GREEN INFRASTRUCTURE IN-DEPTH CASE ANALYSIS

THEME 2: MULTIFUNCTIONAL USE OF FARMLAND AND FORESTS

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1 Introduction

Agricultural and forestry systems dominate the European landscape, covering approximately 50% (EEA, 2010a) and 42% (Eurostat, 2011[1]) of the territory of the EU-27 respectively. As a consequence, they are hugely important land-use types, both for the maintenance of biodiversity and for the provision of services necessary for society. Their impacts show both similarities and differences. Agriculture, by its very nature, alters the composition of the pre-existing natural environment and species composition for the purpose of food or material production, with considerable impacts – both negative and positive – on the environment. Changes over the past 50 years, driven by policy and technological advances, have been particularly dramatic with often negative impacts on biodiversity. Nonetheless, certain agricultural forms (such as low-intensity farm systems) continue to provide a range of social and environmental services, for example through the maintenance and enhancement of biodiversity and landscape, and the promotion of good soil and water management. In addition, certain practices can be adopted across all farming systems that deliver services such as enhanced carbon storage, increased resilience to flooding, and can produce improvements to air and water quality. Agriculture also often plays an important role in shaping the cultural heritage of a region, which supports economic activities such as rural tourism and recreation and helps sustain social capital in rural areas.

Forests, too, constitute a hugely important resource for both biodiversity and the provision of ecosystem services. Forests in Europe include those that are natural (unlike agricultural habitats), semi-natural (similar to low-intensity forms of agriculture) and those that have been planted for material and fuel production. Forests are a key repository of biological diversity, providing vital habitat for a huge range of species of plants, birds, mammals and insects. They also provide important services with respect to carbon sequestration and storage, maintenance of water quality and soil protection, as well as the provision of fuel and building materials. For example, it is estimated that forests take up 7–12% of the European carbon emissions every year (EEA, 2010b). The area covered by forests has increased slightly in most European countries between 1990 and 2005 due both to policy measures supporting forestry and abandonment of agricultural land (EEA, 2010b). Nonetheless, their capacity to provide both biodiversity and ecosystem services depends to a large degree on their environmental condition. Old-growth natural forests and semi-natural forests in particular are the most valuable in terms of biodiversity and carbon storage, for example (Zisenis et al., 2010). Changes in silvicutural practices, such as intensification and the use of exotic species, can result in uniformity of forests which reduces their biodiversity value and certain ecosystem services. Fragmentation of the existing natural and semi-natural forests is listed as one of the major threats to forest biodiversity (Zisenis et al., 2010) making Green Infrastructure and ecological network approaches to landscape management important for forest integrity.

The cases included cover three case studies which offer important insights into how Green Infrastructure initiatives can be implemented in agricultural and forest areas and are considered

[1] Eurostat (2011) *Forestry Statistics*. Forest systems here include forests and other wooded land of which there is approximately 178 million ha, http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Forestry_statistics.

most representative of the measures reported under this theme. The Pumlumon Project, which is the lead example, was selected as it provides detailed information on the costs associated with the provision of both biodiversity and service benefits and initial estimates of the presumed ecosystem services have been carried out. While the Pumlumon Project, a predominately agricultural project, is based over a defined area of 40,000 ha, the Protection Forests policy initiative applies across Austria, providing an example of a different way of implementing a policy initiative. Lastly the Ecosystem-Based Natural Resources Planning in Finland provides an example of an integrated planning approach to forest lands to best incorporate competing land-use demands.

2 Overview of Initiatives

2.1. Lead Initiative: The Pumlumon Project (Wales, UK)

The Pumlumon Project is a partnership project led and hosted by the Montgomeryshire Wildlife Trust (MWT) on behalf of Wildlife Trusts Wales (WTW) over a project area of 40,000 ha in size. The vision for the project is to create "a connected, functioning, sustainable landscape for wildlife and people." This is to be achieved through halting biodiversity decline, inspiring people to value the natural world and the promotion of sustainable use of ecosystem services. It is intended that the project could in time be used as a model for sustainable land use in other upland areas facing similar challenges.

The work on the project to achieve this goal is expected to be ongoing for the period of approximately 30 years. It contains a multitude of sub-projects specifically aimed at protecting endangered species, restoring threatened habitats and promoting specific services such as carbon sequestration and water management. Work carried out to date includes the blocking of drains to restore heathland, replanting of woodland and changes of agricultural practices to ensure sympathetic grazing.

2.2. Secondary Initiative I: Protection Forests (Austria)

Approximately 47% (39,600 km^2) of the Austrian land territory is covered by forest,[2] with only 7% estimated as "artificial". They are largely privately owned and managed for centuries in smaller plots and have remained relatively semi-natural (CBD, 1997). Approximately 7,800 km^2 (20%) of these forests are classified as "Protection Forests" (*Bann- und Schutzwälder*) by the Austrian Forest Act. The primary objective of the Act is not the conservation of biodiversity, but the protection of forests which play an important role regarding the benefits provided to human wellbeing, particularly with respect to their role in natural hazards control, their value for recreation and tourism and general socio-economic functions. Nonetheless, the status "Protection Forest" limits the use of forests for timber production or sets requirements for the application of specific silvicultural measures.

While the lead example is primarily concerned with delivering biodiversity benefits and the sustainable use of ecosystem services, this initiative focuses on their use to society; biodiversity is therefore a secondary consideration and not a major consideration in the planning of investments although it is likely to benefit through reduced intervention and harvesting. While a total of €275 million was invested in 2010, the Ministry of Environment estimates that without Protection Forests an additional €600 million would need to be invested in technical solutions every year to achieve the same level of protection against natural hazards. It is difficult to compare the cost-benefit with the lead example, which is at the initial stages development and therefore at a much smaller scale. Nonetheless, the benefits of the Protection Forests are mainly of a different kind than Pumlumon, focused particularly around natural disaster prevention, owing to the unique topography and high risk of such disaster in the country.

2.3. Secondary Initiative II: Ecosystem-Based Natural Resources Planning (Finland)

Since 2000, landscape ecological plans (LEP) have formed an integral part of state-owned forests in Finland. LEP is an integrated approach to forest management planning in which ecological goals are aligned with different forms of forest use, while bearing in mind the objectives of forestry in the

[2] CBD Country Profiles: Austria. http://www.cbd.int/countries/profile.shtml?country=at#status.

area. These ecological aspects include, for example, those related to nature conservation and biodiversity, landscape ecology, establishing ecological networks and improving connectivity. In principle, landscape ecological planning views an extensive forest area as a whole, including managed forests, nature conservation areas, game areas and special areas for recreational use.

The goal of Ecosystem-Based Natural Resources Planning is to reconcile different forest land uses in a sustainable manner, including nature conservation, forestry, recreation, ecotourism, real estate development and the sale of soil resources. The key aim of the process is to ensure a sustainable, multiple-use of forests by harmonising ecological, economic and socio-cultural objectives of forest management. In practice, the process is carried out by analysing the interlinkages and trade-offs between different land-use options (e.g. comparing costs and benefits) and ensuring a wide participation of relevant regional and local stakeholders in the planning process. This initiative focuses on the multifunctionality of the forest and balancing different uses of the resources. The cost-benefit ratio of this initiative is to a large degree undetermined, both with respect to ecological and economic benefits. Nonetheless, it is expected that ecological benefits are likely to be gained in the longer-term.

3 The Pumlumon Project

3.1. General Background Information

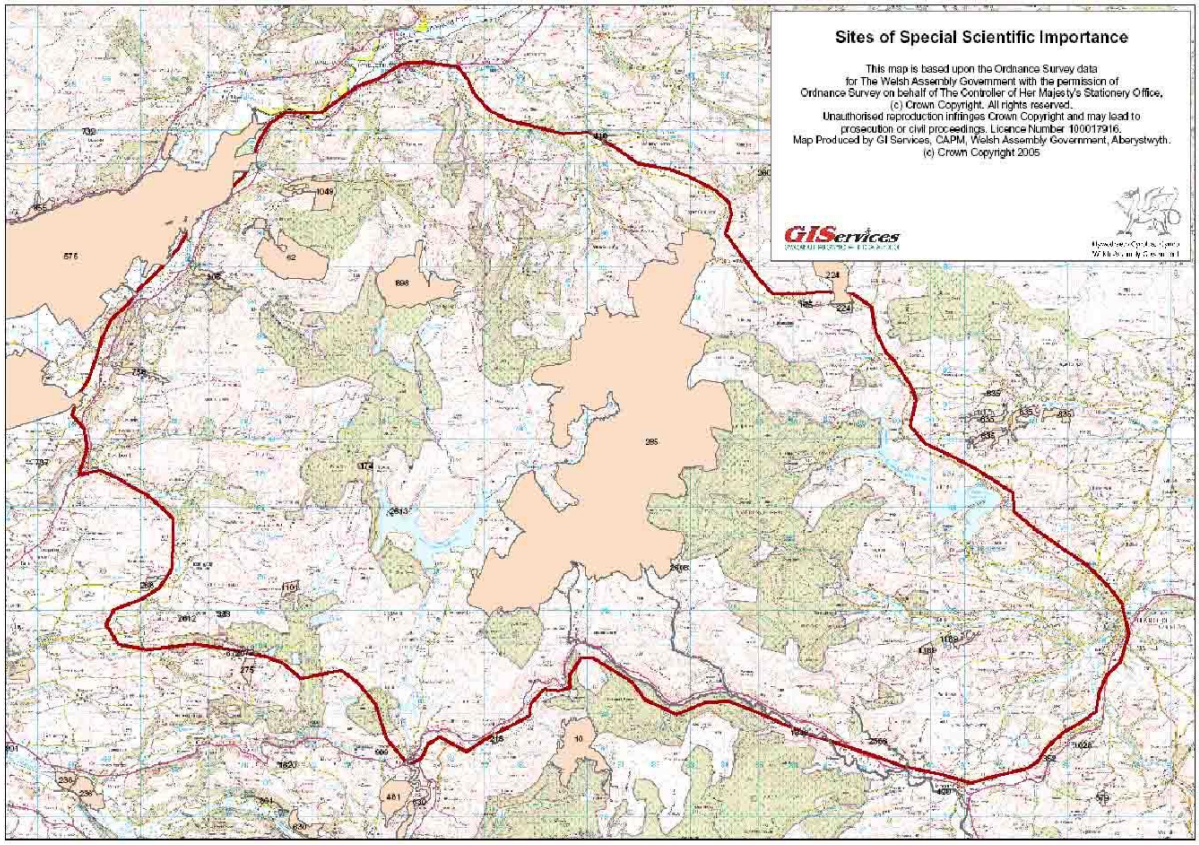
Pumlumon is the most central point of the Cambrian Mountains – the spine of Wales, which stretches north to Snowdonia and south to the Brecons. It is also the highest point at 752 m and the area is often referred to as the last isolated wilderness in Wales. It is also the largest watershed in Wales, being the catchment for five rivers (including the Severn and Wye) which supply water to four million people. The area holds important upland habitats and species (including several bird species of conservation concern). Approximately 5,000 ha are designated as a Site of Special Scientific Interest (SSSI).

Agriculture is the main land use in the area but, as with most of the uplands across Wales, overgrazing by sheep has resulted in a significant loss of biodiversity, with many of the habitats being either lost or degraded to poor condition (The Wildlife Trusts, 2006). It has also caused soil compaction, which is contributing to increased flooding of the lowland areas. Furthermore, as a result of poor socio-economic conditions, many rural communities across Wales are struggling to remain viable despite recent attempts to encourage farm diversification and increased tourism in the area.

To address these issues in the Cambrian Mountains, the Wildlife Trusts Wales (WTW), Countryside Council for Wales, Forestry Commission, Environment Agency (all governmental agencies) and the John Muir Trust (NGO) developed in 2004 the concept for this landscape-scale and ecosystem services-focused approach to land management. The Pumlumon area was identified as the favoured location, and the project was launched in 2007 covering approximately 40,000 ha of upland landscape that supports at least 11 local communities, 250 farm holdings and 15,000 people (Wildlife Trusts Wales, 2011a) plus tourist services and facilities. Upland areas account for approximately 12,000 ha, with other parts of the area sloping down to a reduced altitude. The overall project is envisaged to last until 2038.

Overall to date, there are six pilot projects, four of which fall within a 1,000-ha zone of the core SSSI area (a total of 5,000 ha). The SSSI, located primarily in an upland region, is regarded as the "biodiversity core" of the project which provides the better-quality habitats and which can be built upon to extend into adjacent years. Nonetheless, much of the SSSI is not in favourable condition and requires greater management.

Figure 1. Map of the Pumlumon project area and the SSSI.



Key: Pumlumon project area boundary marked in red; SSSI marked in yellow fill

Ecology and Ecosystem Service Projects

Activities organised in the area are focused around the sustainable management of the landscape in a manner so as to achieve multiple benefits, socio-economic as well as environmental. For this to happen, WTW, who manage the project on the ground, recognise that locals need to be connected and involved in the process, and the conservation objectives of the programme need to integrate carefully with existing land uses. This underpins all of the conservation work that is carried out.

A number of conservation activities have already taken place:

- Extensive drain blocking, which in total affects a catchment of 754 ha and has resulted in a raising of the water table of approximately 5 cm (over 754 ha). The overall volume of peat rewetted is estimated to be 4 million m^3,which is now considered safeguarded. This equates to effective conservation management in that it favours a highly varied heathland, blanket bog, acid grassland, and valley mire.

- This area also includes the removal of conifer plantations (in partnership with the Forestry Commission) of roughly 100 ha – which has been used commercially without replacement.

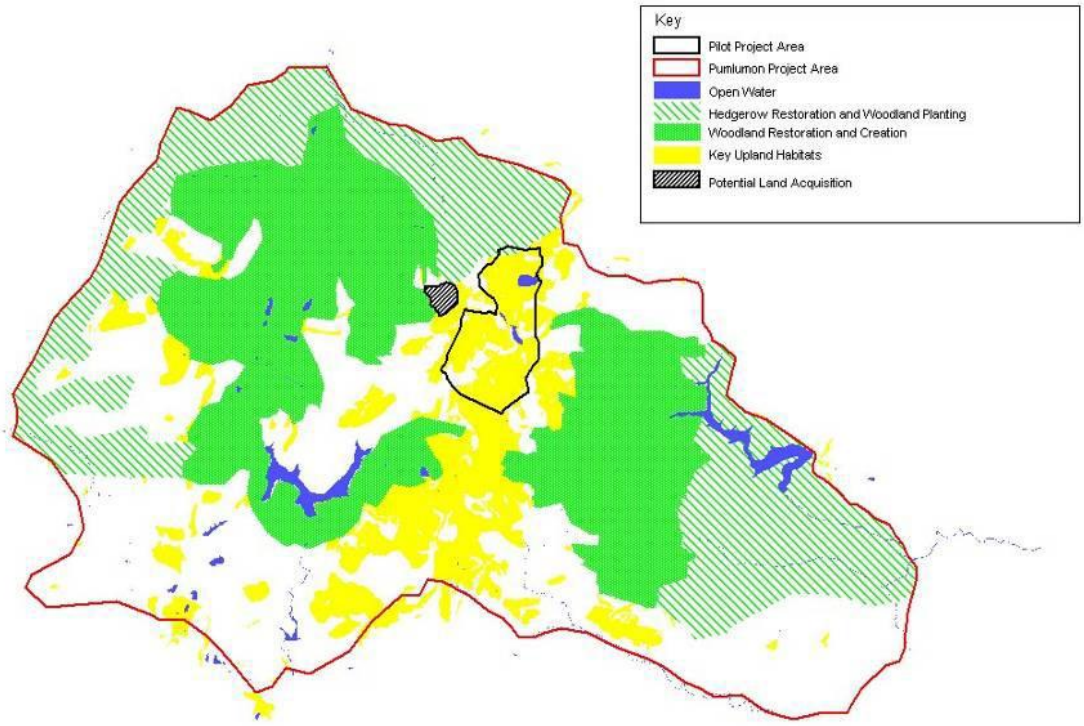
- Sympathetic grazing (i.e. achieving optimal grazing densities of appropriate livestock designed to maintain a range of habitat types) has been carried out over 24 ha with 44 head

since 2008, from either sheep grazing or no grazing at all.[3] There has also been value-added sheep grazing over 100 ha since 2008. This conservation grazing is higher density than habitat maintenance as it is a mixture with habitat-restoration grazing to get it up to standard.

The project foresees an increasing need to mitigate against the loss of diverse habitat (due to habitat fragmentation, climate change and intensification of farming) through improving functional connectivity between lowland and upland habitat, via creating permeable, multi-species connectivity routes. To date, 1 ha plantation of birch, woodland and rowan has been created to implement the CCW Upland Framework (a policy to provide the idealised habitat condition for Welsh Uplands).[4] With this purpose in mind, the Pumlumon project has identified target areas for the restoration of 2,970 ha woodland riparian habitat and 1,890 ha of species-rich acid grassland and heathland (Figure 2 and

Figure **3**) for the purpose of restoring functional connectivity.

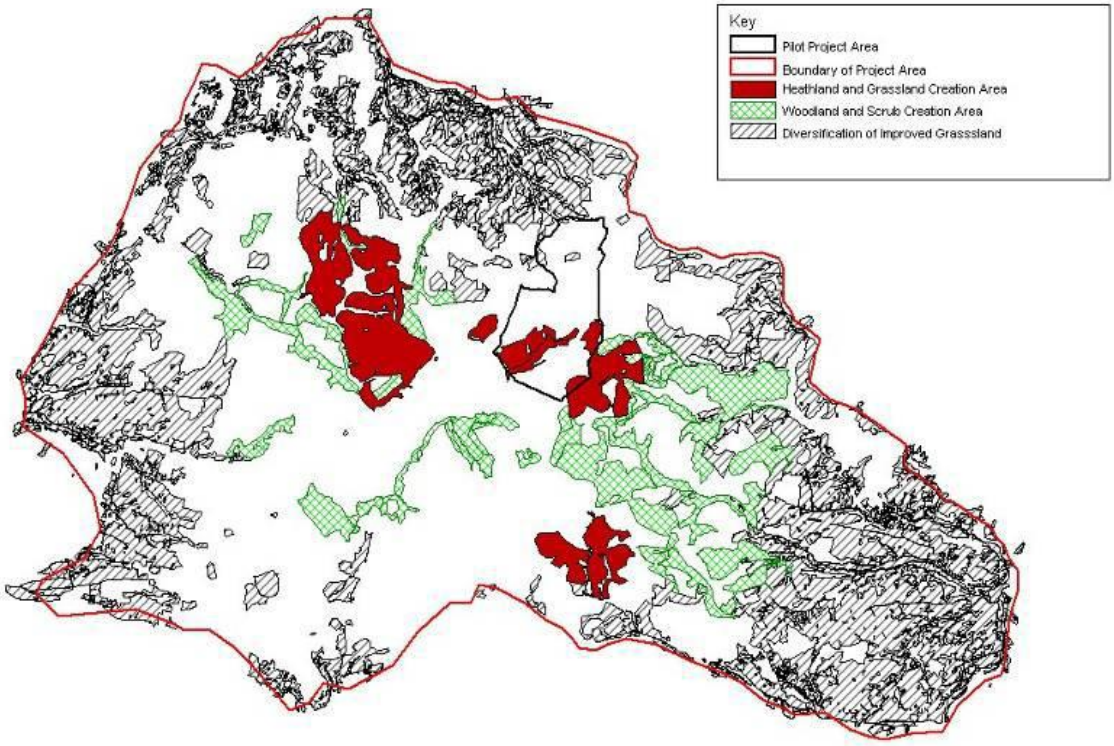
Figure 2. Target areas for restoration at Pumlumon. (Wildlife Trusts Wales, 2011b).



[3] The Pumlumon area is mostly grazed by sheep resulting in vast areas of very short turf and tufts of coarse grasses that are not of great value for wildlife. By introducing more cattle and by varying the times the animals graze and the number of animals on each area, the project intends to create a varied landscape with more diverse habitats. http://www.montwt.co.uk/pumlumon.html.

[4] This Framework is not yet fully implemented but is the most detailed aspirational document for the uplands to date and includes a detailed identification of the preferred location of corridors and core areas.

Figure 3. Target areas for habitat creation (Wildlife Trusts Wales, 2011b).



In addition, the project is carrying out several sub-projects to better ascertain the status of key species within the project area. The "3 Birds and Butterfly" project has been initiated to establish an Upland Bird Survey of the SSSI uplands. The small heath butterfly (*Coenonympha pamphilus*) in the project has recently been added to the BAP. In addition, grouse counts are underway using pointers (dogs), a more intensive method than the Upland Bird Survey.

The presence of the pair of osprey (*Pandion haliaetus*) on the reserve (first breeding pair for 400 years) was assumed to be a result of improved land management in the area and the erection of an osprey pole along a known osprey migratory route. This has triggered the creation of the fastest growing visitor centre in Wales.

Community Activity

The engagement of farmers and the local community lies at the heart of the way the project is managed. It has developed the AGRI-SGOP Project to increase cooperation of farmers (grazers and stock owners) with WTW to create a brand of the sustainably sourced agricultural products (for example, conservation-grade, slower-growing hill beef) which could attract greater premiums in the market. The project as a whole adopts an opt-in approach for farmers who can provide biodiversity benefits, and is based on the assumption that if it added value to the farmers can be demonstrated over time then more farmers will join. This initiative, originally started in Pumlumon, has now been extended to other parts of Wales.

The project also works closely with the Powys Peat Network, a consortium of organisations working on peat conservation to share best practices and funding experience, who are active partners of the scheme.

3.2. Specific Objectives

Although the project does not explicitly refer to the term "Green Infrastructure" in its publications, it is clearly consistent with the concept. This is demonstrated through its landscape-level approach to biodiversity conservation by increasing habitat quality, size and connectivity, through measures that also improve other ecosystems services (such as water resource availability and quality, flood attenuation, carbon storage and sequestration, recreation and tourism) and their socio-economic benefits.

The stated vision for the project is: "The Pumlumon Project will provide a sustainable landscape that supports a renewed wealth of biodiversity, a place where people can thrive and make a living from the land, and a place where people can go to experience a unique culture and natural heritage" (The Wildlife Trusts, 2006).

To achieve its vision, the project is developing a strategic framework that identifies core, buffer and transition zones. The core area is a relatively intact block of good quality viable habitat to which ecological networks can be connected to link other significant areas. The buffer and transition zones have been identified as areas that have the potential to be connected to the core area by creating or restoring ecological networks across the entire landscape. The zonation takes into account the CCW Landscape Character Assessment [5] for the area, and CCW's Upland Management Framework (Jones, 2007) will help guide future management objectives.

The approach to land management is considered innovative by the project managers in that it follows a holistic management of the land to deliver multiple services in contrast to conventional approaches which focus on limited services. This is replicable for any large area. It is one of several initiatives in the UK taking a similar approach, and falls under the Wildlife Trust "Living Landscapes" initiative to promote a landscape approach to land management that includes incorporating biodiversity-friendly features throughout the landscape. The project is looking to test innovative ways of financing biodiversity such as through payments for ecosystem services. This approach also aims to demonstrate an effective way of implementing a number of EU, Wales Assembly Government (WAG), regional and local strategies including:

- Birds and Habitats Directives;
- Environment Strategy and Action Plan for Wales (WAG);
- Natural Environment Framework (due 2011);
- The Wales Spatial Plan (WAG – see above);
- EU Water Framework Directive;
- EU Flood Directive;
- EU Climate Change Directive;

[5] http://www.ccw.gov.uk/landscape--wildlife/protecting-our-landscape/assessing-the-landscape.aspx.

- Rural Development Plan (under WAG);
- UK Biodiversity Action Plan (UK BAP Partnership);
- Wales: A Vibrant Economy;
- Beecham Review – One Wales, One Planet (WAG).

The Wildlife Trusts Wales state justification for this project is grounded in sound research, including an economic scoping study for the area, numerous consultation exercises with stakeholders and a number of pilot projects (Wildlife Trusts Wales, 2010).

The specific project objectives to achieve the vision are:

1. Build capacity within rural communities to ensure the future of sustainable hill farming, including the conservation of local natural and cultural heritage;
2. Provide appropriate mechanisms to enhance, expand and reconnect natural upland habitat features and the wildlife they support;
3. Actively promote the financial and cultural links between farming, wildlife conservation, local communities and commercial enterprise and the combined opportunities they provide;
4. Advance the education of the public and local communities, emphasising the important relationships between sustainable upland hill farming, agriculture and wildlife conservation;
5. Provide advice, means and support for local people to implement innovative and sustainable projects;
6. Widely promote the natural beauty and cultural heritage of the area and encourage innovative tourism, recreation and farm diversification opportunities;
7. Lobby both partner organisations and external bodies to ensure that landscape-level conservation is viewed positively.

3.3. Green Infrastructure Elements

The inclusion of an area within a pilot project is entirely based on an opt-in option for farmers and landowners, providing their land can contribute to ecology restoration. Over the last three years the project has trialled six pilot schemes (four of which fall within 1,000 ha of the core SSSI area) which have focused on three restoration measures:

- Blocking drainage ditches (which leads to the re-establishment of the peat-forming mosses which lock up carbon) – 17km ditches blocked to end of 2010;[4]
- Switching from sheep to low-density cattle grazing (which tends to improve habitat quality and therefore biodiversity);
- Planting willow, birch and rowan trees to create connecting woodland scrub between upland habitats and lowland woodland.

In addition, there are now 11 ecosystem- and habitat-restoration projects underway (Wildlife Trusts Wales, 2011a).

Protected areas: The 5,000-ha SSSI acts as a core area for habitats and UK BAP species. The habitats within the SSSI, however, are not necessarily in good condition. The majority of the restoration is happening within the protected area. The osprey conservation work is another nature reserve (estuary) at the northeastern edge of the project area.

Restoration zones: To date there have been several restoration projects, including 50 ha of acid grassland, 50 ha of scrub communities and 200 ha of heathland. Most of this is in the SSSI. Restoration of 314 ha of drained bog and acid grassland is underway (Wildlife Trusts Wales, 2011a).

Sustainable use areas: 754 ha of land is under favourable conservation management after persuading local farmers that cattle grazing in marginal areas could be profitable. For tourism, the area is even larger. No areas have been taken out of agricultural production. Re-establishing grazing is important to prevent overgrowth of seedlings and the re-establishment of forest cover, which would be detrimental to key plant species.

Natural connectivity features: Outside the 40,000-ha project area are other biodiversity hotspot areas including the Forestry Commission. In 2009, 1 ha of willow birch and rowan trees was planted in 2009 by staff and volunteers. This forms part of a larger intended network with the intention of providing connectivity from the upland habitats to lowland riparian and valley woodland (WTW, 2010) within the framework of the CCW Upland Framework (see above).

The project is also carrying out riparian corridor restoration (500 m) and 1,000 m of hedgerow connectivity. There has been no species-specific corridor work, but it is considered to be a habitat corridor. The riparian restoration in particular has been about water quality and flood water management.

3.4. Implementation Costs

The cost data for this project were provided from the detailed project budget covering the 5 year period 2010–2015. The project is considered to have a cost-benefit ratio of 1:5 (Bailey, 2010).

Table 1: Overview costs (total & per Green Infrastructure element) / Cost associated with the implementation of the initiative.

	Total (Local Currency)	Core areas	Restoration areas	Sustainable use / ecosystem service zones	Green urban and peri-urban areas	Natural connectivity	Artificial connectivity features	Comments
Total Costs						£202,000 (projected)		– Fencing out 15 km of hedgerows (£44,441) – Restoration of 20 km of hedgerows (88,410) – Fencing out 5 km of Riparian habitat (£13,822) – Creation of 60 ha of scrub habitat and subsequent management (£26,522) – Creation of 72 ha of Woodland habitat/tree planting (£32,048) – (Wildlife Trusts Wales, 2011b)
Total costs				£70,727 (projected)				Carbon management: To enhance and maintain 1000 ha of acid grassland, heathland and peatland mosaics by improved sustainable grazing practices by 2017. Actions involve: • Rewetting/ditch blocking – 9kms of ditch blocking,* creating 450 peat dams. Some fencing will be used during establishment phase. • Fencing – 4 kms of fencing to exclude grazing animals until habitat has recovered and to prevent the loss of stock. This will not be necessary once the LGS shepherding is in place (Wildlife Trusts Wales, 2011b). • Management agreements for farmers to alter management regime (£8,841 on average per year over 200 ha).
Time covered by total costs (years)				5				
Annualised costs				£14,000				

Area covered [ha]				200ha				
Cost per hectare				£70				
Financial Costs (list any details e.g. establishing management bodies)								
Opportunity costs (uncompensated) (list any details e.g. foregone resource use)								

Table 2. Detailed costs.

Each investment will deliver a whole range of services (biodiversity and various ecosystem services). The costs below refer to a five-year funding period from 2009–2014 for a total of £4.3million. This is an aspirational budget and is therefore dependent on achieving funding for the activities. Nonetheless, it provides a detailed account of the cost types involved. Surprisingly, it was stated that capital costs tend to be lower than expected, and therefore some money is left over from past budgets for previous work (WTW, pers. comm.).

FINANCIAL COSTS		
	Cost	**Comments**
One-Off Costs		
Administrative, management and information costs		
• Establishing management bodies		
• Surveys	£71,400	- Black grouse survey costs (£5,000 + 3,750) - Red Grouse survey with dogs with travel and equipment (£24,000 + 3,000 + 1,000) - 3 birds and a butterfly volunteers + costs+ equipment (1,500 + 3,000 + 1,500) - Small pearl fritillary contractor + costs + equipment (17,500 + 2,000 + 400) - Dywfi mammals survey costs including volunteer travel & equipment (£5,000 + 3,750)
• Research		
• Consultation		
• Management plans		
Costs of green infrastructure provision		
• Land purchase:		
• One-off compensation payments		
• Creation of green infrastructure elements	£8,600 £45,000	- Creation of 20 ha of flood mitigation tree belts - Carbon safeguard project – includes fencing costs (over 3 years)
• Restoration of green infrastructure	£405,000	Includes: Restoration of 50 ha of acid grassland (£74,800), restoration of 50 ha of heathland (£74,800)creation of 200 ha of scrub communities (£88,410) but excludes monitoring (£12,000) and management of scrub communities (£88,000).
Ongoing Costs (all costs over 5 years)		
Administrative, management and information costs		
• Running of administrative bodies	£2,066,000	This includes salaries, expenses, training, overheads and equipment and activities for the following 8 staff: project manager, economist, ecologist, grazing ecologist, estate worker, administration and financial worker, learning officer, community officer, but excludes ongoing time for carbon safeguard (£144,000)

• Monitoring	£53,000	Capital costs for equipment: - Carbon safeguard (materials required to measure) (£15,000) - Water survey equipment (£36,000) Monitoring of restored and created areas (£12,000)
• Ongoing management planning		
• Communications	£301,000	Marketing resources
• [Fundraising]	£105,000	
• Managing sites:		
Costs of green infrastructure provision		
• Maintenance of green infrastructure	£587,000 £196,500 £88,410	- For specific biodiversity projects such as black Grouse, red grouse, 3 birds, 2 butterflies, Dyfi Furball - Carbon safeguard (minus £45,000 for land management agreements and £15,000 monitoring). This includes staff time (£144,000) which is duplication of staff time above. This does not count for the potential ongoing cost of checking blocked drains over a 10-year period as it is not known if funding will be available. - Management of scrub communities
• Costs of management agreements	£10,000 £83,164	- Black grouse management, £2,500 per year; total cost for black grouse £380,000 over 5 years. This is for looking after the one-off investment, or for grazing agreements. - Water management(e.g. sympathetic grazing) but includes some capital expenditure.
• Costs of protective actions		

OPPORTUNITY COSTS (uncompensated)		
	Cost	**Comments**
Foregone development opportunities		There is a potential opportunity cost in the siting of wind farms – where these are placed in poor positions. However, as it is a voluntary scheme, there are no additional restrictions on development. Ecologically, they could put it a degraded area and could generate mitigation monies which could have a positive impact. Each is therefore judged on its merits. In fact, the project is creating a number of development opportunities (particularly tourism) which wouldn't happen without the project.
Value of potential development foregone		
Foregone resource use		
• Loss of mineral extraction		
• Loss of water abstraction		
Foregone output from land management		
• Foregone agricultural output		There is nothing stopping a farmer reseeding an area. Rather they are trying to create the argument that it is more economical to manage it in a sympathetic way (ideally through brand creation, payments from water companies for water quality etc.). Some of this will inevitably be dependent on government funding.
• Foregone forestry output		Those that they are there, their management is being changed to improve water quality through drain blocking, hard wood creation, grazing. An argument within the NGO community is the desirability of regeneration of hardwoods due to low stocking densities. However, the project asserts that there is no place for additional conifer plantation. (Timber price have doubled recently which makes it just about profitable, but in normal circumstances it was unprofitable). Woodland creation near towns is thought to have a higher cultural service value.
Foregone socio-economic opportunities		Will benefit these so a positive impact
• Loss of regeneration opportunities		
• Loss of community uses of land		
Reductions in land values		Land value is already very high to do with it being a diminishing resource. Very hard for young farmers without family farms to get their own land. Making farming more viable. The farm subsidies increase the value.
Price of land		
Total net economic cost		

The project team suggest that the opportunity costs for opting into the scheme are low or non-existent. Rather, opting in should provide opportunity and will potentially provide greater economic opportunitie, such as value-added meat products. Clearly, however, this is still at the developmental stage and is subject to consumers responding and being prepared to pay a premium for high-quality meat.

Costs that Reflect Opportunity Costs

Farmers are paid £50/ha as a management or maintenance payment for inclusion of a land within the scheme in return for ecosystem service provision in addition to 100% of the capital costs. Farmers already in agri-environment schemes (AES) cannot be paid for management, but can be paid for the maintenance of dams at £9 per dam. Under the terms of the AES scheme, there should not be double-funding for the same management activities. This is funded from the overall budget of the project, which has multiple sources (see below).

Funders

The funders of the project over the funding period 2009–2014 already secured are shown in Table 3:

Table 3. Pumlumon project funders list 2009–2014.

Funder	Total
CCW Partnership	£44,000
JP Getty Trust	£90,000
Waterloo Foundation	£160,000
Biffa (private business)	£135,000
Strategic Development Fund (UK fund)	£40,000
Welsh Assembly Government (WAG)	£12,000
RDP funding from Glasu (Powys County Council)	£15,000

3.5. Observed and/or Projected Impacts

Biodiversity Benefits

The biodiversity benefits of the project are primarily evidenced through the improvements of typical habitat types as a result of the raising of the water level and sympathetic grazing patterns. The monitoring of these habitats is planned to occur every five years. Nonetheless, anecdotal evidence of the habitats has indicated the likely return of key indicator species to the blanket bog (WTW, pers. comm.). For example, pools created in 2008–2009 are displaying increases in Sphagnum species and the rise in the water table has increased which can be used as an indicative environmental quality. The project team define success generally as increased broadleaf woodland and heathland cover; increased acid grassland, blanket bog quality and valley mire quality, reduced conifer cover, halting loss of blanket bog degradation, and the production of open oakland mixed forest with grazing. The areas of land included under the plan for 2009–2014 (dependent on achieving £4 million in funding) are shown in Table 4. As well as improving habitats, there are a number projects focused on priority species, namely black and red grouse (*Tetrao tetrix* and *Lagopus lagopus scotica* respectively), skylark (*Alauda arvensis*) (which are BAP species), meadow pipit (*Anthus pratensis*) (important indicator species) as well as rare mammals in the Dyfi region – common (hazel) dormouse (*Muscardinus avellanarius)*, water vole (*Arvicola amphibious*) and otter (*Lutra lutra*).

Table 4. Area of land under the 5-year programme.

Project	Area and type of activity
Black grouse	– 30ha – site habitat management
Habitat restoration/ creation projects	– Reseeding/ restoration of 50 ha of acid grassland – Restoration of 10 km of hedgerows* – Sensitive management of 10 km of Riparian habitat* – Creation of 200 ha of scrub habitat and subsequent management – Creation of 10 ha of Woodland habitat/tree planting – Promotion of 1,000 ha sustainable habitat management through mixed grazing
Flood water management	– Plant 20 ha of flood mitigation tree belts – Create 3,000 ha upland flood water buffering capacity – Implement sustainable land management across 1,000 ha of upland habitat
Carbon safeguard	– Rewetting 150 ha of peatland habitat – Implement sustainable land management across 700 ha of restored peatland habitat

Continuing at the current rate of funding and activity, the project team expect there to be real biodiversity benefits, but these would not be at a sufficiently large landscape scale to result in substantial ecosystem services (there would be some due to the joining up of pilot projects). The main vision is to bring all the major landowners on board, which will require funding that they expect to obtain, in order to produce the large-scale ecosystem-service provision envisioned. Further wooded corridors are planned but there is debate about whether the forest has a place within the upland landscape. Table 5 shows in more detail the land management outputs expected delivered to date.

Table 5. Land, biodiversity and ecosystems management outputs delivered up to 2011 (Wildlife Trusts Wales, 2011a).

ON GOING Projects	Dates	Project area ha	Length Ditches m	No of bunds	Catchment Area ha	Volume of peat M m3	Habitat area ha	Management Actions	Habitat type
Allt Ddu	2006	30.00	2321.00	105.00	30.00	0.45	30.00	Ditch blocking	Raised Bog
Glaslyn Habitat	2009-11	14.70			14.70		14.70	Cattle Grazing	Acid grassland and mire
Rhos y Garreg A	2008	8.60	3122.00	84.00	72.70	0.13	8.60	Ditch blocking	Blanket bog and mire
Glaslyn Ditch	2009	14.90	4238.00	381.00	43.00	0.22	14.90	Ditch blocking	blanket bog
Maesnant	2009	0.50			2.00		0.50	Tree planting	Woodland
Croeslyn	2010	9.80	1236.00	75.00	34.40	0.15	9.80	Ditch blocking	Acid grassland and mire
FC Dolgau	2010	39.80		?	43.00		39.80	Cattle Grazing	Acid grassland and mire
FC Hafren	2010	92.10	1000.00	45.00	103.40	1.38	92.10	Ditch blocking	Acid grassland and mire
Y Felin	2010-11	2.60			2.60		2.60	Cattle Grazing	species rich neutral grassland
Cefngwyrgrug	2011	58.00	8481.00	600.00	212.00	0.87	58.00	Ditch blocking	Raised Bog
Rhos y Garreg B	2011	43.00	6000.00	270.00	175.00	0.65	43.00	Ditch blocking	Acid grassland and mire
Cefngwyrgrug B	2011	16			16	0.24	16	Bog restoration	Peat hagging
Carreg Dressage	2011	4			5		4	Cattle Grazing	Streamside corridor and cattle grazing
Current Totals		334	26,398	1,560	754	4	334		

Biodiversity Outputs				Ecosystem Service Outputs		
Conservation management	753.8	ha		Value added Cattle	44	
Area of habitat restored	334	ha		Value added Sheep	100	
Area of peatland restored	272.40	ha		Volume of rewetted Peat	4	M m3
Area of acid grassland restored	61.10	ha		Length of ditches blocked	26,398	ha
Area of Woodland created	0.50	ha		Rainfall catchment area	754	ha

Effectiveness of Connectivity Features

The project team acknowledge that efforts to improve connectivity are based more upon the principle of connecting areas of similar habitat rather than specifically designing these for a particular species. Given the uncertainties about future species composition due to climate change, the rationale for the connectivity measures (see 3.3 above) is that it is hard to know which species are the most likely to require the connectivity and therefore designing corridors at the species level is not considered necessary. The problem with estimating the precise benefits of connectivity measures is that it requires considerable academic research, which in turn is dependent on a funder's priorities. The ecologists on the ground tend to use their resources in the direct management and for measuring changes in status and trends (habitat condition monitoring). Additionally, the staff do not have the specific expertise to establish baselines of existing connectivity status or have the capacity for detailed monitoring of the use of corridors, which is seen as a role for universities.

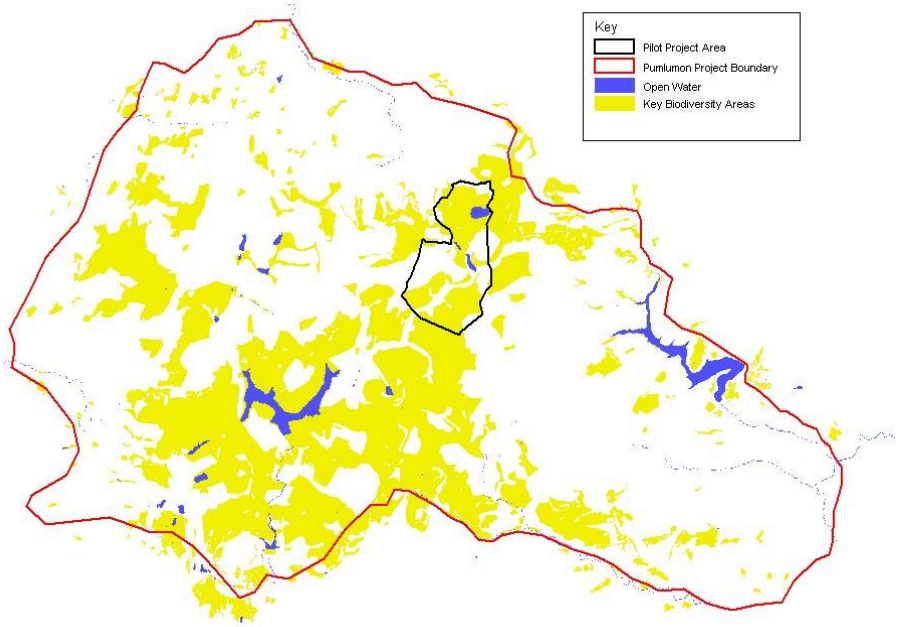
Socio-Economic Benefits

Over the next five years it is estimated (Bailey, 2010) that the project will deliver:

- 1,500 ha of land managed for carbon storage, holding 1.87 million tonnes of carbon;
- 3,730 ha of land managed for flood water, storing 30.67 billion litres of water;
- 5,050 ha of habitat managed for connectivity (Figure 4, yellow 'Key Upland Habitats' – there are also other opportunities for connectivity including the hedgerow and riparian work).

In addition, the area hosts the Dyfi Osprey Project which attracted 30,000 visitors in 2009 and brought in £10,000. This is part of the overall project, e.g. the osprey is both biodiversity and green economy.

Figure 4. Key upland BAP habitats including heathland, bog and species-rich grasslands.



Source: (Wildlife Trusts Wales, 2011b)

Table 6. Overview of biodiversity and socio-economic benefits by 2011

Biodiversity Benefits		
Species	**Habitats**	**Genetic Diversity**
	784 ha under conservation management. In addition, the following restorations have been completed: – 334 ha of habitat – 272 ha of peatland – 61 ha of acid grassland – 0.5 ha of woodland	

Ecosystem Service/Socio-Economic Benefits	
Provisioning	Water quality: there is clear evidence from similar projects in the UK that restored bogs leak considerably less organic carbon and therefore less particulates and colour.
Regulating	4 million m^3 carbon stabilised. Flood water management (although see the potential trade-offs and caveats below).
Cultural	Creation of an audio trail. £300,000 per year attributable to the osprey project from 30,000 visitors.
Supporting	
Wider socio-economic benefits (e.g. fuelling economic activity, job creation, health benefits**)**	8 full-time direct jobs created include: – Project team: 4 jobs (= 3.75 FTEs) – Contractors: 1 job (=0.25 FTE) – Visitor centre: 3 jobs (= 2 FTEs) Indirect and induced employment: from visitor spend 0.5 jobs (FTEs); from incomes 1.0 job (FTE).

Source: (Wildlife Trusts Wales, 2011a)

Trade-Offs and Synergies Between Ecology and Ecosystem Services

In general, the project team expect the two priorities of biodiversity and ecosystem services to overlap, with sustainable management likely to pay off in the long-run. For example, it is assumed that the cost of reducing stocking density will have a positive economic benefit (soil quality and water). Nonetheless, certain trade-offs have been identified through interviews with the Pumlumon staff and with Pete Jones, a peatland expert working for CCW who has had some involvement in the project.

Open water and methane release: the creation of small pools from ditch blocking was found to be creating methane release with a significant short-term spike. However, these pools create a direct biodiversity benefit, causing a direct conflict with carbon sequestration. As a result, they have

reduced pool creation but improving the hydrological structure will recreate these naturally over time.g

Flood water management: a fully saturated bog is better for ecology but may have reduced water retention and therefore reduce its ability to regulate water provision. However, this apparent conflict is only short-term as dry peat will oxidise and be lost in the longer term (over 10 years). Keeping it wet is a likely better water retention measure over the long term as it is rarely fully saturated, and the better structure and riparian area will slow the movement of water in times of high flow (WTW, pers. comm.). Indeed, the evidence around this topic appears to be still incomplete. Pete Jones (pers. comm.) contends that when they are restored they generally are mostly saturated and therefore less useful for flood attenuation than they are often given credit for. Their flood prevention capability depends a lot on different aspects (such as the topography of the area) and therefore dependent on where the sample is made. Nonetheless, he agrees that for certain parts of the flood cycle it can attenuate heavy flow – in the summer it will be less saturated and therefore more able to reduce the impact of heavy rainfall, and the blocked drains are also likely to slow run-off even during the wetter periods.

Universities (through Investing in peatland) are doing a huge amount of work on this subject. CEH are using Pumlumon data and they are looking to improve monitoring. Aberdeen are looking at economic evaluation of peat restoration. The universities require funding which limits what research can be carried out; often there is a conflict with controlled experiments versus NGOs who want to do the work as soon as possible.

The riparian vegetation is also expected to provide benefits other than connectivity, such as the tempering of climate change on water temperature for salmon. With riparian vegetation, there exists a problem regarding the restriction of access for animals to water. This potential conflict has been avoided by the consultation method by allowing the farmers to opt in for the conservation measures that they would like to partake in. Engagement has often worked through being offered a poor site by a farmer somewhat unsure of the project. However, if this goes well, the farmer often allows more activities on other parts of the land.

3.6. Observed and/or Projected Economic Impacts

The project is perhaps unusual in that it employs an economist. The job is to ensure that there are positive socio-economic outputs from the project. Therefore, they have had to follow an ecosystem service model to pay farmers and to secure funding. This also includes the development of tourism infrastructure such as the Audio Trail. Work is being carried out around the economics of the project of a whole, although as yet only for pilot projects such as evaluating the osprey project impact on attracting finance to the local economy – £300,000 per year attributable to 30,000 visitors. This information comes from visitor surveys and evaluation of estimates of spend on accommodation. The evidence was accepted by the European RDF funders and the project now funds three staff. The intention is to inform those visitors of the other possibilities in the area.

The ability to attract the osprey is in part thanks to improvements in water quality averages across a large area. The best-quality waters are still declining but the worst are improving. The ability to attract a charismatic species has had a huge benefit – partly economic, but it also gives them an opportunity to communicate to a much larger audience and communicate to locals about the potential benefits of biodiversity restoration. There is a potential conflict here, however, with the desire to expand accommodation in sensitive areas. There is also an issue that the profit could be internalised and the project will try to recuperate some of the costs via the business. This involves a dialogue with the businesses to try to change attitudes and ensure more sympathetic development.

Even better, the project will attempt to support new business opportunities as a result of the biodiversity project.

The project has carried out an assessment of the likely increase in value of key ecosystem services provided over the next 10 years. The study report is not readily available, but according to the Project Manager (Bailey, 2010) the preliminary figures suggest that the project is likely to generate almost £23 million over 10 years, with a cost-benefit ratio approaching 1:4.7. This is calculated from value transfer since there are no direct data from the project to date following the Defra framework case studies. This implies a net present value, after costs and discounting, of £14.3 million. Nonetheless, this is thought to be an under-estimate of the benefits as very conservative assumptions were used for the benefits in each case.

The value of key ecosystem services are estimated to be as follows:

- Outdoor recreation = £7.6 million; this is based on willingness to pay studies using very conservative assumptions.
- Greenhouse-gas emission reductions (in particular carbon safeguarding) = £6.2 million; this is thought to be a reliable figures as there are good data on carbon storage from upland peatlands.
- Historic landscapes = £2.8 million; this is based on willingness-to-pay studies using very conservative assumptions. The landscape is partly designated as a Cultural Important Landscape (lead mining, contribution to Welsh speaking etc.).
- Flood storage = £2.1 million; this is the most speculative figure. It assumes that only 1% of the total cost of flood costs for a limited area will be reduced by this work.
- Water quality = £1.6 million; this comes from United Utilities. In a similar sort of environment, UU have saved a certain amount per m^3 from colouration improvements, and they have applied this to the amount of water provided by the catchment.
- Biodiversity = £1.4 million: taken from other studies on WTP and intrinsic values. There will be some double counting between this and other WTP parts of the study.
- There is an additional extra value of the value-added food production of £0.8 million of conservation grade from premiums.

The project is expected to result in increased incomes for farmers and local contractors, and as a result the communities where they live should also benefit. It is also roughly estimated that the project might create 40 new jobs. This is partly based on tourism spend, contractual work, securing jobs on farms etc., using the data from another similar project estimating job creation in agricultural settings. This is probably a conservative, if crude, estimate. So far, the project has resulted in eight Full Time Equivalent (FTE) jobs, four of which come from the project itself.

The total employment generated by project so far is as follows:

- Direct employment:
    - Project team: 4 jobs (= 3.75 FTEs)
    - Visitor centre: 3 jobs (= 2 FTEs)
    - Contractors: 1 job (= 0.25 FTE)

  - Total: 8 jobs (= 6.00 FTEs)

- Indirect and induced employment:
  - From visitor spend: 0.5 jobs (FTEs)
  - From incomes: 1.0 job (FTE).

The visitor centre should become self-sustaining within three years. Nonetheless, the Pulumon Project may also be necessary as a permanent overhead cost as a coordination role to ensure ecosystem services.

Land management agreements have also been secured through the support of two landowners into Glaistir (the Welsh agri-environment scheme) and the payment of local landowners as contractors for ditch blocking and stock management worth £25,000.

The audio trail has attracted a reasonable number people since launched in September 2010 but no economic information so far. An eco-hostel is being refurbished, a direct outcome of the project, which will bring more spend into the area. This will hold 25 beds and a campsite. This type of work is likely to be replicable in areas marginal for farming and areas that are able to attract charismatic species and those in areas of outstanding natural beauty. Cereal areas would not be included.

3.7. Recent Developments and Outlook

It is clear that since the start of the project, the political understanding and support for this type of project has grown. The 2008–2010 progress report (Wildlife Trusts Wales, 2010) notes that "early fundraising and support for the project was not altogether successful as the model being presented was almost ahead of its time and little understood. But that has since changed, funds to deliver pilot projects for habitat restoration, natural carbon storage and flood water management have been secured as government looks to science to inform the case for a market place for natural capital."

As noted above, sufficient funding has now been secured for at least three years and it is anticipated that significant progress will be made over the period. Indeed, the WTW note that there have been significant developments in understanding the ecosystem approach in the UK, within government, academics and NGOs. Positive developments in this respect include the National Ecosystem Assessment, the positive statements within the Natural Environment White Paper and NGO initiatives such as Living Landscapes and Futurescapes. Nonetheless, government regulatory changes and cuts to funding and state aid will present challenges over the coming years to secure sufficient budgets. Therefore, they have developed a new funding strategy which includes applying for funding from at least 10 funders between June and November 2011 to private sector, foundations and government.

The vital question will be where the funding comes from. The future markets are not yet developed, statutory agency roles are not yet defined and whether they will fund these types of projects is therefore uncertain. Ensuring staff retention will require a tricky balance.

3.8. Summary

GREEN INFRASTRUCTURE BENEFITS	
Ecosystem resilience	✓
Climate change adaptation	✓
Disaster prevention	✓
Ecosystem service provision	✓
Main indicators for measuring ecosystem service provision	
1. Tonnes carbon capture/storage	
2. Income generated through a) tourism b) premium for sale of pro-biodiversity farm products	
3. Water retention and provision	

3.9. Contact Details

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4 Comparable Initiatives

1. Policy Initiative

Protection Forests in Austria (*Bann- und Schutzwälder in Österreich*).

2. General Background Information

Approximately 780,000 ha (20%) of Austrian forests are classified as "Protection Forests" (*Bann- und Schutzwälder*) by the Austrian Forest Act. The primary objective is not the conservation of biodiversity, but the protection of forests which play an important role regarding the benefits provided to human wellbeing, particularly regarding their protective function (e.g. natural hazards control), their value for recreation and tourism and general socio-economic functions. The status "Protection Forest" limits the use of forests for timber production or sets requirements for the application of specific silvicultural measures.

3. Specific Objectives

According to the Austrian Forest Act, protection forests are divided into:

- **Site-protection forests** – issued to protect the site itself (Standortschutzwald), e.g. to halt soil erosion;
- **Object-protection forests** – forests which protect humans, human settlements or agricultural areas against natural hazards and dangerous environmental impacts (*Objektschutzwald*);
- **Protective forests per se** (*Bannwald*) – forests whose use is restricted by the authority, either for the provision of a protective function against natural hazards (e.g., avalanches, wind) or in view of positive environmental impacts (e.g., climate regulation, water provision).

Different requirements apply depending on how the forest has been classified. Timber production is still allowed for the first categories as long as they do not impact the stability of the forest ecosystem. Timber production might be strongly limited for *Bannwälder*, as the welfare value of limiting the use is considered higher than the value associated with its use. Where the forest does not provide full protection, technical or spatial planning measures are applied.

4. Green Infrastructure Elements

- Sustainable use;
- Ecosystem servicess areas.

5. Implementation Costs

The owner of the site-protection forests is required to cover costs arising from the management of the areas through revenues arising from timber production in the same area. Owners of object-protection forests are required to carry out the management of those forests in so far the costs are covered by public entities, and has the obligation of reforestation. The owner of a protection forest per se is entitled to compensation if the classification leads to loss of income.

In the framework of the initiative "Forests Protect Humans", the Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMFLUW) of Austria is committed to investing €10 million in afforestation and restoration measures every year starting in 2010 (Tiroler Tageszeitung 2011).

6. Observed and/or Projected Impacts

Although protection forests are often subject to designation for nature conservation reasons (e.g. natural forest reserves, Natura 2000 sites), they often cover forests at montane and subalpine altitudinal levels and fail to cover forest communities outside those areas. Their relevance for the conservation of forest biodiversity at national level is therefore perceived to be limited. No detailed assessment was publicly available, probably because biodiversity conservation is not the main objective of the initiative.

By the very nature of reduced human abstraction and involvement and a limited amount of management, ecology is likely to benefit. Nonetheless, these measures often do not cover certain habitat types. The 4th CBD Report on Austria (CBD, 2010) states that these forests are "likely to be in a semi-natural state, almost without exception." There are additional clear-felling restricitons of a maximum of 0.2 ha clear felling area.[6]

Recognising their role in the protection of sensitive water courses, forests on steep river banks are generally declared Protection Forests by the Forest Act in Austria.[7]

7. Observed and/or Projected Economic Impacts

In 2010, €275 million were invested in 1,900 projects across Austria for protection against natural hazards, €160 million of which were covered by the BMFLUW (Tiroler Tageszeitung, 2011). There is unfortunately no apparent estimate of the area that these projects cover. According to the Ministry, without protection forests an additional € 600 million would have to be invested in technical solutions every year to achieve the same level of protection against natural hazards such as avalanches and rock slides. In the regional state of Tirol, the value of the protective function of these forests was estimated at €100,000/ha.

8. Recent Developments and Outlook

No recent developments worthwhile outlining besides the above on costs and benefits.

9. Summary

GREEN INFRASTRUCTURE BENEFITS	
Ecosystem resilience	✓
Climate change adaptation	
Disaster prevention	✓
Ecosystem service provision	✓
Main indicators for measuring ecosystem service provision	
1. Estimated savings for grey infrastructure investment	
2. Sustainably harvested timber	

6 http://www.fao.org/docrep/W3646E/w3646e0b.htm.

7 http://www.fao.org/docrep/W3646E/w3646e0b.htm.

10. Contact Details

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1. Policy Initiative

Ecosystem-Based Natural Resources Planning and Landscape Ecological Planning on state-owned land (*alue-ekologinen luonnonvarasuunnittelu*).

2. General Background Information

Fragmentation of landscapes and ecosystems has been identified as a moderate-scale problem in Finland. In order to improve the integrated management of ecosystems and landscapes, including reduce habitat fragmentation, an integrated land-use planning approach, called Landscape Ecological Planning has been implemented in Finland (Kettunen et al., 2007). The long-term ecological objective of landscape ecological planning is to assure the survival of the area's native species as viable populations. Another central goal of planning is to ensure the existence of nature-based sources of livelihood in the area, e.g. continuation of multiple forest-use practices.

Ecosystem-Based Natural Resources Planning (ENRP) forms the basis for land use on state-owned forests. These plans are developed at the regional level and they outline the general principles and goals of land use in the area for a ten-year period.

Since 2000**, Landscape Ecological Planning** (LEP), has formed an integral part of ENRP in state-owned forests in Finland. LEP is an integrated approach to forest-management planning in which ecological goals are aligned with different forms of forest use, while bearing in mind the objectives of forestry in the area. These ecological aspects include, for example, aspects related to nature conservation and biodiversity, landscape ecology, establishing ecological networks and improving connectivity. In principle, LEP views an extensive forest area as a whole including managed forests, nature conservation areas, game areas and special areas for recreational use (Lahti, 2008).

The development of LEP in Finland started as a cooperative project between Metsähallitus and the Finnish Environment Institute in 1994. The guidelines for LEP were published in 2000 (Kurvonen, 2000). The practical planning method has taken shape in the course of pilot projects, which were started and implemented in areas administered by Metsähallitus in 1996 (i.e. state-owned forest areas). Participation of relevant stakeholders play an important role in the LEP process. In practice, the ENRP/LEP plans are implemented and updated as part of ongoing forest management practices.

(Note: Since 2003 the first attempts to consider applying LEP in privately owned forests has been carried out as a part of the Forest Biodiversity Programme for Southern Finland (METSO) – see below.)

3. Specific Objectives

The goal of ENRP is to reconcile different forest land uses in a sustainable manner, including nature conservation, forestry, recreation, ecotourism, real estate development and the sale of soil resources. The key aim of the process is to ensure the sustainable, multiple use of forests by harmonising ecological, economic and socio-cultural objectives of forest management. In practise, the ENRP process is carried out by analysing the interlinkages and trade-offs between different land-use options (e.g. comparing costs and benefits) and ensuring the wide participation of relevant regional and local stakeholders in the planning process.

As for the LEP, i.e. the ecological component of the ENRP process, the long-term objective is to assure the survival of an area's native species as viable populations. Among other things, this requires the conservation of existing valuable habitats and ensuring that new ones can evolve. The planning also involves the effort to assure the conditions for the spread of various species by enhancing the connectivity of the protected-area network in surrounding production forests (Ministry of the Environment 2010; Kettunen et al., 2007; Lahti,2008).

(Note: More specific and detailed objectives for ENRP/LEP (e.g. quantitative objectives) are set in the regional ENRP plans. These include, for example, targets for protected area coverage (ha) and sustainable forestry (m^3 of timber).)

4. Green Infrastructure Elements

The ENRP/LEP process includes a range of elements integral to the Green Infrastructure concept, including key biotopes and areas with threatens species (e.g. protected areas), areas important for ecological connectivity, areas in need of restoration and/or enhancement of biodiversity, game reserves, areas important for their scenic or cultural value and special areas for traditional livelihoods. Naturally, all these need to be considered in the context of areas managed for forestry purposes.

Establishing ecological networks and improving connectivity play an integral role in the LEP process. All state-owned forests are covered with landscape ecological plans, totalling 6.5 million ha and 112 landscape ecological plans. In 2006, the area under LEP included (in managed forests, productive forest land) 150,000 ha of ecologically valuable set aside areas and 81,000 ha of productive forest land that had been designated as ecological corridors. Typically, the corridors followedthe landscapes' small waterways, wet depressions and sometimes wetlands (Kettunen et al., 2007). Given the above, most of the Green Infrastructure elements are covered in the context of ENRP/LEP. Table 4.1 summarises the different categories.

Table1. Green Infrastructure elements addressed in the context of ENRP/LEP.

Green Infrastructure element	Included / possible to include under ENRP/LEP
Protected areas E.g. areas established to protect key biotopes and areas with threatened species.	YES
Restoration zones E.g. areas for restoration and in need of enhancing biodiversity.	YES
Sustainable use areas/ ecosystem service areas Sustainable use areas: areas under forestry. Ecosystem service areas: the term "ecosystem service area" is not used but game reserves, areas of scenic or cultural value and special areas for traditional livelihoods can be considered to fall under this category.	YES
Green urban areas	NO
Natural connectivity features I.e. areas important for ecological connectivity.	YES
Artificial connectivity features	NO

5. Implementation Costs

Opportunity costs: In production forests managed by Metsähallitus (i.e. state-owned forests), about 5% of the area is fully or partly restricted from cutting due to biodiversity conservation, e.g. as part of the ecological network. In addition, a further 9% has restrictions due to recreational needs or landscape protection. Also, the expectations of reindeer herders and needs of the Saami people favour the sensitive landscape approach. It is estimated that these restrictions for the state-owned production forests reduce the annual profit by about €30 million (Ministry of the Environment, 2010).

Costs of implementation: No national estimates are available related to the costs of implementing ENRP/LEPs (i.e. costs of management measures). Some indication of costs could be obtained by analysing and aggregating information from regional ENRPs, but such an analysis was not feasible in the context of this short assessment. Estimated costs of managing and restoring the state-owned protected areas in southern Finland are outlined in Section 2.2 . The total costs of the planning process were €7.6 million (IEEP and Alterra, 2010).

6. Observed and/or Projected Impacts

LEP coverage: In 2009, the area under LEP in state-owned forests included 168,000 ha with high biodiversity value and 18,000 ha of land that has been designated as ecological connections under the LEP (Table 2 below). In addition, close to 600,000 ha of land under LEPs were with limited or no forestry activities. (Note: These areal coverages do not include the national protected area network, i.e. can be considered as additional to the protected area network.

Table 2. Coverage of protected or extensively managed state-owned land under landscape ecological plans (excluding protected areas).

Landscape ecological planning in Finnish state-owned land		
	Size (ha)	On productive forest land (%)
Valuable habitats	168 000	60
Ecological connections	181 000	50
Areas left permanently outside forestry on productive forest land	215 100	
Areas with limited forestry activities on productive forest land; Scenic forests; Cultural areas; Game areas	379 200	

Source: Ministry of the Environment 2010

Other physical/ecological/welfare impacts: No quantified information on the overall impacts of ENRP/LEP are available. Some indication of protected impacts could be obtained by analysing and/or aggregating information from regional ENRPs, but such an analysis was not feasible in the context of this short assessment. According to the evaluation of LEP programmes in 1996–2000, the main principles of planning ecological corridors within the LEP approach were sufficient. However, there was a lot of variation in terms of practical implementation of the approach (Kettunen et al., 2007). It is expected that the ecological benefits will be realised in the longer-term without apparent immediate impacts (IEEP and Alterra, 2010).

LEPs are implemented by the forestry operations of Metsähallitus (Finnish state enterprise for managing state-owned land). The results of the LEPs are stored in the geographic information system (GIS) of Metsähallitus. The logging plans of Metsähallitus are drawn using the data from

the GIS. The ecological quality of the loggings is assured each year by control measurements based on a random sample of logging sites. Since 2000, landscape ecological plans have formed an integral part of planning and management of state-owned forests in Finland. The LEPs are implemented and updated as part of ongoing forest management practises. The LEP has an important role in reducing habitats fragmentation by planning ecological corridors as an important part in natural resource plans. Until now LEP has been used on state-owned land but efforts are being made to apply LEP to private land, i.e. planning the use of areas that have several private landowners involved (Kettunen et al., 2007).

7. Observed and/or Projected Economic Impacts

No information on the overall economic impacts of ENRP/LEP is available. Some indication of projected impacts could be obtained by analysing and/or aggregating information from regional ENRPs but such an analysis was not feasible in the context of this short assessment.

8. Recent Developments and Outlook

It is likely that ENRPs and LEPs will provide the framework for land-use planning on state-owned land in the years to come.

As for the management of LEP areas, a wider, landscape-scale planning approach is currently being proposed (Ministry of the Environment, 2010). It is recommended that various types of protected area can be purposefully clustered together under single management plans, including privately owned areas where they form part of wider Natura 2000 entities or other local networks of protected areas. Furthermore, the ecosystem approach is promoted as an integral part of the management planning process. For this purpose, suitable functionally coherent areas should be identified together with landowners, local residents and other stakeholders. The aim is to create cooperative bottom-up planning processes that also consider objectives and sites of socio-economic importance to developing regions.

9. Summary

GREEN INRASTRUCTURE BENEFITS	
Ecosystem resilience	✓
Climate change adaptation	
Disaster prevention	
Ecosystem service provision	✓
Main indicators for measuring ecosystem service provision	
None	

10. Contact Details

For ENRP: Metsähallitus (a state-owned enterprise responsible of managing state-owned land).

For ENRP/LEP: Metsähallitus Natural Heritage Services (the body of Metsahallitus responsible for the conservation of biodiversity on state-owned land, such as national parks).

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5 Conclusions

5.1 Overview of the Initiatives

These three initiatives provide quite different perspectives and approaches on the provision of Green Infrastructure. The Protection Forests initiative in Austria particularly stands out as one almost entirely established for the mitigation of natural hazards rather than for the protection of biodiversity. They differ also in their implementation approaches: Protection Forests is a nationwide policy initiative that applies a particular landscape type throughout the country; Landscape Ecological Plans operate over a wide area but almost exclusively on state owned land in Finland, whereas the Pumlumon Project is based mainly on private land and is implemented through voluntary agreements with the intention of sustaining the work through the creation of new markets.

5.2 Achievements and Successful Measures

The Pumlumon Project has showed some interesting ideas and achievements over the past several years. In particular, the engagement with local stakeholders has been successful in securing a mutually positive relationship by inviting landowners to opt-in. There has also been a level of success in the creation of a market for premium meat produced in a sustainable way, as the initiative has now spread to the whole of Wales (although this is still in the early stages of development). Also, a significant success has been the ability to attract an osprey pair to settle in the area, which has brought considerable money to the area as a result of tourism. This has also had the impact of improving local attitudes towards Green Infrastructure maintenance. Several key services have been provided including the securing of a large area of peatland for carbon sequestration and the improvement of typical upland habitat.

The multifunctional role of Protection Forests was recognised at a very early stage. In this case, there were considerable savings to be made, through the provision of Green Infrastructure rather than technical solutions.

The significant success of the LEPs in Finland has been the ability to satisfy multiple land needs and to provide at least considerable areas of structural connectivity and habitat restoration.

5.3 Weaknesses of the Initiatives

The Pumlumon project team acknowledge that efforts to improve connectivity are based more upon the principle of connecting areas of similar habitat rather than specifically designing linkages for particular species. The problem with estimating the precise benefits of connectivity measures is that it requires considerable academic research, which in turn is dependent on a funder's priorities. The ecologists on the ground tend to use their resources in direct site management and for measuring changes in status and trends (habitat condition monitoring). The long-term situation of the Pumlumon Project is threatened by a cut in funding before it has had a chance to establish markets that are key to its continued success. It also requires a step-up in funding if it is able to create the scale of habitat restoration that will really provide significant ecosystem services.

The Protection Forests initiative has considerable potential to deliver ecological benefits, but these currently are an aside to the main purpose of the initiative. Thus it is difficult to ascertain what benefits it has had so far on biodiversity. For biodiversity, however, not much effort was made.

Perhaps overall, what has been least promising from the examples is the guarantee that the work will result in biodiversity gains. Pumlumon perhaps provides the greatest assurances in this regard as

the measures for upland bog restoration are based on proven methodologies and changes in environmental condition can be used as a proxy in the short term. For the other two initiatives, there is insufficient effort applied to ensuring that the measures are having a tangible benefit on biodiversity.

There are also important trade-offs between biodiversity and ecosystem services. In Pumlumon, the creation of standing pools of water are very beneficial for biodiversity but can be the source of significant methane creation (a potent greenhouse gas). A fully saturated bog is better for ecology but may have reduced water retention and therefore a reduced ability to regulate water provision. Indeed, bogs are frequently given more credit for flood protection that is often the case, as this often depends on local conditions and topography.

5.4 Potential to Contribute to Green Infrastructure

The potential of the approaches described to contribute to Green Infrastructure are quite significant. Firstly, given the large areas that the examples cover, the importance of this land area for both ecology and ecosystem services is vast. Potentially more important are their efforts to bring a "value-added" and economic benefit as a direct result of Green Infrastructure provision through the creation of a market for premium products and markets for ecosystem service provision. In Finland, the LEPs consulted very widely with all stakeholders and forest users to ensure that potential obstacles were removed before work began which could have significantly affected the implementation of the plan.

The Pumlumon project area is also highly representative of many parts of western Britain and Ireland and therefore the actual management approaches (such ditch-blocking and sympathetic grazing) could be replicated over quite a large area. Certain features, such as the engagement and market-creation models, could be replicated over much larger areas, provided some support is provided. The example of the osprey visitor centre demonstrates the potential of the presence of charismatic species to attract tourism to a marginalised area and to help change mindsets locally about the value of Green Infrastructure provision.

Nonetheless, there are a number of issues. Pumlumon is dependent upon the support of its national government and agencies which provide vital assistance, funding and support, without which the project would be untenable. In Member States where the level of understanding or support for Green Infrastructure projects does not yet exist, this type of project may never get off the ground, regardless of potential.

The Protection Forests initiative could provide some useful lessons for other countries. It is, in many ways, a progressive approach to land management, resulting in the compensation of income foregone to landowners in return for the continued maintenance of areas to mitigate natural disasters. In this respect, the model could be replicated in other areas where this opportunity exists. Nonetheless, this precise model may have limited application as Austria is a particular case with a very high percentage of mountain areas close to human habitation which makes the initiative economically more worthwhile.

5.5 Lessons for a Potential EU Green Infrastructure Strategy

- The EU should ensure that there are sufficient markets established to create the market forces for the restoration of upland areas that are providing carbon and water regulation.
- The EU should make biodiversity-impact monitoring of Green Infrastructure projects an imperative. This should be in association with research centres. The EU needs to help align

research funding along the priorities of Green Infrastructure to ensure that measures such as those promoting connectivity or carbon sequestration are in fact delivering, as this funding and expertise is beyond the capacity of the projects delivering the project on the ground.

- The EU may need to find a way to ensure that projects that are developed to provide ecosystem services also seek to optimise the ecological opportunities at the same time, which could result in significant improvements in biodiversity. These may be through payments for "ecosystem services foregone" where there is a trade-off between the two or support in developing new markets (such as tourism) as a result of the improved biodiversity. These opportunities could be exploited with improved knowledge-sharing between initiatives in similar circumstances or seed funding for capital investments.

- The EU may have to either step in to support good project proposals when the Member State is unwilling to do so or place a requirement on Member States to guarantee a minimum level of funding for promising Green Infrastructure projects.

- The EU could require Member States to first examine if certain services could be provided by Green Infrastructure before large grey infrastructural investments.

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