA Consulting (2010)
Biodiversity / habitat		
Wetland creation	20 ha	JBA Consulting (2010)
Broadleaved copse	4 ha	DVGHP (2011)

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 premia 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 is decision making context, place, ecosystem services and population affected. The estimates also need to be robust or at least variations explainable.

Table 4 shows the unit value estimates that are selected for further analysis. The same estimates are presented in bold throughout the text.

Table 4: Unit economic value estimates used in the analysis

Ecosystem service	Value	Reference	Key reason for selection
Food and fibre			
Assume a marginal loss of Winter Wheat fields in return for conservation grazing densities of beef	£456/ha	Nix (2010)	Standard gross margin data
Climate regulation			
Non-traded carbon price	£51.70 per tonne in 2010 to £268 in 2100	DECC, 2010	Standard UK carbon prices
Recreation			
£ per household per km per year	£4.11	Cambridge Econometric Associates et al (2010)	Improvement in opportunity in an urban fringe area
Landscape and aesthetics			
Habitat provision – agricultural landscape	£80.74 per hectare per year	Shrestha et al. (2007)	A strong meta-analysis for rural land use changes
Biodiversity / habitat			
Wetland	£2,200 per hectare (single payment)	Brander et al (2006)	Both of these are based on strong meta-analyses and so based on a range of studies, and more likely to be accurate and transferable than an individual valuation.
Broadleaved copse	£1,820 per hectare	Willis et al (2003)	

Food and fibre: Values are based upon the Nix handbook variable income data (Redman, 2011). This assumes that all changes are marginal and do not have any significant impact upon the fixed costs for the farms. Arable income is based upon an average Winter Wheat gross margin of £606 / ha (Redman, 2011). Conservation grazing is harder to estimate. We take an average price of £1.47/kg deadweight beef and assume a conservation stocking rate of approximately 0.66 cattle /ha (Chapman, 2007). Nix suggests each head produced is 0.33 tonnes when bought and 0.54 tonnes at sale and also estimates further costs of approximately £89 per head of beef. This leads to income per hectare of approximately £150 per ha for conservation grazing beef.

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 reach £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 this 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.

The ChREAM travel cost study (2011) examines improvement in water quality, for rivers in an urban area in the North of England. The conditions are close enough to those at River Dearne to allow value transfer. The study estimates individual willingness to pay for an improvement across sites from medium to good quality as £5.90 per visit. Increasing quality from poor to good, the adult WTP per visit is £6.80.

Christie et al (2000) present contingent valuation evidence of the value per household of recreation improvements across the Grampian region, ranging from £1.59 for creation of long paths to £4.24 for path maintenance. The survey instrument used open ended WTP for basic and intensive levels of an improvement, followed by allocation of bid amounts across six types of area.

The Inland Waterways Day Visit Survey (British Waterways, 2008) reports £5.57 mean expenditure for all visitors. However expenditure estimates are only minimum expressions of value 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 5. 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.

An alternative approach is to look at average values per hectare, as for example in Willis et al (2003) who present the average amenity value of UK woodlands as £172.77 per hectare per year. This does not allow for the specific characteristics of the area, and would likely

provide an underestimate in this case since the population density is high, and the recreational value of urban fringe woodlands is significantly greater.

Table 5: Estimated consumer surplus/visitor/trip

Activity	Value	Valuation Method
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.

The value which we use for the marginal increase in the green lanes is based upon a project by Cambridge Economic Associates, eftec and Cambridge Econometrics (2010). The work was in the North East of England in an ex-coal mining area around Seaham, East Durham. The population and landscape are therefore more similar to Dearne than other possible estimates from the literature. This study also specifically valued a marginal improvement in foot and cycle paths (for example, providing new cycle routes away from major roads). This improvement in access rather than an increase in the length of footpaths is also more reflective of the work in the Dearne Valley. The project carried out choice experiments in which green lane improvement was a single choice. **The average marginal benefit was found to be £4.11 per km per household per year (95% confidence interval of £0.39 - £7.84).**

Bird watching values for wetlands have been estimated in meta-analysis by Woodward & Wui (2000). Their model allows valuation of the impacts of various amenities including bird watching. The results convert to 2010 prices of low, medium and high estimates of £1,262, £2,896 and £6,648 per hectare, respectively. However it should be noted that there are already a suite of alternative bird watching sites including Old Moor. The new site will certainly add value to all of these sites as it improves the connectivity of the network of habitats. It will also provide a more convenient site for some, a welcome change for others and perhaps a new hobby for others still. However, value transfer is not able to tease apart the subtleties of such marginal increases in value from a total valuation as in Woodward and Wui (2000). Given the large average value for wetland in the UK (see below) which will include recreational values it is most appropriate not to directly add bird watching separately in this case to avoid double counting.

Improvement to fishing availability might also be important. If we had sufficient scientific evidence of the impact of the project on fish stocks there are a range of valuations we might use. For instance Johnstone and Markandya (2006) provide a model which can estimate the value of a trip based upon the travel cost method for angling trips. This study found values of between £22 and £50 per trip.

The eel and fish release work will help to support inland fisheries industries. In the Yorkshire and Humberside region fishermen spend over £133 million each year on angling (Radford, Riddington, & Tingley, 2001). Commercial eel fisheries are more common in the South West and South Wales. Estimating the marginal impact of the work done in this are to support these industries ought to be accompanied by modelling of the eel populations in the area and the impact of any current decline upon fisheries which is not available.

There is also the issue that European nations have National Eel Management Plans which require that this work be done. As such any work carried out would have to have been without the project (in the baseline). It might therefore be reasonable to value this work based upon the cost of doing it elsewhere. Any savings in cost DVGH offers will then be the benefit of DVGH rather than the benefit of increased eel population. There is little reason to assume that the eel passes and introductions were done any more cheaply in DVGH than they might otherwise. Thus, this change is excluded from the valuation.

Education and knowledge: A significant part of the DVGH project is dedicated to community engagement and education. It is uncontroversial to assume that such work is vital and beneficial. However, converting this benefit into a monetary value is not currently possible. We might estimate costs of provision and assume these are a minimum value but that is not sufficient. Work could be done to estimate the marginal impact on the valuation of the protection of an environmental good of this knowledge. However even if this were done the specific impact of knowledge would be tied to the current level of knowledge in the area, the impact of the work and the good being valued as well as local cultural norms. As such any model produced would be likely to be so variable in terms of the values estimated that it would not be tractable within a value transfer exercise.

If you have been reading the other case studies in this series you would notice that a cost estimate was used based on class field trips and HLS Farm Stewardship payments. In those instances we were valuing farm visits to the farms. Here, we are now looking at a range of school and college based lessons. As such the cost estimate (proxy for value) developed in those case studies is not considered to be appropriate here.

Cultural and spiritual: eftec (2006) examined household willingness to pay for conservation of cultural heritage of landscape at the scale of English regions. For a ‘large’ change (from ‘rapid decline’ to ‘much better conservation’), Yorkshire and Humberside households were willing to pay £11.93 (8.47-15.44) per household per year. While this is evidence of value, it is difficult to transfer to an intervention at a specific small site.

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.

Overall, additional cultural and spiritual impacts are minor from this project. Community engagement may have some cultural impacts but it is largely a semantic argument over whether we might assign these benefits to “education” or “cultural”.

Landscape and aesthetics: Shrestha et al. (2007) present meta-analysis of valuation of open space in agricultural landscapes. Values in £/ha/year, with 90% confidence interval, give:

- Viewing (scenic) only: £50.43 (11.67 – 222.73);
- Open space only: £64.93 (7.42 – 637.42);
- Habitat provision only: £76.51 (23.33 – 254.55); and
- All 3 services, at mean values: £207.76 (98.64 – 444.39).

The washlands are already open views and so we are restricted to the value for habitat provision only at £80.74 per hectare per year (converting £76.51 to 2010 prices).

Biodiversity/habitat: Brander, et al*.,* (2006) present a meta-analysis of wetland valuation studies, estimating an average value for UK wetlands of €2,480 (~£2,200) per year, approximately double the European average. Inland marshes were estimated at €4,129 per year, for Europe, almost four times the average. 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.

The ELF study (Oglethorpe 2005) gives an average value of £155 (133-176) per household per year, based on the avoidance of a 10% reduction in abundance of wetlands.

Garrod (1997) found a willingness to pay of 51.7 - 56.4 pence for another unit of biodiversity rich forest compared to 30.3-33.4 pence for "standard" forest. 70% of respondents stated that the value was linked to a desire to visit, highlighting the overlap with recreation values.

White et al. (1997) valued the biodiversity action plan for otters in Yorkshire. They found a mean WTP of £11.91 (~£15.50 in 2010) per household as a one-off payment for otter protection. While evidence of willingness to pay for such actions, it is difficult to transfer this value as the impact of work planned for the area on the otter population is not well defined.

Dutton et al (2010) used the same study (White et al 1997) which reported household WTP of £8.82 for water vole population increases of 25-50%, as a result of biodiversity action plans. Misspecification bias in the underlying valuations 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. translated these values into per metre of river values for water vole habitats weightable 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 a one off payment of £12 per metre of suitable habitat. However, since the effect of DVGH project on the vole population cannot be estimated, this value estimate is not used.

Willis et al (2003) found that providing a broadleaved woodland view is worth £269 per household on the urban fringe. The study also find that UK households are willing to pay £0.84 per household for an extra 12,000 ha increase in broadleaved native forest across the

UK. As such the gross benefit per 12,000 ha can be found by multiplying 0.84 by the total number of UK households and by dividing by 12,000 we get a 1 ha value of £2,155 when converted to 2010 prices. This does not include any increased willingness to pay of local people for the amenity value of the forest, so there is in principle no double-counting with recreation or aesthetic values. However this second value might be better placed under biodiversity and is used in the biodiversity/habitat service category.

The values chosen for the wetland and forest were: Brander et al (2006) £2,200 per hectare per year and Willis et al (2003) estimate for broadleaved woodland of £2,155/ha, and Willis et al (2003). These values were used as they are both based upon meta-analyses and so have already incorporated a range of different values. They are also useful as they are average values which avoid double counting difficulties which we might face if trying to combine complex marginal recreational benefits described above and non-use values such as for voles. For value transfer work these average values are more appropriate where detailed quantitative information for ecosystem service changes is not available.

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 6 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).

Food and fibre: The values developed in Section 4 can be multiplied by the total areas for each enterprise. As such the 60 ha of arable land in Adwick would yield (60 x £606) approximately £36,360 /year. The development of Adwick will leave approximately 57 ha of graze-able grassland which at conservation grazing stocking rates we estimate to be worth £8,500 / year. This results in a net loss of £27,800 / year. These values only include the marginal income and cost, ignoring any sunk costs and excluding subsidy payments.

Climate regulation: As explained in Section 3, we estimate the net sequestration to be very approximately 300 tonnes of CO_2 per year over 50 years. This is multiplied by the appropriate price for each year from the DECC guidance prices for non-traded carbon (2010). Changes arising due to shift in agricultural practices (arable to grazing) are estimated at 140 tonnes per year.

Table 6: Summary of Values for Likely Ecosystem Service Changes

Ecosystem service	Environmental Change	Economic Value	Value £/Year
Food and fibre			
Assume a marginal loss of arable converted largely to conservation grazing	Loss of 60 ha of arable; gain of 57 hectares of conservation grazing livestock	-£456/ha arable/year	-£27,831
Climate regulation			
Carbon sequestration with the project	300 tonnes/year over 50 years for land cover; 140 tonnes per year for agriculture.	Yearly carbon price as in DECC (2010) guidance	£ 22,700 in 2010
Recreation			
Improved cycling paths	3 km	£4.11 per km per household per year	~ £1.1 million
Landscape and aesthetics			
Landscape habitat improvements	66ha	£80.74 per ha per year	£5329
Biodiversity / habitats			
Wetland	20 ha	£2,200 per ha per year	£44,000
Broadleaved copse	4 ha	£2,155 per ha	£8,620 (single year)

Recreation: In Section 4 we highlighted work in another North East coal mining area where residents were willing to pay £4.11 per km per household per year for improvements. We estimate that 3km of paths will be affected by this project creating a value of £12.33 per household per year. There are 207,726 people in the local urban area and the average household size in the UK is 2.4 (National Statistics, 2007). We can therefore estimate that there might be 86,553 households in the area. We therefore estimate the total value of the cycle and footpath improvements at ~£1.1 million/year.

The extra bird watching will provide another valuable addition. However there are alternative sites within easy reach. Adding a separate value for bird watching may lead to an overestimate of the marginal added value. The value described under biodiversity will include recreational values for wetland. We therefore assume that the recreational value is built into the average value used below under biodiversity.

Education and knowledge: This is not estimated. The education and knowledge provided by this project and the subsequent relationship between this community and its greenspace may form the largest lasting legacy of the project. However the benefits are subtle and subject to many variables. To adequately assess these impacts would require either a project developing the capacity to include such estimates in value transfer valuations or else

a bespoke valuation of this project. We could however assume the value to be at least equal to the costs of the educational work. This would include cost A-level coursework provision and school theatre workshops for which we have no reliable cost information.

Cultural and spiritual: There are no direct impacts upon the cultural provisions in the area. Where there are impacts these are tied into the education (for example, Goldthorpe Arts Group) and aesthetics (for example, underpass painting). The broader area does contain a range of cultural heritage sites. Whilst the project does not actively provide further protection for the existing cultural heritage, its community engagement and access work is likely to improve access to and possibly appreciation of these sites. We assume that these values are partially captured within our recreation value.

Landscape and aesthetics: It is difficult to estimate landscape values in a way that avoids overlap with cultural, recreation or biodiversity values. The sites which are being developed already have open views with access. The baseline involves ongoing antisocial behaviour and deterioration in the area, making for unattractive views; the project seeks to clean up the image both through direct investments, and also through the impact of changing the user population and its behaviour. Changes could therefore be important, though for most users this would be reflected already via the recreation values. For surrounding households with direct views over the area, these values could be important (as could values associated with reduced noise or other nuisances) however the number of households so directly affected is likely to be relatively small. We consider the habitat improvements to the Adwick Washlands site and multiply the per hectare value of £80.74 per hectare per year by the 66 ha of the project.

Biodiversity/habitat: The Brander et al (2006) value of £2,200 per hectare per year is multiplied by the 20 ha of wetland created. The total figure is £44,000 per year.

The Harlington site involves creation of approximately 4ha of broadleaved copse. This is multiplied by the Willis value for broadleaved woodland of £2,155 per ha. The total figure is £8,620 as a one-off payment.

The values for riparian mammal conservation are assumed to be included in the habitat cover valuation.

6. Aggregation

The benefits identified above can be summed over time to give a comparison of the baseline (business as usual) and the project scenario (Table 7). 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 7: Aggregate Ecosystem Service Values

Ecosystem Service	Present Value		
	10 years	**50 years**	**100 years**
Food and fibre	-£231,000	-£659,000	-£803,000
Climate regulation	£205,000	£1,025,000	£1,236,000
Recreation	£9,150,000	£26,100,000	£31,800,000
Landscape and aesthetics	£44,000	£126,000	£154,000
Biodiversity / habitats	£411,000	£1,160,000	£1,410,000
Gross total	£9,580,000	£27,800,000	£33,800,000

The benefits above are assumed to begin immediately. These values are all constant over time and so the only variation comes from the discounting. Discounting over 50 and 100 years allows us to build a picture of the total up front cost which might pass a cost benefit analysis. Net of the food production costs and leaving out the uncertain hydropower plant the project might fail a cost benefit analysis over 50 years at costs of around £28 million.

7. Sensitivity Analysis

There are significant losses at Adwick from the loss of arable production. However these may be over estimates. The calculations are based on gross margin income (net of variable costs, but not counting fixed costs). Fixed costs vary substantially farm to farm, which is why the Nix handbook does not report them. The gross margin income used here is £606/ha, while average net income for arable farms is predicted to be £242/ha in 2011. This might reduce total food costs to £50,000 over 10 years and £150,000 over 50 years.

Education values are potentially a significant omission, since a lot of this partnership's work has concentrated on community engagement and education activities. However there could also be a risk of double-counting here and it is likely that education and community engagement benefits are reflected through other values, including recreation and biodiversity/habitats.

The DVGH project could also have negative impacts on the community – or at least their perception of the project. For instance, a community meeting set up to discuss the washland work at Little Houghton was dominated by angry community members complaining about the lack of flood defences (Anon., 2011). The project does not propose any changes to the flood defences and has been carefully designed not to damage existing ones. However what the local people wanted to see was flood defence work, which was slow in coming, and what they saw was an eel pass being built. A community's perceptions of work and their local environment drives how they value the benefits and can in one instance lead to significant benefits or in another resentment and potentially a negative value.

The dominant value for this project is from recreation. The 95% confidence interval for the value used of £4.11 per household per km per year is quite large running from £0.39 to £7.84. Table 8 shows the variation in present values created by these different values. The high variation and the potential importance of these values suggest that the key uncertainties associated with the service valuation for DVGH is associated with the changes in recreation values.

Table 8: Values estimated for recreation benefits of DVGH project

Value	Present Value		
	10 years	**50 years**	**100 years**
Low	£868,000	£2,470,000	£3,010,000
Mean*	£9,150,000	£26,100,000	£31,800,000
High	£17,500,000	£49,700,000	£60,600,000

*: value used in Section 5.

Recreational fishing impacts are also left out of this valuation. If the fish and eel passes have significant impacts upon the viability of the fish stocks then the impact may be large. However we are not able on the basis of information available to make a clear assessment of the value to angling arising specifically through this project.

The biodiversity value is also large here but based upon the mean value from Brander (2006). The median is the equivalent of roughly £107/ha/year in 2010 prices. The project has restored approximately 20 hectares of wetland. This would provide a benefit of under £2,140 per year if median is used rather than the £48,800 used. Median values are sometimes used out of concern to make conservative estimates, but use of the mean is theoretically more justified.

8. Conclusions

This collaborative project was aimed at increasing the net benefits of the work being done by the partners. As such amongst the most important values ought to be the educational and community liaison work. However work with communities and environmental education does not lend itself easily to economic valuation and even less so to value transfer methods.

The DVGH project is one part of a broader conservation plan for the area. The value of the project is a reflection of this as the benefits are marginal improvements of having this project added rather than simply having no conservation benefits in the area. For instance the Old Moor site was developed outside of this project though improvements were made during the DVGH project.

Other work has been done under the remit of the project which is more easily valued. Much of the rest of the benefit is found in the margins with improvements to cycle paths or education in schools. Value transfer methods deal more easily with absolute changes such as access created where there was none before. However, as a minimum the wetland and broadleaved copse creation is likely to produce benefits in the order of £0.5 million over the first 10 years and the recreational benefits might add between £800,000 and £17 million over the same period.

Summary

The DVGH project is as much about co-ordinating and marketing existing activities as it is about new physical changes. Given that a range of projects would most likely go ahead without the project this leaves the tricky job of isolating the marginal impact of the project above and beyond a given baseline. However a range of activities are directly associated with the project and these are what can be valued.

Significant positive benefits have accrued from the project. Much of the benefit is found in margins with improvements to cycle paths and wetland and broadleaved copse creation. Educational and community work investments are likely to result in benefits which are not possible to estimate.

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