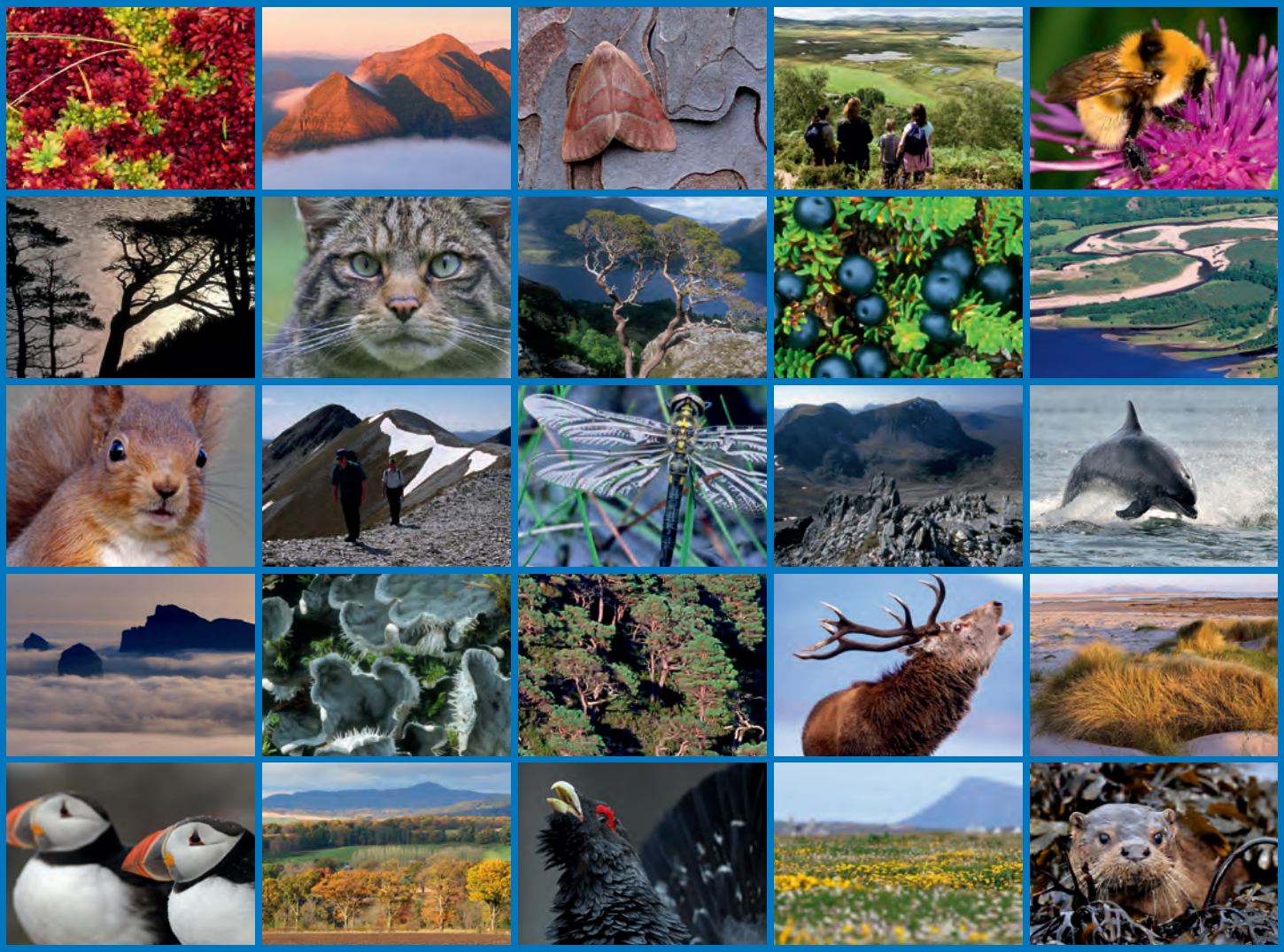
Scottish Natural Heritage
Commissioned Report No. 532

Applying an ecosystems approach to land use – Stirling ecosystems approach demonstration project: Developing a methodology



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COMMISSIONED REPORT

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COMMISSIONED REPORT

Summary

Applying an ecosystems approach to land use – Stirling ecosystems approach demonstration project: Developing a methodology

Commissioned Report No. 532
Project no: 13756
Contractor: Land Use Consultants in association with STAR Group
Year of publication: 2013

Background

Scottish Natural Heritage commissioned Land Use Consultants (LUC) to review appropriate methods and recommend an integrated approach for taking forward the Stirling Ecosystems Approach Demonstration Project.

The aims of the project were to:

- Identify priority actions which will provide improved benefits from nature in ways which integrate public policy objectives and local perspectives; and
- Demonstrate the practical benefits of applying an ecosystems approach to land use, and a way of doing so that is practical and realistic.

This report sets out the results of a review of projects which have used an ecosystems approach.

Main findings

Key recommendations resulting from this work:

- **Identify and involve stakeholders** early in the project to secure ownership of the process and its outputs;
- Use clear, **non-technical language** when discussing ecosystem services;
- Base an analysis of ecosystem services on the **ecosystem and land use characteristics of the study area**, distinguishing between services and their social and economic benefits;
- Use **scenarios** to take account of pressures and drivers for future change on the provision of ecosystem services;
- Plan for and address **lack of data** for some ecosystem services, using and qualifying existing data where appropriate, but also supplementing this with qualitative information derived from stakeholder engagement;

- **Decision-making** should be an integral part of the process to ensure the project aim - to influence the provision of ecosystem services on the ground - is secured.

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1. INTRODUCTION

This Report is designed to inform the development of a methodology for the Stirling Ecosystems Approach Demonstration Project. It is intended that the demonstration project will have two key outcomes:

- Identify priority actions within the Project area to deliver improved benefits from nature in a way that integrates public policy objectives and local perspectives;
- Demonstrate the benefits of applying an ecosystems approach to land use, and a way of doing this that is practical and realistic.

The report sets out the results of a review of other projects based on an ecosystems approach and evaluates options for delivery before outlining a preferred option for the study methodology. An initial programme and costing is provided for this option.

1.1 Aims and objectives

This project represents the first step in a larger project whose aims are to:

- identify key stakeholders who benefit from and manage the environment in the area, including land managers, local communities, visitors and interest groups;
- identify and map the baseline ecosystem (landscape, land use and habitats);
- identify the public policy objectives that influence management or delivery of ecosystem services;
- identify the benefits (ecosystem services) which people receive from the environment using local as well as scientific knowledge;
- work with local stakeholders to value or prioritise the ecosystem services;
- assess the current capacity of the natural environment to support and deliver ecosystem services in the area, identifying barriers to delivery;
- present options for change and future scenarios, including the implications for ecosystem services, at various scales;
- work with local stakeholders to assess and elicit preferences for the scenarios, including assessment of trade-offs and synergies;
- identify the mechanisms, opportunities and barriers to delivering the preferred scenarios; and
- evaluate the success of the Project.

This project is designed to review and recommend potential methodologies to deliver the larger project. Its aims are to:

- provide a review of possible methods for delivering the Project, drawn from experience in the UK and elsewhere;
- recommend a suite of methods that would best deliver the Project's outcomes, within the timescale. If appropriate, the recommendations may include alternative options, setting out the pros and cons; and
- identify any issues or risks that could impact on successful delivery of the Project.

1.2 Report structure

The rest of this report comprises the following sections:

- Section 2: an ecosystems approach – context;
- Section 3: desk review;
- Section 4: options for delivery; and
- Section 5: the preferred approach.

2. AN ECOSYSTEMS APPROACH: CONTEXT

The idea of an ecosystems approach has been established through the Convention on Biological Diversity[1]. This defines such an approach 'as a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way'. The approach is based on the essential processes, functions and interactions of organisms and their environment. The definition recognises that 'humans, with all their cultural diversity, are an integral part of ecosystems'.

The Convention on Biological Diversity sets out twelve complementary and interlinked principles that should be embedded within an ecosystems approach, set out in Table 1.

Table 1: Principles of an ecosystems approach (Convention on Biological Diversity, 2000)

Principles	Explanation
The objectives of management of land, water and living resources are a matter of societal choice	Different sectors of society view ecosystems in terms of their own economic, cultural and society needs. Indigenous peoples and other local communities living on the land are important stakeholders and their rights and interests should be recognized. Both cultural and biological diversity are central components of the ecosystem approach, and management should take this into account. Societal choices should be expressed as clearly as possible. Ecosystems should be managed for their intrinsic values and for the tangible or intangible benefits for humans, in a fair and equitable way.
Management should be decentralised to the lowest appropriate level	Decentralised systems may lead to greater efficiency, effectiveness and equity. Management should involve all stakeholders and balance local interests with the wider public interest. The closer management is to the ecosystem, the greater the responsibility, ownership, accountability, participation, and use of local knowledge.
Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems	Management interventions in ecosystems often have unknown or unpredictable effects on other ecosystems; therefore, possible impacts need careful consideration and analysis. This may require new arrangements or organisation for institutions involved in decision-making, and for them to make appropriate compromises, if necessary.
Recognising potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem management programme should: a) Reduce those market distortions that adversely affect biological diversity; b) Align incentives to promote biodiversity conservation and sustainable	The greatest threat to biological diversity lies in its replacement by alternative systems of land use. This often arises through market distortions, which undervalue natural systems and populations and provide perverse incentives and subsidies to favour the conversion of land to less diverse systems. Often those who benefit from conservation do not pay the costs associated with conservation and, similarly, those who generate environmental costs (e.g. pollution) escape responsibility. Alignment of incentives allows those who control the resource to benefit and ensures that those who generate environmental costs will pay.

[1] http://www.cbd.int/ecosystem/

use; c) Internalize costs and benefits in the given ecosystem to the extent that is feasible.	
Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach	Ecosystem functioning and resilience depends on a dynamic relationship within species, among species and between species and their abiotic environment, as well as the physical and chemical interactions within the environment. The conservation and, where appropriate, restoration of these interactions and processes is of greater significance for the long-term maintenance of biological diversity than simply protection of species.
Ecosystems must be managed within the limits of their functioning	In considering the likelihood or ease of attaining the management objectives, attention should be given to the environmental conditions that limit natural productivity, ecosystem structure, functioning and diversity. The limits to ecosystem functioning may be affected to different degrees by temporary, unpredictable or artificially maintained conditions and, accordingly, management should be appropriately cautious.
The ecosystem approach should be undertaken at the appropriate spatial and temporal scales	The approach should be bounded by spatial and temporal scales that are appropriate to the objectives. Boundaries for management will be defined operationally by users, managers, scientists and indigenous and local peoples. Connectivity between areas should be promoted where necessary. The ecosystem approach is based upon the hierarchical nature of biological diversity characterised by the interaction and integration of genes, species and ecosystems.
Recognizing the varying temporal scales and lag-effects that characterise ecosystem processes, objectives for ecosystem management should be set for the long term	Ecosystem processes are characterised by varying temporal scales and lag-effects. This inherently conflicts with the tendency of humans to favour short-term gains and immediate benefits over future ones.
Management must recognise that change is inevitable	Ecosystems change, including species composition and population abundance. Hence, management should adapt to the changes. Apart from their inherent dynamics of change, ecosystems are beset by a complex of uncertainties and potential "surprises" in the human, biological and environmental realms. Traditional disturbance regimes may be important for ecosystem structure and functioning, and may need to be maintained or restored. The ecosystem approach must utilize adaptive management in order to anticipate and cater for such changes and events and should be cautious in making any decision that may foreclose options, but, at the same time, consider mitigating actions to cope with long-term changes such as climate change.
The ecosystem approach should seek the appropriate	Biological diversity is critical both for its intrinsic value and because of the key role it plays in providing the

balance between, and integration of, conservation and use of biological diversity	ecosystem and other services upon which we all ultimately depend. There has been a tendency in the past to manage components of biological diversity either as protected or non-protected. There is a need for a shift to more flexible situations, where conservation and use are seen in context and the full range of measures is applied in a continuum from strictly protected to human-made ecosystems.
The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices	Information from all sources is critical to arriving at effective ecosystem management strategies. A much better knowledge of ecosystem functions and the impact of human use is desirable. All relevant information from any concerned area should be shared with all stakeholders and actors, taking into account, inter alia, any decision to be taken under Article 8(j) of the Convention on Biological Diversity. Assumptions behind proposed management decisions should be made explicit and checked against available knowledge and views of stakeholders.
The ecosystem approach should involve all relevant sectors of society and scientific disciplines	Most problems of biological-diversity management are complex, with many interactions, side-effects and implications, and therefore should involve the necessary expertise and stakeholders at the local, national, regional and international level, as appropriate.

Defra[2] describes an ecosystems approach as a framework for looking at whole ecosystems in decision-making, and for valuing the ecosystem services they provide in order to ensure that society maintains a healthy and resilient natural environment. It suggests that such an approach provides a way of ensuring that decision-making reflects the fact that the natural environment works as a system, taking account of spatial scale, constraints and the people involved in supplying and receiving ecosystem services and benefits.

The approach is summarised in the recently published Scottish Government information note[3] on an ecosystems approach to land use in three main principles:

- considering natural systems;
- taking account of the services that ecosystems provide; and
- involving people.

The concept of an ecosystems approach therefore offers a potentially powerful tool in guiding the way that we manage the environment. Rather than focusing on a single land use, or a particular benefit, whether that is landscape, recreation or agricultural production, an approach based on the idea of ecosystems and the services they provide to people encourages a more comprehensive and integrated approach. It can help demonstrate not only the range of ways that the environment benefits us, but also their dependence on maintaining healthy ecosystems and their interlinked and connected nature. Decisions to improve the delivery of one kind of ecosystem service are very likely to have implications for the way the environment provides other services – sometimes this may be negative, other times positive.

[2] http://www.defra.gov.uk/environment/natural/ecosystems-services/ecosystems-approach/
[3] http://www.Scotland.gov.uk/Resource/Doc/345453/0114927.pdf

Developing an approach based on analysis of the full range of ecosystem services offers the potential to look more carefully at the choices and trade-offs resulting from a particular decision. It can help ensure that negative effects are identified early on and, as far as possible, designed out. It can also help identify opportunities for positive synergies and so-called win-win solutions, delivering benefits across a range of ecosystem services.

This more integrated decision-making framework can also benefit stakeholder engagement, helping people think more holistically about their local area, tapping into local knowledge and providing people with confidence to define what is important to them, and why. It can also aid understanding and communication between different types of stakeholders (e.g. land managers, local residents, developers, NGOs etc.) by making it more explicit why people value a particular area in different ways. Furthermore, by making the trade-offs, choices and potential synergies clearer, stakeholders are exposed more explicitly to implications of their decisions that might normally be externalised or subject to a regulatory process (e.g. planning).

Pilot work carried out in two river catchments for the Environment Agency identified the following advantages of an ecosystems approach:

- helps us work across silos and recognise the interdependency between environmental, social and economic processes within and outside catchments;
- helps us identify cost-effective (best 'bang for buck') solutions which deliver multiple benefits, often restoring natural processes, and better identifies the unintentional consequences of actions;
- makes us recognise and factor in the value of the environment across numerous interests;
- acts as an excellent framework and common language for considering and bringing together different and diverse policies and initiatives operated by different organisations;
- represents an excellent framework for directly working with a diverse range of stakeholders communicating in a way they will understand, focused around the way people use the environment;
- makes transparent the policy level constraints on progress, highlighting where change is required in socio-economic and political processes; and
- generates energetic and progressive dialogue and lots of new ideas.

The potential benefits of an ecosystem approach are accompanied by a number of important challenges that need to be reflected in the way projects are designed and implemented.

One of the most significant issues revolves around terminology, particularly if the aim is to engage more fully with a wide range of stakeholders with an interest in the study area. The term 'ecosystem services' is itself a challenging concept for many stakeholders; consequently, we have tended to refer to environmental benefits, or simply the reasons why a particular area is considered important. Similarly, a number of the individual services are quite technical and require presentation in a way that is more straightforward and understandable.

Further challenges are associated with identifying the data needed to quantify, map or value ecosystem services. In some cases there are quite good datasets, but in many cases the information base is partial, has been developed for another purpose, is at an inappropriate scale or does not exist. In some cases proxy datasets can be used, or there is a need to rely on qualitative information such as stakeholder views. Ideally, there will be good information covering the existing baseline, a target position and recent trends. Site condition monitoring provides a relatively rare example where this kind of information is available. For many we have some baseline information but less on trends and targets. To some extent this reflects

the novelty of ecosystem approaches and it is likely that studies such as the one proposed for Stirling will help define data requirements more clearly. In the short term, however, it does suggest the need for a degree of pragmatism, perhaps considering some ecosystem services in greater detail than others, and being realistic in terms of the complexity of data analysis across the suite of ecosystem services.

A suggested suite of ecosystem services and associated definitions is contained in **Appendix 1**. It is based on the services used in the Millennium Assessment, with some elaboration of cultural services. This could provide a starting point for the identification of services provided by the Stirling demonstration project study area.

2.1 Overview of the area

The area defined for the Stirling Ecosystems Approach Demonstration Project extends west from the M9, taking in a large part of the Carse of Forth, part of the Touch and Gargunnock Hills to the south and the rising foothills between. It includes the Lake of Menteith and the villages of Balfron, Buchlyvie, Arnprior, Kippen, and Gargunnock and Cambusbarron on the western edge of Stirling.

The area has a diverse physical environment. The Carse itself comprises an overdeepened valley (with former beaches and river channels) which has become infilled with silts and clays, overlain with peat mosses. To the north, the Lake of Menteith comprises a giant 'kettle hole' formed in glacial moraines when a large ice block melted. To the south lie the harder igneous rocks of the Gargunnock Hills, with a number of the rock outcrops which, further east, provide the setting for Stirling Castle and the Wallace Monument. The hills have a steep, north facing escarpment, and gentler southern slopes, draining into the Carron Valley and Endrick Water.

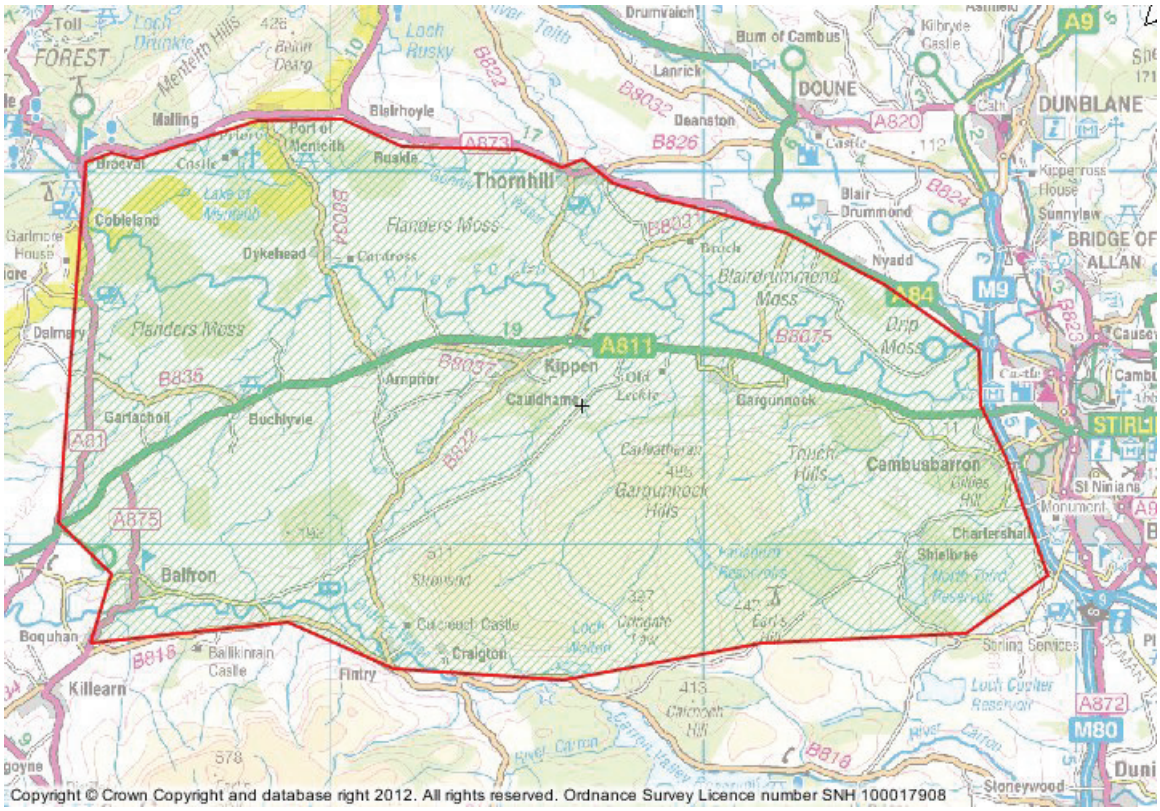

Figure 1. Outline of indicative project area

The peaty character of the Carse is reflected in the presence of a series of mosses, many of which have been reclaimed for agriculture or planted with woodland. Remaining peatland mosses are of great ecological importance, many being designated as SSSIs and together forming the internationally important Flanders Moss Special Area of Conservation. These peatlands are increasingly recognised as being important carbon stores, as well as part of natural flood management processes. The area includes other designated habitats including the Lake of Menteith and Wester Balgair Meadow. The low lying nature of much of the area, combined with the upland nature of much of the Forth's upper catchment and the river's tidal character, mean that flooding is a key issue in parts of the study area, with some areas of farmland protected by flood embankments. The 'improvement' of peatlands to provide agricultural land, and the drainage of upland areas, will have exacerbated the flood risk, increasing the rate of run-off into rivers and burns.

The area's landscape is also widely appreciated, with often dramatic views over the flat carse to the Highland Boundary Fault and mountains beyond, to the north, and to the escarpment of the Gargunnock Hills to the south. Views east focus on Stirling Castle and the Wallace Monument, sitting on their craggy outcrops, and the dramatic scarp of the Ochils. Westward views extend into the heart of the Trossachs, with the hills, mountains and forests of the National Park providing an often dramatic backdrop. Unlike the Carse to the east of Stirling, the area has been relatively unaffected by industrial development and settlement expansion. Small vernacular settlements and farmsteads characterise the area, often occupying locations on slightly higher ground, away from the risk of flooding. Other historic sites range from the castle and priory at the Lake of Menteith to the nineteenth century mill buildings at Cambusbarron. The area has less in the way of recreation provision than the National Park to the west, though the Gargunnock Hills are popular among walkers (with mountain biking provision further south in the Carron Valley) and a number of campsites and golf courses, together with attractions such as the Blair Drummond Safari Park, found around its fringes.

2.1.1 Communities and stakeholders

Communities in the area are in the main very proactive in their own development, with most of them having prepared their own Community Action Plans, and many have their own Community Development Trusts (Cambusbarron, Gargunnock, Thornill, Balfron, Fintry) as well as Community Councils.

Community Action Plans in the area highlight the importance of the natural environment as a key asset and have prioritised the importance of a range of projects and actions that help to protect and enhance the environment as well as to make best use of it for recreation, tourism, education and learning, renewable energy, food production, health and well-being, heritage and cultural activities. In general terms there is a strong awareness of the links between communities and their surrounding countryside and landscape and the benefits that they derive from this relationship.

As a result the communities have experience of working with other stakeholders that have an interest in the environment and landscape – e.g. local farmers and landowners, SNH, Stirling Council, Historic Scotland, Loch Lomond and the Trossachs National Park Authority, RSPB, SEPA, etc.

The study provides a valuable opportunity for communities and other stakeholders to come together to think about the Carse collectively. There has not been as great an opportunity for communities within the area to do this as might first be thought. For example, for networking purposes, communities within the prescribed study area are split between at least three Stirling Council Community Planning Area Forums. Similarly, the study area forms part of three different Electoral Wards.

There is opportunity to build on the work of SNH at Flanders Moss where there has been a conscious effort over the last six or seven years to develop links between the NNR and the surrounding communities – through, for example, oral history projects and work with schools and nurseries.

2.1.2 Future change

The study area is likely to be affected by a range of pressures and changes in the future. These could include:

- the impacts of climate change, including potential increases in winter rainfall and rainfall intensity, combined with reductions in summer rainfall and rising temperatures;
- the potential for agricultural intensification as a response to climate impacts elsewhere and an increased emphasis on food security;
- increased emphasis on woodland management and expansion, in part to contribute to carbon sequestration, the creation of sustainable sources of wood fuel and the development of habitat networks;
- a growing emphasis on carbon management which could affect the way that peatland soils are managed;
- new local authority responsibilities and mechanisms for flood management, including a likely increased emphasis on sustainable approaches based on slowing catchment response times;
- continued pressures for development associated with settlement expansion and population growth, agricultural changes and renewable energy technologies;
- the continued emphasis on community and stakeholder engagement, including the wider localism agenda; and
- growing recognition of the role of the wider environment in contributing to physical and mental health and well-being.

Some of these issues provide the context for future land management policies and decisions; others could inform the development and testing of scenarios.

3. DESK REVIEW

3.1 Introduction

This section of the report summarises the results of a desk review. This comprised four principal elements, namely:

- a review of some of the key policy drivers influencing land management within the study area;
- a review of comparable ecosystem approach projects, drawing out some of the issues and challenges relevant to the Stirling Ecosystems Approach Demonstration Project;
- an overview of broader approaches to stakeholder engagement relevant to the demonstration project;
- a review of existing datasets which could be used to analyse the supply of ecosystem services across the study area.

3.2 Key policy drivers

The following section provides an initial review of some of the policy drivers which could affect the future management of the study area. The review is focused at the national level, though with some consideration of strategic policy implications for the study area, as appropriate.

3.2.1 Climate Change (Scotland) Act 2009

The Climate Change Act represents a key commitment towards reducing Scotland's greenhouse gas emissions and supporting the transition to a low carbon economy. The Act set targets for the reduction in carbon emissions of 42% by 2020 and 80% by 2050 (1990 baseline). From 2020, Scotland will need to reduce its emissions by at least 3% per year. The Act defines the duty of public bodies in contributing to these targets as well as to climate change adaptation.

The Climate Change Act will be a key driver in relation to the way the study area contributes to reductions in carbon emissions, whether through the development of renewable energy, measures to improve energy efficiency or initiatives to maintain and increase the amount of carbon sequestered in soils and vegetation.

3.2.2 Scottish Climate Change Adaptation Framework

The Climate Change (Scotland) Act requires the preparation of an Adaptation Programme for Scotland to be developed by 2013. The Climate Change Adaptation Framework is the non-statutory precursor to this. It presents a national, coordinated approach to ensure that Scotland understands the risks and opportunities these changes present and is adapting in a sustainable way. It sets out:

- the overarching model for adapting to climate change in Scotland; and
- summaries of climate change adaptation in key sectors.

Through the Adaptation Framework, the Scottish Government will work with strategic partners to address Scotland's vulnerability to changes in our climate. These include organisations that deliver public services, that manage Scotland's natural environment and that develop social and economic policy. The Adaptation Framework also establishes support mechanisms to work with local businesses and communities.

The Adaptation Framework will be relevant to the way that the study area adapts to the changing climate. This could include, for example, measures to encourage sustainable flood management, provision for outdoor access and recreation, or ways in which agricultural and forestry practices may need to change in response to rising temperatures or drier summers.

3.2.3 Land Use Strategy for Scotland

The Strategy defines a vision for the future of land use in Scotland:

> *A Scotland where we fully recognise, understand and value the importance of our land resources, and where our land and decisions about land use deliver improved and enduring benefits, enhancing the well-being of our nation.*

The document sets out three Objectives relating to the economy, environment and communities - the three pillars of sustainability:

- land based businesses working with nature to contribute more to Scotland's prosperity;
- responsible stewardship of Scotland's natural resources delivering more benefits to Scotland's people; and
- urban and rural communities better connected to the land, with more people enjoying the land and positively influencing land use.

The Strategy provides a set of Principles for Sustainable Land Use to guide policy and decision-making by public agencies. It builds on existing strategies such as the Scottish Forestry Strategy to influence the way that key land uses will contribute to climate change adaptation and mitigation.

The Land Use Strategy will provide a key driver for the study, encouraging an integrated approach based around a greater understanding of the benefits provided by the area's natural environment, and facilitated by greater involvement of everyone with an interest in the land. The Stirling Ecosystems Approach Demonstration Project can help to deliver Proposal 8 in the Strategy: 'Demonstrate how the ecosystem approach could be taken into account in relevant decisions made by public bodies to deliver wider benefits, and provide practical guidance'.

3.2.4 River Basin Management Planning

River Basin Management Plans (RBMPs) are prepared under the Water Framework Directive. They describe how SEPA, the Scottish Government and Scotland's authorities and public bodies can enhance the environmental quality of rivers, lochs and seas, delivering greater benefits for the environment and safeguarding them for the future.

In 2009, SEPA published RBMPs for the Scotland River Basin District and the Solway Tweed River Basin District - the latter jointly developed with the Environment Agency. The RBMP consultation process involved many sectors, public bodies and non-governmental organisations, as well as the public, all contributing to the development of these plans.

The measures set out in the RBMPs are designed to achieve a balance between the protection of our water environment and wildlife and the interests of those who depend upon it for their prosperity. Area Advisory Groups have been established to assist the process of river basin management planning, advising on and supporting:

- the development of river basin planning at the area level;
- the preparation, delivery and implementation of the Area Management Plan;

- the identification of priorities for environmental improvement and protection;
- the measures required to deliver environmental improvement and protection within the area; and
- the setting of environmental objectives for the area.

The RBMP process will be a key driver in terms of the way that different land uses interact with the water environment. This might include, for example, the impacts of agricultural practices such as ploughing or fertiliser application on water quality, or the dependence on key habitats and ecosystems on the water environment.

3.2.5 Flood Risk Management (Scotland) Act 2009

The Flood Risk Management Act was introduced to create a more integrated and coordinated process to manage flood risk at national and local levels. The Act established:

- a framework for coordination and cooperation between all organisations involved in flood risk management;
- assessment of flood risk and preparation of flood risk management plans;
- new responsibilities for SEPA, Scottish Water and local authorities in relation to flood risk management;
- a revised, streamlined process for flood protection schemes;
- new methods to enable stakeholders and the public to contribute to managing flood risk; and
- a single enforcement authority for the safe operation of Scotland's reservoirs.

Guidance published to support implementation of the Act defines the following outcomes:

- a reduction in the number of people, homes and property at risk of flooding as a result of public funds being invested in actions that protect the most vulnerable and those areas at greatest risk of flooding;
- rural and urban landscapes with space to store water and slow down the progress of floods;
- integrated drainage that decreases burdens on our sewer systems while also delivering reduced flood risk and an improved water environment;
- a well informed public who understand flood risk and take actions to protect themselves, their property or their businesses;
- flood management actions being undertaken that will stand the test of time and be adaptable to future changes in the climate.

The Flood Risk Management Act will be a key driver for the study in guiding the way that land use interacts with flood risk. This may, for example, influence the provision of woodland within the river catchment in order to intercept rainfall and slow run-off into rivers, or lead to the restoration of functional floodplains where these have been lost in the past.

3.2.6 Scottish Rural Development Programme

The Scottish Rural Development Programme (SRDP) is a programme of economic, environmental and social measures, utilising some €680m of European Agricultural Fund for Rural Development funding plus Scottish Government match funding. The programme is designed to support rural Scotland from 2007 to 2013. Individuals and groups may seek funding to help deliver the Government's strategic objectives in rural Scotland.

SRDP brings together a wide range of formerly separate support schemes including those covering the farming, forestry and primary processing sectors, rural enterprise and business development, diversification and rural tourism. It includes measures to support and encourage rural communities and delivers the LEADER initiative for local innovation in rural areas.

Regional priorities have been defined to assist in the delivery of five key outcomes (business viability, water quality, mitigation and adaptation to climate change, biodiversity and landscapes and thriving rural communities) through the work of Regional Proposal Assessment Committees (RPACs), including one covering the Forth area.

A refreshment or replacement of the current programme is due in 2013.

SRDP and its successor programme will be key drivers in guiding delivery and implementation across a wide range of social, economic and environmental issues. There is potential for the study to feed into the definition of priorities at the regional level, and assist their interpretation within the study area.

3.2.7 Central Scotland Green Network

The CSGN is a national development within the National Planning Framework which aims to make 'a significant contribution to Scotland's sustainable economic development'. The CSGN operational area extends from Ayrshire in the west, through Glasgow and the Clyde Valley, Edinburgh and the Lothians, Stirling, Falkirk and Clackmannanshire to Fife in the east. The initiative involves public agencies and stakeholders working together to align their policies, programmes and actions to achieve a common aim.

The CSGN vision is that:

> *By 2050, Central Scotland has been transformed into a place where the environment adds value to the economy and where people's lives are enriched by its quality.*

Five themes are designed to help achieve this vision, describing a place for growth, a place in balance, a place to feel good, a place to belong and a place for nature. Each of these themes has a more detailed series of outcomes and ambitions and a description of who should benefit from the measures brought forward under the initiative.

CSGN will provide an important driver for the study area, defining how a rural area close to urban populations can contribute to the delivery of the wider vision and the more specific thematic outcomes.

3.2.8 National Ecological Network

The National Planning Framework also introduced the concept of a National Ecological Network to build environmental capital and enhance benefits for people, for example through large scale ecological restoration projects. This could include, for example, extensive wetland, riparian or woodland restoration projects, or schemes comprising a mosaic of interconnected habitats at a 'landscape scale'. Examples include the Great Trossachs Forest to the west, and the Inner Forth Landscape Partnership project to the east.

The restoration or expansion of key habitats within the study area could contribute to the National Ecological Network, for example the network of surviving mosses, the woodlands on the margins of the Carse, or the upland parts of the study area.

3.2.9 Scottish Forestry Strategy

The Scottish Forestry Strategy was published in 2006 and set a broad range of environmental, economic and social objectives for the way that woodlands and forests are

managed. While timber production remains an objective, the strategy places increased emphasis on contributing to climate change mitigation and adaptation, and providing new opportunities for community involvement and rural economic activity. The Strategy established an objective to increase woodland cover from 17% to 25% by the second half of the century. Guidance from the Scottish Ministers (The Right Tree in the Right Place) is being reflected in a new generation of Forest and Woodland Strategies which provide a framework for implementation of the national strategy at a more local level. A Forestry and Woodland Strategy is currently being prepared for the Stirling area and it is likely that it, together with national forestry policy, will be a driver for land use across the area.

To help deliver the Scottish Forestry Strategy targets, the Woodland Expansion Advisory Panel, convened under the Scottish Land Use Strategy, will provide advice to Scottish Ministers by June 2012 on identifying more closely which types of land are best for tree planting in Scotland, in the context of other land-based objectives; and on promoting good practice and local processes in relation to tree planting so as to secure multiple benefits. This will have an impact on decision-making in the Stirling area.

3.2.10 Land Reform (Scotland) Act 2003

The Land Reform Act established the right of responsible access and prompted the preparation of local authority outdoor access strategies and statutory Core Path Plans. The provision and management of access infrastructure and exercise of the wider right of responsible access are likely to be drivers for the study area.

3.2.11 Nature Conservation (Scotland) Act 2004

The Nature Conservation Act imposes a wide-ranging duty on Scotland's public sector to conserve biodiversity and protect the nation's precious natural heritage. Given the range of nationally and locally important habitats found across the study area, this is likely to be an important driver for the future of the study area.

Implementation is linked to a national biodiversity strategy that is endorsed by the Scottish Government. The Act strengthens protection for Sites of Special Scientific Interest (SSSIs).

3.2.12 Scottish Biodiversity Strategy

The Scottish Biodiversity Strategy, "Scotland's Biodiversity: It's in Your Hands" aims to conserve biodiversity for the health, enjoyment and well-being of the people of Scotland now and in the future. It was published by the Scottish Government in May 2004. The strategy covers the period up to 2030. A response to the new international biodiversity targets for 2020 (*2020 Challenge for Scotland's Biodiversity*) is being prepared as an addition to the Strategy.

3.3 Review of comparator Ecosystems Approach projects

3.3.1 Projects reviewed

There are a growing number of projects and studies which have used an ecosystems approach. This review therefore drew on a cross section of such projects, aiming to focus on those which, by virtue of their objectives, study area, or process evaluation, appeared to provide the most relevant learning points for the Stirling project. The review therefore provides a summary of approaches and experience in this area, but should not be regarded as being exhaustive in its coverage.

The following reports and projects have been reviewed:

- Collingwood Environmental Planning and the GeoData Institute, 2008. *Case study to develop tools and methodologies to deliver an ecosystem based approach - Thames*

Gateway Green Grids - NR0109. Department of Environment, Food and Rural Affairs (DEFRA). [Hereafter referred to as the Thames Green Grid project].

- EFTEC, 2011. *Scoping study on valuing ecosystem services of forests across Great Britain.* Forestry Commission. [Hereafter referred to as the Eftec Scoping study].

- Environment Agency, n.d. *Draft paper on application of an ecosystem services approach to river basin management - development of an outline process and initial experience from application on two catchment case studies: the Wandle catchment and the Tamar catchment.* Unpublished. Environment Agency. [Hereafter referred to as the Environment Agency pilot work in the Wandle and Tamar catchments].

- Glaves, P., Egan, D., Harrison, K. and Robinson, R., 2009. *Valuing ecosystem services in the east of England. Main report. Pilot projects*. East of England Environment Forum, East of England Regional Assembly and Government Office East England. [Hereafter referred to as the East of England pilots, or specifically Blackwater Estuary, the Maston Vale or Cambridgeshire Fens].

- Icarus Collective, 2011. *Ecosystem services public dialogue project evaluation.* Sciencewise ERC. [Hereafter referred to as the Sciencewise evaluation].

- Land Use Consultants, 2011. *Climate change conversations*. Scottish Natural Heritage Commissioned report No 492. [Hereafter referred to as the SNH Climate Conversations project].

- Land Use Consultants, Bangor University, and Victoria University of Wellington, 2011. *Cambrian Mountains adaptive landscapes project.* DEFRA (Department of Environment, Food and Rural Affairs). [Hereafter referred to as the Cambrian Mountains project].

- Land Use Consultants, Fabis Consulting and Countryscape 2011. *Preparing a detailed Project Plan for CQueL (Character and Quality of England's Landscapes). Work Package 1 Methodological Review*. *Final Report.* Natural England. [Hereafter referred to as the work by LUC for the CQuEL programme].

- Macaulay Land Use Research Institute, 2010. *A field guide to an ecosystem approach in Scotland.* Unpublished report to Scottish Government. [Hereafter referred to as the Macaulay Model Ecosystem Framework].

- Macaulay Land Use Research Institute, 2011. *Model ecosystem framework – guidance for practitioners, phase 2: case study from NE Scotland.* Unpublished report to Scottish Government. [Hereafter referred to as the Macaulay study in North East Scotland].

- McInnes, R.J., Crane, M., Rodda, H.J.E., Danks, P.W., Hogan, D.V. and Field, A.I., 2008. *Management of the Otmoor protected area (Oxfordshire)* in *Multifunctional wetlands in agricultural landscapes: an evaluation of values, impacts and the application of the ecosystem-based approach. NR0112 – Full Report.* Defra. [Hereafter referred to as the Otmoor project].

- Metropolitan Glasgow Strategic Drainage Partnership, 2011. Metropolitan Glasgow Strategic Drainage Partnership *(MGSDP) Strategic Environmental Assessment (SEA) Scoping Report.* Unpublished. [Hereafter referred to as the Strategic Environmental Assessment of the Glasgow Metropolitan Drainage Strategy].

- Natural England and Cranfield University, 2011. *Monitoring and modelling ecosystem services – a scoping study for the ecosystem services pilots. Natural England Commissioned Report NECR073*. [Hereafter referred to as the Natural England pilot project scoping report].

- Potschin, M., Fish, R., Haines-Young, R, Somper, C. and Tantram, D., 2008. *The Parrett Catchment: a case study to develop tools and methodologies to deliver an ecosystems approach (Catchment Futures). Full Technical Report to Defra, Project Code NR0111*. [Hereafter referred to as the Parrett project].

- Rebanks Consulting Limited, 2010. *Case Study: The Economic Benefits of Ecosystem Services in the Bassenthwaite Catchment.* Cumbria County Council and Natural England. [Hereafter referred to as the pilot study in the Bassenthwaite catchment].

- SEPA (Scottish Environment Protection Agency), 2012. *Ecosystem services – River Basin Management Planning – research specification.* Unpublished. [Hereafter referred to as work for SEPA to inform preparation of the second River Basin Management Plan].

The review also included more limited reference to the use of an ecosystems approach in the Cairngorms National Park, the Tweed catchment, Wales and the South West Uplands in England.

3.3.2 Broad approaches

The Macaulay Model Ecosystem Framework sets out a stepwise process as part of an ecosystems approach:

1. identify the issue (outcomes, goals, decision criteria);
2. characterise the system (define the study area and context; analyse ecosystem functions; explore social and cultural capital; identify ecosystem goods and services, attributing them to land systems, beneficiaries, governance and scale of provision; analyse the contribution of ecosystem services to human well-being; and understand past change and the effects on ecosystem services including trends in demand and supply);
3. develop policy or management options;
4. appraise management options;
5. make a decision based on the appraisal of options;
6. monitor and evaluate impacts.

This approach is broadly similar to those of several of the other projects reviewed here. Key aspects to note include the analysis of the contribution of ecosystem services to human well-being (rather than capturing this within cultural services) and distinguishing between demand for and supply of ecosystem services. The approach allows for the development and testing of options or scenarios, decision-making, monitoring and evaluation. A number of these points are drawn out in more detail later in this review.

The Thames Green Grid project was designed to evaluate the use of an ecosystems approach within existing land use planning frameworks and the role of a range of decision support tools, including network analysis and GIS. The network analysis method is based on the concept that there are links and interaction pathways between individual components of the environment and when one component is affected, this will also have an effect on other components that interact with it. It identifies the pathway of an impact or interaction through

a series of chains (network) or webs (systems diagrams) between the cause and the receptor. The approach can help identify conflicts between different services and land uses as well as the direct, indirect and cumulative effects (positive and negative) of changes in land management on the provision of ecosystem services.

Figure 2 provides an example of network analysis of ecosystem services currently provided by the Thames Green Grid. The project used a stakeholder workshop to link a generic suite of ecosystem services back to the benefits provided by individual types of green grid site.

Since network analysis has no geographic expression, GIS was used to provide a spatial dimension to the analysis of these networks and relationships, identifying the role of green infrastructure for food production, climate regulation, flood regulation, aesthetic values, recreation, community integration, and biodiversity, and to look at the combined provision of services. Figure 3 shows the spatial analysis for one type of ecosystem service (food production).

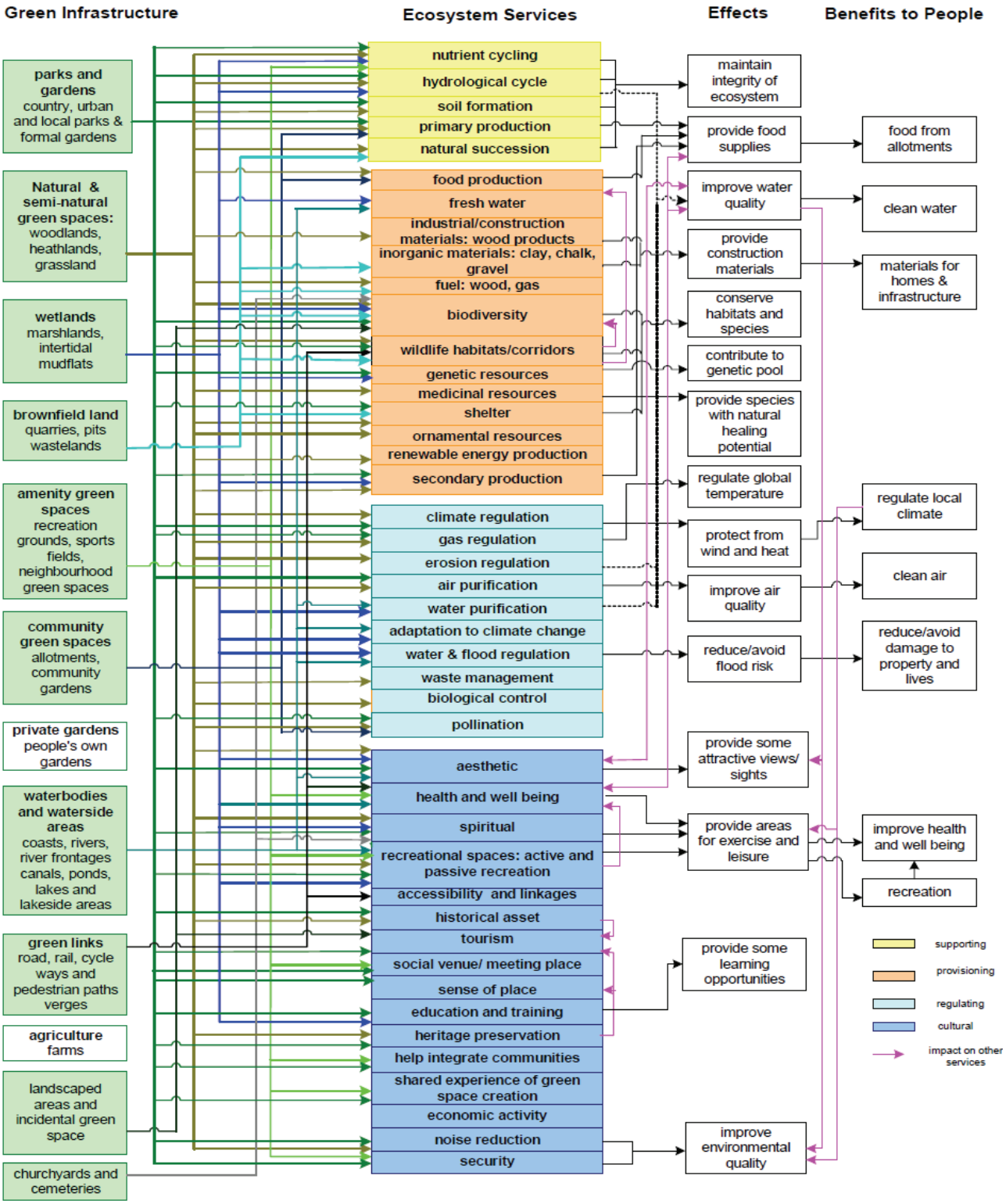

Figure 2. Thames Green Grid network analysis

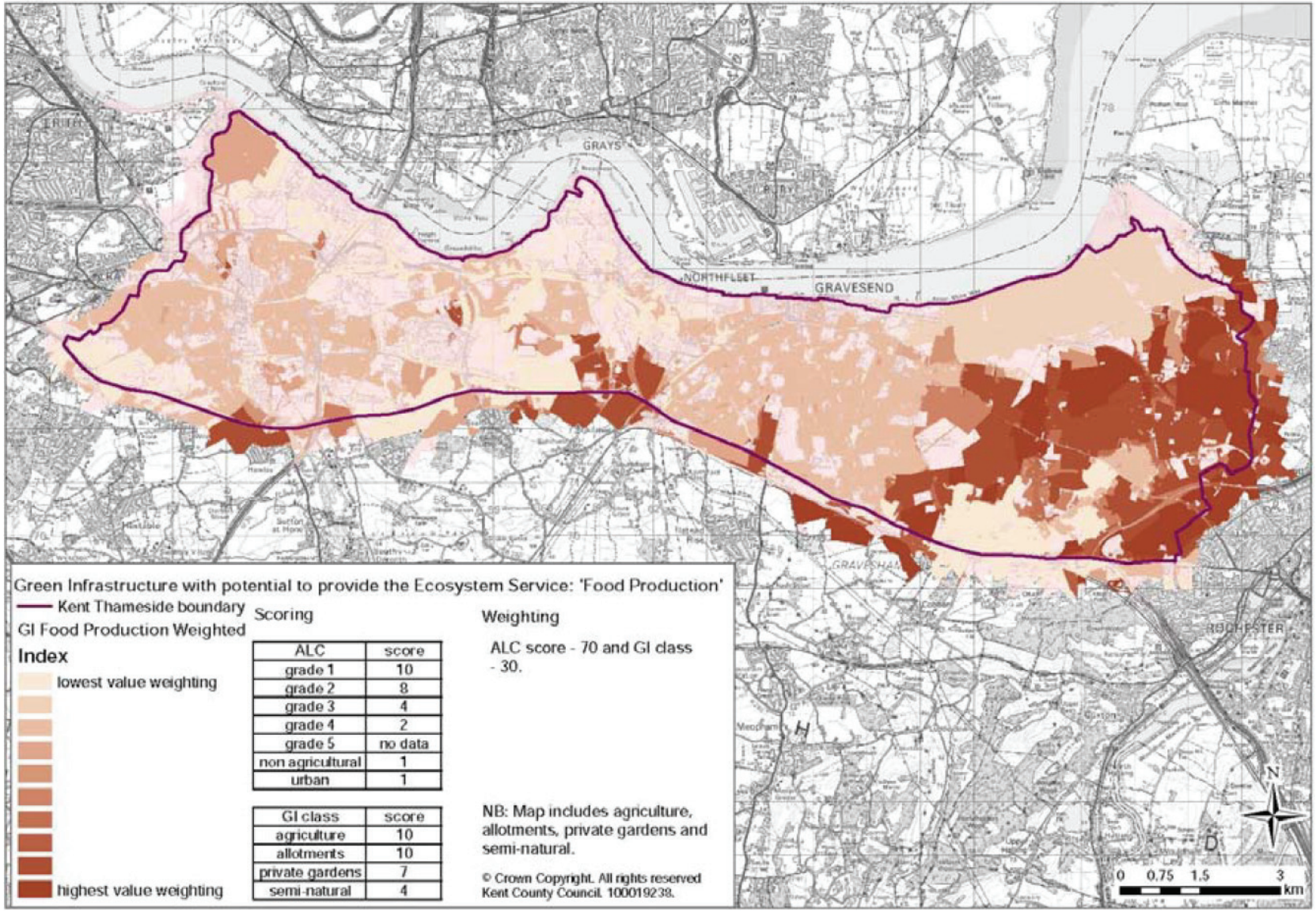

Figure 3. Thames Green Grid GIS mapping

The report concluded that the network analysis was helpful in identifying key linkages and relationships, and to exploring the potential effects of different scenarios. Since it is unquantified, it needed to be complemented by GIS analysis, although this highlighted some shortfalls in the quality and accuracy of some datasets. While the study aimed to quantify ecosystem provision, it concluded that many generalisations and assumptions are needed to achieve such quantification for a strategic scale project. The scope of the project meant that it was not possible to integrate analysis of all the ecosystem services provided by an area at the same time.

Work currently underway for SEPA, designed to inform preparation of the second River Basin Management Plan, includes definition and application of simple criteria designed to assess the significance of different ecosystem services. It also includes analysis of the key current pressures on ecosystem services, the activities that particularly contribute to these pressures and the significance of each activity in terms of the pressure it places on the ecosystem service in question. It would be valuable to explore the potential to use the results of this work to inform the approach developed for the Stirling demonstration project.

The Natural England pilot project scoping report outlines a cascade approach which bases analysis of ecosystem goods and services on ecosystem properties and functions, measured by indicators and analysed using data or model outputs. This highlights the importance of understanding the nature of ecosystem functions and the ecosystem delivering them. It suggests that trade-offs and synergies between the ecosystem functions, both in terms of the spatial and temporal 'inputs' of environmental properties and processes and also the 'outcomes' for ecosystem service delivery are of particular significance to understanding the effect of land use/land management change on the ecosystem services. The report also notes that a rigorous assessment of ecosystem service delivery requires the identification of indicators that quantify the provision of services. Ideally, this requires information on the baseline, a threshold or limit beyond which functioning of the ecosystem is threatened, a target value or figure (where we would like the indicator to be) and a measure of change so it is possible to determine whether the indicator is heading towards or away from the target, and at what speed. This level of information is available for few of the data sources available for mapping ecosystem services within the Stirling study area, though it would be valuable to map out the potential benefits of developing such a baseline in the future.

While some projects have focused on single policy areas, or on the remit of a single organisation, there is evidence that a more holistic approach, with the partnership working that this implies, is an important component of many projects based on an ecosystem approach. This was most clearly summed up in the Environment Agency paper on work within the catchments of the Rivers Wandle and Tamar which found that an initial focus on issues around River Basin Management had broadened, raising a concern that the project was extending beyond the Agency's remit.

Key issues and options for the Stirling project.

- The project should aim to distinguish between the supply of ecosystem services and demand for them (spatially, temporally, financially, etc.)
- It should draw out the distinction between ecosystems, their functions and the services they provide.
- There may be benefits in the Stirling project making a clear distinction between ecosystem services and the socio-economic benefits resulting from them, particularly if this aids understanding of the benefits provided by nature within the study area.
- Network analysis could provide a helpful framework with which to map out the provision of ecosystem services within the study area (and the socio-economic benefits) and test different scenarios.
- Ideally, the work would identify and draw on suitable indicators, baselines, thresholds, targets and trend information for ecosystem services; however, it is likely that a more pragmatic approach will be more appropriate, using information that is available and filling gaps where necessary. However, the study could help justify a more comprehensive and consistent approach to data collection for work based on an ecosystems approach. This could make use of the Scotland Environment Web (see below).
- The aim should be to bring all relevant policy partners into the process to ensure a comprehensive and integrated approach to the analysis of ecosystem services and the relationship with policy and implementation decisions.

3.3.3 Stakeholder engagement

Stakeholder engagement is recognised as an important component of most projects adopting an ecosystems approach, reflecting one of the principles set out by the Convention on Biological Diversity. The range of stakeholders, the nature of their involvement and methods used, do, however, vary considerably across the range of projects within the review.

3.3.3.1 Purpose

The reasons why stakeholders are involved in projects based on an ecosystems approach vary widely.

In the first, more technical phase of the Cambrian Mountains work, stakeholders were mainly involved to evaluate a number of different scenarios, rather than to help identify or evaluate different ecosystem services. A subsequent phase of the project focused on wider stakeholder engagement as a means of exploring current understanding of ecosystems goods and services, the implications of climate change mitigation and adaptation, and policy decisions flowing from this.

The SNH Climate Conversations work used a limited framework of ecosystem services as a structure with which to explore those aspects of the local area that local people considered important or valuable in some way, and to help map out the significance of climate change impacts (direct, mitigation and adaptation) and the policy choices and trade-offs relevant to the area in question.

The Thames Green Grid work used stakeholder involvement to help confirm the project study area and to review the results from pilot work. The first stage of the SNH Climate Conversations work asked stakeholders to confirm or refine the study area.

The Sciencewise evaluation of public engagement found that there was sometimes a lack of clarity on why the work was being carried out, and the purpose of stakeholders' involvement in the process. To some extent, this reflects the role of a number of pilot projects in developing and testing a methodology, and the absence of a specific and well-defined application. In other cases it may reflect poor communication about how the results of the work will be translated into policy or action on the ground. It is therefore important to demonstrate the purpose and application of the project in order to encourage stakeholder involvement and the investment of their time and energy in the process. On the other hand, the evaluation (and a number of other reports) point to the real value that effective engagement can contribute, tapping into sources of local information that would otherwise be unavailable to 'experts', and helping to build consensus (though several projects found that the engagement process highlighted a number of conflicting views which could prove difficult to reconcile).

3.3.3.2 Range of stakeholders

Work in the Parrett catchment defined stakeholders as any person or institution with an interest in, influence upon or right over the management of natural resources. Within this, it distinguished between different types of stakeholders, using different engagement techniques for each. Three main groups were identified – strategic decision-makers, front-line deliverers and residents/community groups.

The Otmoor work engaged with a broad range of owners, visitors, local residents, farmers, local authorities, the Ministry of Defence, Thames Water, the Environment Agency and Defra.

The Marston Vale study focused on a narrower range of stakeholders, comprising government agencies, local authorities and non-governmental organisations. The study did, however, recognise that some consumers of ecosystem services are located beyond the study area.

Stakeholder engagement within the first, more technical, phase of the Cambrian mountains project was limited to farmers and other land management interests, though the later exercise did involve a wider range of community, business and public stakeholders. The Sciencewise evaluation of public engagement underlined the importance of engaging more widely than the 'usual suspects' and ensuring that those involved have some form of relationship with the study area. It noted specific difficulties or challenges in involving young people, pointing to the need to develop tailored methods of engagement for this part of the population.

3.3.3.3 Methods

The evaluation of different scenarios provided the focus for stakeholder engagement for a number of projects.

The 'technical' Cambrian Mountains work used a combination of GIS mapping and 3D representation based on Google Earth as a means of illustrating and communicating different scenarios. The work highlighted the challenge of keeping any modelling, or at least the outputs of the modelling, relatively simple since complexity can be counterproductive, discouraging stakeholder involvement, or raising more questions than answers.

The Sciencewise work in the Cambrian Mountains used a combination of two community workshops, a business workshop and street stalls in three shopping areas. The engagement process explored the benefits people currently get from the environment, how such benefits might change as a result of climate change, CAP reform etc., which benefits people most wanted to maintain (using monopoly money to secure the most important benefits) and identifying ways in which land management might need to change as a result.

Macaulay's work in the north-east of Scotland used stakeholder engagement to identify important aspects of the local area including habitats, cultural heritage, landscape character, significant natural and cultural heritage designations, accessibility and services. Maps, aerial imagery and computer visualisations were used to represent options for future land management.

Work within the Parrett catchment used a combination of a questionnaire survey, presentations to decision-makers, focus group meetings for local residents, semi-structured interviews and a web interface as a means of engaging with stakeholders on three scenarios. The number of people engaging with the focus group meetings and the web interface were relatively low (12 and 27 respectively).

The Otmoor project focused on the use of 44 structured interviews, exploring people's understanding of ecosystem services together with site specific issues such as flooding, conservation and land management.

3.3.3.4 Issues and challenges in stakeholder engagement

As might be anticipated, the concepts and language associated with an ecosystems approach emerged as a key issue for several projects. Work within the Parrett Catchment noted that many stakeholders were unfamiliar with much of the terminology and concepts, concluding that it is better to refer to terms such as quality of life or well-being, wherever possible. The literature review highlighted a number of different ways of describing the ecosystems approach, including an increasing number of acronyms which are likely to make effective engagement with many stakeholders more difficult.

Several reports (e.g. the Macaulay work in North East Scotland, the Sciencewise evaluation of public engagement and the Environment Agency pilot work within the Wandle and Tamar catchments) highlight the time-consuming nature of effective engagement, particularly where it extends to the wider community. Time needs to be invested in identifying suitable stakeholders, encouraging them to take part and developing and running the engagement process itself. Excellent facilitation and good supporting information including graphic presentation are essential. The Sciencewise evaluation also noted that sometimes the discussion of policy choices and trade-offs tended to be squeezed at the end of a longer session and was less successful and rewarding for participants as a consequence.

The Parrett project, along with others including the Cambrian Mountains study, highlighted the importance of presenting information in a meaningful and accessible way for stakeholders, making use of maps, three-dimensional graphics and other tools as a basis for communication, discussion and exploration of policy choices and trade-offs. The project report also notes stakeholder views that integrating information from different policy sectors within an ecosystems approach can be difficult, though a number of methodological measures, including the development of standard ecosystem service maps, and the structuring of information held by regional observatories would help address this concern. The report also questions whether river catchments are always the most understandable geographic units for wider stakeholders.

A number of studies (e.g. the East of England Blackwater Estuary project, and the SNH Climate Conversations) found it is easier to engage stakeholders where a local project or community structure already exists.

In the Cambridgeshire Fens project there were also concerns about the low public evaluation of some ecosystem services, particularly those of a more technical nature. This highlighted the fact that stakeholder engagement should be seen as an input to decision-making, not the sole driver.

Key issues and options for the Stirling project.

- There is a need to be clear about the purposes of stakeholder engagement and the wider Stirling demonstration project, and how the results of the process will be used. This is important in encouraging people to take part, and in making them feel their inputs are valued.
- Practice suggests that the extent and focus of stakeholder involvement varies, but that there are benefits of meaningful engagement at key stages in the process. This suggests that the Stirling project should aim to involve stakeholders from the stage of defining the study area, through the mapping and evaluation of ecosystem services, definition and analysis of scenarios and discussion of future management priorities.
- There may be value in distinguishing between different types of stakeholder and engaging with them in different ways. Some beneficiaries of ecosystem services may be located outside the study area. This suggests that the Stirling project should map clearly the different stakeholders that should be involved in the project and develop a strategy to communicate with each.
- There are benefits in linking community engagement to existing projects or social structures and organisations. With the Stirling study area, there may be benefits in linking into existing community councils, development trusts and community groups, together with land management and business networks.
- Effective stakeholder engagement is time-consuming, requiring investment of time in preparation, and careful management of consultation events to ensure there is sufficient time and energy to deal with key issues late in the process. High quality graphics and supporting information are needed to help communicate ecosystem services to participants in a clear and understandable way. This will need to be reflected in the methodology and time invested within the Stirling project.
- Stakeholder engagement can help build consensus, but is not a complete panacea. People are generally more able to comment on some types of service than others. The Stirling project approach should be designed to build consensus as far as is possible, and to help participants consider as wide a range of relevant ecosystem services as possible. Terminology, concepts and information therefore need to be tailored to the audience.

3.3.4 Identification of Ecosystem Services

A number of different approaches to the identification of ecosystem services were highlighted by the review. Differences include the range of services covered by the project, and the methods that were used to map and analyse them.

Which ecosystem services?

While the Millennium Assessment and Defra's national-level work provide a starting point for the definition of ecosystem services (even if some projects subsequently narrowed the focus onto a subset of these), most applications refined, redefined or unpacked this to suit the purposes of the project in question. Sometimes this resulted in a slightly different title or explanation. In some cases, additional services or benefits were identified, particularly under the heading of cultural services. These include aspects such as health, quality of life and employment (e.g. East of England pilot projects). As noted above, some approaches separate out some of these more explicitly socio-economic benefits which can be derived from a range of different types of ecosystem service. A number of studies also noted the potential importance of recording disbenefits or disservices, particularly where valuation is taking place.

Research carried out by LUC in developing a detailed project plan for work on CQuEL (Natural England's integrated monitoring framework) included a review on how different ecosystem services had been addressed in a range of recent projects. It found that while provisioning, regulating and cultural services are generally included to a greater or lesser degree, supporting services are often excluded from studies, either because they are potentially ubiquitous (e.g. soil formation) or because their interpretation overlaps with other categories (e.g. biodiversity is sometimes identified as a supporting service, but also as one which provides services in its own right). A workshop conducted during the CQuEL work debated the focus on sustainable forms of provisioning (e.g. renewable energy under the heading of fuel) and highlighted some of the difficulties in measuring cultural services.

Within the range of projects covered in this review, there appears to be a tendency for more applied projects to focus on a narrower range of ecosystem services than those which are more exploratory in nature or purpose.

The Cambrian Mountains project was designed to explore ways in which different approaches to land management can help make the project area better able to adapt to climate change. Rather than focusing on the full range of ecosystem services, the work focused on four kinds of service, namely biodiversity, agricultural production, surface water run-off and carbon storage. The report notes the importance of including services that relate to the stakeholders involved in the study. In this case engagement focused on farmers and land management, so an assessment of agricultural production (provisioning) was considered essential to make the work credible and relevant.

The SNH Climate Conversations project adopted an ecosystems approach in order to develop a better understanding of the relationship between landscape, quality of life and the effects of climate change. As a result, the main focus of the work was on an expanded suite of 'cultural services' to which were added some of the less esoteric 'provisioning' and 'regulating' services such as the provision of food and fuel, or the regulation of flooding.

The Otmoor project focused on four ecosystem services – water purification (relating specifically to nitrogen and phosphorus issues), natural hazard regulation (flooding), food and recreation. However, the report notes a concern that this focus may have been drawn too tightly and that other, potentially more important, services were therefore omitted. The Eftec study focused on ecosystem services most closely related to woodlands.

The Strategic Environmental Assessment of the Glasgow Metropolitan Drainage Strategy scoped in six ecosystem services most closely related to the water environment, but highlighted an important distinction between the *supply* and the *demand* for services, both in terms of spatial patterns, and existing or potential mismatches. The Parrett catchment project also noted the importance of thinking about the supply and demand for ecosystem services, recognising that they may occur in different places.

The East of England pilot studies also adopted a 'scoped' approach to which ecosystem services to include in the study. This was based on the identification of the key ecosystem types within the study area and of the main ecosystem services associated with each ecosystem type. Further analysis identified the most important services for each case study. The Natural England pilots also tailored the selection of ecosystem services to the range of ecosystems present in the upland areas in question.

The Macaulay Institute project in the north-east of Scotland also adopted a staged approach based on the identification of ecosystem functions and related services and goods. Within the Tarland catchment, for example, the work concentrated on services relating to food production, though some socio-cultural benefits, more normally considered as 'cultural services', are identified in terms of their contribution to human well-being as an additional

stage (allowing the inclusion of a wider range of socio-economic and community benefits to be considered).

The Thames Green Grid project used network analysis to map out the ecosystem services provided by different kinds of greenspace within the study area, using this as a means of focusing on the most relevant services to the study. Fifteen ecosystem services were considered in detail. Like the Macaulay work, the Green Grid project distinguished between green infrastructure (the ecosystem function), ecosystem services, and effects and benefits to people. It noted the importance of linkages and interdependencies between different ecosystem services.

LUC's work developing a project plan for the incorporation of an ecosystems approach into the CQuEL programme explored the potential for a hierarchy and grouping of services with the aim of making them more logical and understandable with less overlap or ambiguity between different categories. For example, nutrition was identified as main category of ecosystem, broken down into terrestrial, freshwater, and coastal food production together with harvesting from the wild. A further level in the hierarchy distinguished between 'commercial' and 'sustainable' food production under each category. It might be helpful to develop a classification equating to the first two levels of this kind of category, to help ensure that all services are considered in a systematic way.

The Macaulay work in the north-east of Scotland distinguished between what were termed direct ecosystem functions (crops, amenity, water) and indirect functions (air, climate, pollination).

Some work expressed a concern that even with expert judgement we do not understand the relative importance of different habitats in contributing to the overall provision of ecosystem services. The Parrett project report noted that the combination of habitats and their spatial arrangement can be more important than a simple analysis of their spatial extent.

Clearly, there is a need to understand the context-specific properties of datasets and their ability to return meaningful results as a result of a range of analytical techniques. In relation to habitats, area can be a useful measure of the ability of an asset to support metapopulations of key species, and of potential resilience, particularly in relation to climate change.

These issues are explored in more detail at 3.3.4.1 below.

3.3.4.1 Data, mapping and analysis

Most of the projects that were reviewed included ecosystem mapping and the use of spatial data to identify and in some cases quantify and value the provision of ecosystem services. For many studies (e.g. Cambridgeshire Fens project) the linking of ecosystem services to GIS analysis provided a powerful tool for analysis and (e.g. Cambrian Mountains) presenting information for stakeholder engagement.

The review identified a number of common issues and challenges around the mapping and analysis of ecosystems and ecosystem services. There is sometimes a tension between the scale of assessment appropriate to the analysis in question, and the availability of information. The Thames Green Grid study noted that different scales may be appropriate when considering different types of ecosystem service. It suggested that scale should be determined by the functional units needed to understand the processes that provide the ecosystem services. The Macaulay work in North East Scotland worked at three different scales, covering the whole of the North East, the Dee catchment and the Tarland sub-catchment, exploring issues at different scales and drawing on different datasets accordingly.

The Cambridgeshire Fens project highlighted a concern about capturing small-scale variations in apparently uniform areas (e.g. ditches in or around large arable fields).

There are considerable concerns about the coverage and quality (suitability) of data available to analyse ecosystem services. Commonly cited issues included a lack of up-to-date data, data inconsistency, gaps in spatial coverage and topic coverage. Most studies were based on the analysis of existing sectoral studies (e.g. Macaulay's work in the north-east of Scotland) or existing datasets, rather than commissioning new empirical surveys for the area in question (e.g. Otmoor). The Natural England pilot project scoping report provides detailed analysis of national and more local datasets relevant to ecosystem functions and services for each of the pilot areas. This details the ecosystem service (e.g. food), the ecosystems/natural assets (e.g. grassland), function (e.g. growth of biomass), indicators and datasets.

Several studies highlight the importance of including information about the baseline environment and trends affecting it (and any targets where these exist). A number also raised questions about how to map and analyse ecosystem services associated with features which are not part of the 'host' ecosystem. Wind turbines were commonly cited as an example.

Further issues included the lack of a standard methodology and mapping base with some concerned that a number of different approaches are being developed, drawing on different datasets in different ways. Others considered that this may change as the approach becomes more embedded.

The Macaulay work in North East Scotland found that a lack of information can mean that the assessment and analysis process gets stuck at a particular stage – in this case preventing a clear decision or outcome emerging from the work. The report notes that better information tends to be available for provisioning services than regulating services, with even less data covering cultural services.

The Otmoor study report argues the case for better, more systematic and standardised data collection, and the use of reference sites. A number of projects referred to the potential role of Regional Observatories in collecting, assembling and providing data relevant to ecosystem services. There is an obvious parallel with the potential role of the Scotland Environment Web in setting the standards for data collection and assembly for ecosystem services projects in Scotland, and in forming a repository for data and signposting to other agency sites. It could also help raise wider awareness of environmental change and could be used to host information specific to initiatives such as the Stirling demonstration project.

The Natural England pilot project scoping report examined a range of approaches to modelling ecosystem functions and services where good data are unavailable. It recommended use of a model based on the Bayesian Belief Networks approach within a GIS framework to model the effects of land use/land management changes on ecosystem services which can be applied across the pilot areas using a spatial scale relevant to the land use/land management changes to be instigated. This would be based on a series of biophysical drivers including land cover, topography, soil, climate and other datasets specific to other ecosystem services.

Key issues and options for the Stirling project to include.

- Most projects adapt the 'standard' framework of ecosystem services established by the Millennium Assessment. It makes sense to use this as a starting point for the Stirling demonstration project, but to tailor it to the study area and the key policy issues of interest.
- Some projects highlight the importance of distinguishing between ecosystems, ecosystem functions and the range of services that are provided.
- Some projects distinguish between ecosystem services and the socio-economic benefits derived from them; others aim to provide a clearer cascading or grouping of services. The Stirling project should consider making this distinction, in part because it would make the pure socio-economic benefits derived from the area more apparent.
- Quite a number of projects focus in on a more limited list of ecosystem services, generally relating to the purpose of the work or the area in question. Some are chosen, or elaborated, to ensure they are relevant to the target audience. The Stirling demonstration project should aim to provide a reasonably comprehensive assessment of all ecosystem services relevant to the study area.
- Some studies draw a valuable distinction between the supply of ecosystem services, and the demand for ecosystem services. This could be of value for the Stirling demonstration project, helping to identify types of stakeholders outside the study area boundary, and allowing consideration of how both demand and supply could change in the future.
- Problems have sometimes arisen when poor or missing information prevents a key stage of the process from taking place. Early review of available datasets, the identification of any critical gaps and focused work to address these qualitatively or quantitatively should help minimise the risk of later stages of the process faltering.

3.3.4.2 Scale

Most of the projects reviewed conducted analysis at a fairly broad scale, typically a river catchment, upland area or recognisable 'landscape scale' zone. The legibility of these areas was identified as an important aspect where the project engaged with wider stakeholders. Few of the projects worked at more than one scale. The principal exception was the Macaulay study in the north-east of Scotland which worked at three scales – regional (Aberdeenshire/Aberdeen City), catchment (River Dee) and local (Tarland).

None of the examples reviewed worked at the scale of individual land holdings or national nature reserves, though most used data sources which do distinguish between different land units. This is not to say that such areas cannot be identified within wider assessments provided that suitable datasets are available at sufficiently detailed resolution. This could form part of an initial task to review the data sources available for the project. Certainly, the variety of land uses, management systems and environmental sensitivities within the Stirling project area suggest that a more detailed focus on a number of smaller, contrasting areas could be valuable in enhancing the understanding of ecosystem service provision, and the relative contributions made by different areas. This could also provide a baseline to explore the more localised implications of scenarios (see below).

Where there is a requirement to look at the more detailed provision of ecosystem services within a land holding, and where data are not available at suitable resolution, one option would be to carry out a qualitative assessment as part of the stakeholder engagement process, perhaps in the form of a case study.

Key issues and options for the Stirling project to include.

- Most projects work at a fairly broad scale, with few examples of nesting at different scales, and no examples of analysis being conducted at the scale of individual land holdings or sites such as Flanders Moss NNR.
- Data issues may be a limiting factor for spatial mapping at the site specific scale.
- Stakeholders could be invited to carry out a qualitative analysis of ecosystem service provision associated with key land holdings or environmental assets within the wider study area, using mapped information for the whole area as a starting point.

3.3.5 Drivers of change

Most of the projects included some consideration of the main drivers for change. Sometimes these drivers were reflected in the objectives of the project (e.g. climate change adaptation); in other cases there was some mapping of the influence of different factors on the provision of ecosystem services.

The work at Otmoor used the ES approach to explore the influence of different policy designations within the study area, and of different land management activities in neighbouring areas. The work included consideration of different policy drivers and how they interact and work together. It found that some ecosystem services are already reflected in policy or decision-making, but that several policy drivers do not recognise the interconnected nature of the environment.

The Natural England pilot project scoping report refers to a series of land management changes which would be considered in terms of ecosystem service provision in the English uplands. These included:

- management of soils and hydrology – blocking drains on peat soils, revegetating bare peat and avoiding soil compaction by livestock;
- management of grazing – avoiding over or under-grazing, introducing sustainable grazing regimes and changing burning practices;
- management of woody vegetation – increasing woodland and scrubland and introducing and encouraging sustainable woodland management for timber and fuel;
- habitat restoration and rehabilitation – restoring habitat connectivity and restoring damage to habitats from pressure of walkers, horse riders and cyclists.

The Cambrian Mountains work included analysis of the drivers of current and future change including climate change, subsidies, market conditions and tourism activity. It used analysis of public policy objectives to scope the selection of ecosystem services.

The Macaulay approach includes analysis of social and cultural capital based on consideration of the organisations involved, and the influence of designations and patterns of ownership and management.

Key issues and options for the Stirling project to include.

- Most projects take some account of drivers for change, some being the focus of the project in question.
- Some projects provide a traditional policy review without analysis of the relationship with different ecosystem services.
- A few studies explore the effects of different land management activities on ecosystem services.

One of the key outcomes from the Stirling demonstration is the identification of actions that integrate public policy objectives with local perspectives. Understanding the implications of different policy drivers for the provision of ecosystem services, and basing the development of scenarios (see below) on policy priorities will therefore be important in achieving this outcome.

3.3.6 Use of scenarios

Most of the studies and projects reviewed included an element of scenario work to explore the effect of different policy priorities on the provision of ecosystem services. Several highlighted the value of scenarios in highlighting and articulating some of the key choices and trade-offs. It was of particular importance for stakeholder engagement. Some scenarios were developed to reflect the character of the study area or the key issues being addressed by the project. Others reflected external drivers such as climate change and some studies simply adopted scenarios developed elsewhere (e.g. within the Millennium Assessment). Even where there was no formal scenario work, most studies considered the implications of different policy approaches.

The Cambrian Mountains study used four scenarios, based around the four ecosystem services included within the study, namely biodiversity adaptation, agricultural productivity, reductions in surface water run-off and carbon storage (not mutually exclusive). Polyscape mapping was used to explore the spatial implications of each scenario in isolation, in combination with the biodiversity adaptation scenario and in combination with all the other scenarios.

The Polyscape model, which was developed by Bangor University, combines spatial data with expert judgement to create user-defined 'rules' which highlight different priorities for the use and management of land. In the Cambrian Mountains study it was used to generate colour coded maps showing priorities for maintaining and enhancing existing land use and opportunities for changing land use, to deliver each of four scenarios. An innovative aspect of this project was the incorporation of these maps into three-dimensional representations of the landscape (based on Google Earth) which users can interact with.

These maps, and the assumptions that underpinned them, were used to inform debate with a sample of farmers and with other stakeholders, and to draw lessons about how interventions to enhance biodiversity adaptation can be planned and implemented.

The East of England pilot projects used a variety of different approaches to scenarios. In Marston Vale the work explored the implications of implementing aspects of the Forest of Marston Plan, including the objectives of landscape connectivity, restoration and the aspiration of achieving 30% tree cover.

Within the Cambridgeshire Fens, the work compared the effects of current patterns of water management with more positive catchment management. In the Blackwater Estuary, work explored the effects of sea level rise with and without managed coastal realignment, though it was recognised that the effects might vary significantly depending on where and how

managed realignment took place. In Norwich the focus was on exploring the effects of implementing the city's green infrastructure strategy.

With the Parrett catchment, scenarios were used to explore different patterns of woodland expansion, focusing on the objectives of carbon sequestration, habitat restoration and connectivity and flood control. The approach was used to map ecosystems potential – highlighting the best locations for new woodland, from an ecosystem services perspective. The report recognises that this approach could also have been extended to other topics.

The Macaulay work in the north-east of Scotland developed scenarios around some of the desired outcomes for the study area(s). It explored future woodland change with the aim of identifying areas where it would contribute to strategic objectives for the north-east, the Dee Catchment and the Tarland sub-catchment, developing scenarios based on existing woodland cover, biodiversity action plan objectives for farm woodlands, recreation and amenity objectives. Focusing more specifically on the Ythan catchment, the work explored the effects of different management scenarios highlighting in particular the implications for the Forvie National Nature Reserve. Scenarios were based around bringing more land into production, achieving higher crop yields, reducing fallow, applying more fertilisers and using flood controls to increase the extent of cultivatable land. Each of these options was considered in terms of changes in ecosystem services, taking account of UKCP09 climate change projections and an analysis of beneficiaries, spatial effects and temporal effects.

Key issues and options for the Stirling project to include.

- Most of the projects used an element of scenario work to explore the effects of different policies on the provision of ecosystem services.
- Some scenarios were based around the implementation or not of existing strategies and plans.
- Other scenarios were focused on different policy objectives, for example woodland expansion, flood management or food production.
- Some studies relied upon, or also included, scenarios produced by other agencies, including UKCP09 climate projections

The use of scenarios to explore different policy and land management futures should form part of the Stirling demonstration project. Some scenarios should be based on established national policy priorities. There may also be value in including stakeholder generated scenarios, building in climate change projections and using other socio-economic scenarios to test the study findings. Scenario work could include case studies focusing on individual land holdings or sites such as Flanders Moss.

3.3.7 Decision-making and action planning

The work in Otmoor was designed to inform the development of balanced policy objectives for the study area. However, the project encountered difficulties in balancing national and local priorities, citing the MoD use of an area for target practice which restricts wider access to an SSSI. The study report argues that there is a need for better top down and bottom up communication, with clearer explanation of national priorities to the local level, and reflection of local priorities in the development and application of national policies. The project report also argued for much better integration of policy development implementation, addressing, for example, perverse incentives which currently act against the provision of some ecosystem services.

Macaulay's work within the Ythan catchment highlighted the divergence of conservation objectives on the one hand and land management practices on the other. It recommended the development of a stakeholder based strategy to bring these two interests together. The Cambrian Mountains project confirmed the importance of partnership working, clear

communication of project objectives, engagement with key players and delivery via established mechanisms (in this case the Welsh Assembly Government's agri-environment scheme).

As noted above, Macaulay's work in the north-east of Scotland encountered data inadequacies in areas such as priority habitats, landscape preferences and regulatory services, which meant that the analysis process could not be completed and no decision or recommendation resulted. Several of the other projects were designed to test or pilot the ecosystems approach so the link to decision-making or policy development was not always apparent. Where there was a stronger link to policy, some studies highlighted the importance of ensuring that plans (and their assessment through the SEA process) are also based on an ecosystems approach.

Finally, a number of projects revealed differences in the views of stakeholders, or stakeholder disagreement with national policy drivers. The ecosystems approach, whilst revealing such areas of disagreement, and providing a framework to encourage informed discussion, does not provide a mechanism for resolving such conflicts completely.

Key issues and options for the Stirling project to include.

- A number of studies were of a pilot nature and did not progress to the decision-making stage. The key outcomes defined for the Stirling demonstration project make it clear that the study is intended to influence the provision of ecosystem services on the ground, and to provide an example that can inform work elsewhere. Decision-making will therefore be an integral part of the process.
- In one case, effective decision-making was prevented by a lack of good information with which to characterise the study area. This demonstrates the importance of identifying and evaluating the significance of any gaps in the evidence base early in the process, and using this to prioritise any additional qualitative or quantitative survey work.
- Some projects identified tensions between local views and national policy drivers without providing a mechanism to build consensus and resolve fully such disagreements. Some pointed to the potential for further stakeholder engagement, or a commitment to partnership working in helping to overcome disagreements and reach a decision. The design of the Stirling demonstration project should aim to build consensus as far as possible, though this can never be guaranteed.

3.3.8 Valuing Ecosystem Services

A number of studies set out with the aim of calculating the financial value of ecosystem services within a particular area. Sometimes this was confined to clearly measurable outputs such as agricultural produce. Others, such as the pilot study in the Bassenthwaite catchment, have taken a broader approach, attempting to place a value on a wider range of ecosystem services or benefits. The latter study identified 11 areas where the study area could make an economic contribution. Some of these were recognised as ecosystem services in their own right (products from the land (food and fibre), tourism, health and well-being, recreation, quality of place, biodiversity, flood alleviation and climate change and mitigation). Others were identified as the benefits that flow from ecosystem services rather than ecosystem services in their own right (economic development and investment, labour productivity, or land and property values). The study aimed to calculate Gross Value Added (GVA) using available information for the Bassenthwaite catchment or the wider area.

The Eftec research for the Forestry Commission found that some ecosystem services were easier to value than others. For example, while softwood timber production and carbon

sequestration were relatively straightforward to quantify and value, hardwood, non-woodland forest products and genetic resources proved more difficult. Some benefits were judged to be location dependent while for others a growing qualitative evidence base did not easily translate into attributable and measurable benefits.

Key issues and options for the Stirling project to include.

- Projects aiming to quantify and value ecosystem services have had mixed success, particularly where they have relied on existing measures and information relevant to the study area.

It is recommended that valuing ecosystem services should not be a primary objective of the Stirling demonstration project since this may further complicate the work and hinder effective engagement with stakeholders. It could be considered for a subset of services, or as a follow-on project.

3.3.9 Evaluation

Many of these studies were designed to develop and test application of an ecosystems approach, so it is not surprising that most include a commentary on the methodology as well as drawing broader conclusions for policy or land management. It is likely that most included some methodological refinement as the project progressed, though there are no examples of formal evaluation feeding back during the course of the project. The Sciencewise evaluation of public engagement pilot projects provides the most exhaustive comparison, though it is limited to one aspect of the ecosystems approach (stakeholder engagement) and is based on a limited number of examples.

Key issues and options for the Stirling project to include.

- Most projects included an element of evaluation, reflecting their pilot nature, though most were conducted as post project reviews rather than feeding into the project as it progressed.

Given the role of the Stirling study as a demonstration project, evaluation will be an important aspect of the work. This should include evaluation with feedback during the course of the project in order to identify and mitigate any methodological issues that arise, and evaluation against measures of success, based on the key outcomes defined for the project.

3.4 Stakeholder engagement

This section complements the analysis of stakeholder engagement within specific ecosystems approach projects to consider the broader approaches to stakeholder engagement.

As noted above, there can be different types of stakeholders to engage, e.g.:

- those directly affected by decision-making and that have a direct role to play in implementation (e.g. land managers);
- those indirectly affected within the study area (e.g. local communities);
- those external to the area but that are also affected (e.g. visitors, recreation users);
- organizations that help to shape policy in addition to the lead agency;
- those that are involved in ‘front-line’ delivery in implementing decisions.

Reasons for engaging stakeholders are often cited as being to:

- harness other people's energies and resources;
- explore issues and come up with fresh ideas;
- network, share ideas and best practice;
- assist in decision-making;
- inform;
- understand local needs and wants;
- encourage local buy-in and ownership of projects;
- achieve more sustainable results;
- better understand and monitor community perceptions;
- establish more open communication channels, gain trust and work on breaking down historic barriers.

The degree of stakeholder involvement can vary and is typically described as ranging from informing to collaboration – and as a result the degree of influence will be greater or less depending on the approach taken.

Table 2: Approaches to stakeholder involvement

- **DEGREE OF INFLUENCE +**			
INFORM	CONSULT	INVOLVE	COLLABORATE
Lead agency provides others with information to assist them in understanding the problem being addressed, the alternatives considered and the final decision made	Lead agency informs others about a decision-making process and also seeks their feedback on analysis, alternatives, and proposed decisions	Lead agency works directly with others to ensure their issues and concerns are understood, considered and directly reflected in the alternatives developed. Feedback is provided on how their input influenced the final decision	Lead agency collaborates with others in decision-making process, including the development of alternatives, and the formulation of the preferred alternative, while retaining ultimate authority for the final decision.

At its core, however, stakeholder engagement emphasises the importance of building the engagement process on common values and visions and being a 'two-way' process so that stakeholders "*have the opportunity to exchange views and information, to listen and have their issues addressed, be free from manipulation or coercion and lead to a long-term commitment from all parties*" (Sequeira *et al*, 2007).

A review of typical features of good practice in stakeholder engagement highlights the importance of stakeholder engagement processes:

- being developed early enough to have an effect on decisions;
- being informed as a result of relevant information being disseminated in advance;
- involving a representative group of stakeholders;
- being targeted at those that are most likely to be affected;

- being representative of stakeholders whether by gender, race, age, class, education or religion;
- not making commitments that cannot be delivered on;
- being meaningful to those consulted because the content is presented in a readily understandable format;
- being relevant to the stakeholder and the context they operate in whether local or global;
- putting in place strong internal processes to build consensus;
- using techniques that are culturally appropriate;
- using appropriate technology for the context, level of education or development of the stakeholders;
- being designed to be context-specific to reflect appropriate timescales, local realities and languages;
- utilising a documentation system to keep track of who has been consulted and key issues raised;
- having a system for feeding back and following up on issues raised during consultation as well as clarification of the next steps;
- being managed by staff that have facilitation and communication skills;
- having clear roles and scope about the objectives and activities to be achieved;
- involving clarity about key contact points on both sides.

The two key questions in designing an appropriate stakeholder engagement process are 'why' and 'how'. As noted above, previous work on stakeholder engagement on ecosystem services has perhaps fallen short in answering the 'why' question.

The why question will determine how to involve stakeholders and in particular will be important in determining the length and depth of the engagement process.

If, for example, the aim is to involve stakeholders in an ongoing approach to integrated land management, then the engagement process would need to consider ways of setting out to create a process that could lead to joint stakeholder involvement (collaboration) over an extended period of time, e.g. through the creation of a forum that brings together a mix of stakeholders. If, on the other hand, the aim was simply to involve stakeholders in feeding their views into a land use strategy document or commenting on it (consulting), then the stakeholder engagement might take a different form, e.g. survey work or a drop-in open day event.

In considering this specific project there would seem to be the opportunity to adopt the former approach and to view multiple and collective stakeholder input as central to both planning and implementation of an integrated approach over an extended period of time. The desk review suggests this is at the heart of the ecosystems approach. This also then raises the issue of helping to build 'capacity' through the process. Capacity would include the ability to work together, absorb new concepts, listen to each other, think collectively, help make decisions, and develop and implement action plans.

The "how" question is determined by the "why". If we are to assume that the study aims to involve/collaborate with stakeholders in an integrated approach to land management using the ecosystem services 'model' as a tool for this approach, then we can start to design a process that fits this requirement.

A key principle would then be to involve stakeholders at each stage of the development of this approach. If we were to take the Macaulay Institute Model Ecosystem Framework as an

example, we would want to design an approach that involved stakeholders in each of the steps.

In engagement terms this could be translated as:

- early engagement with stakeholders to explain the concepts and rationale of the study and approach and what is being proposed – both in broad terms (hoped-for outcomes) and in specific terms (explanation of ecosystem services);
- involvement of stakeholders in defining their area and its assets and needs and exploring how the area has changed – particularly with regard to land use and management. This could include identifying known examples of integrated land management planning and practice already operating in the area;
- involvement of stakeholders in using the ecosystem services 'tools' to identify ecosystem goods and services and 'attributing them to land systems, beneficiaries, governance and scale of provision';
- involvement of stakeholders in thinking through the contribution these goods and services make to human well-being;
- involvement of stakeholders in thinking about how the goods and services and contributions they make have been and are affected by change;
- involvement of stakeholders in looking at options about the development of policy and management; and
- involvement of stakeholders in decisions based on the appraisal of options and then subsequent monitoring and evaluation of impacts.

The benefits of this staged and joint approach to stakeholder engagement include:

- gradual building of trust between stakeholders;
- joint participation in planning and decision-making is more likely to reduce conflict among stakeholders and between stakeholder groups and public agencies;
- the development of 'common language' between stakeholders allows them to consider each other's views and opinions;
- the potential to develop sets of agreed priorities and action plans; and
- increasing willingness to work together to implement integrated strategies.

Key issues and options for the Stirling project to include.

- Recognising that stakeholders will include land managers and communities within the area, but also those living outside it who derive ecosystem benefits from it, and other external strategic and policy partners.
- Agreeing to work at the Involving/Collaborative end of the Spectrum of Participation.
- Designing stakeholder engagement that keeps in mind principles of good practice.
- Linking the requirement for integrated land use management with the need to involve a cross section of stakeholders and to engage with them jointly.
- The need to design a process that mirrors the 'steps' in an ecosystems approach to integrated land management planning.

3.5 Data availability

This section presents the results of an initial review of data sources which might be suitable for mapping ecosystem services in the Stirling study area. It follows the approach adopted in

the Natural England report on modelling ecosystem services. Further work is, however, required to evaluate the appropriateness of the datasets in terms of scale and the extent to which they are up-to-date and accurate. It would also be valuable to determine which data have trends or targets alongside baseline information. Datasets relevant to each ecosystem service are set out in Table 3, below.

The datasets identified below frequently act as proxies for ecosystem services and often provide little information on the functional status or health of the relevant ecosystems. Similarly, the extent to which information on the services actually delivered can be efficiently gathered requires further research – particularly in relation to regulating services where, although levels of pollutants, etc., can be confidently measured at single point locations, little information exists on the effects of – and on – ecosystems as a whole.

Where land management data is linked to Single Farm Payments delivered through SRDP Rural Priorities, a significant data 'black hole' exists, ostensibly due to the implications of the Data Protection Act. This makes it particularly difficult to understand management regimes, functions and services at a spatially-specific ecosystem level – thus a potentially rich source of information on inputs to and impacts on ecosystems is unavailable for analysis.

The review of datasets (Appendix 2) for the Stirling study area indicates that while there is information relating to most types of ecosystem service, the data have been collected for a range of specific purposes.

We anticipate there will be detailed issues, including:

- different scales of data collection;
- format of datasets (numerical, point, polygon, raster) affecting potential for integration;
- different approaches and standards for digitisation;
- effects of the original purpose of data collection (i.e. information that *was not* gathered);
- dates of data collection (and whether this is recorded in attribution or metadata);
- attribution and data structure;
- concordance of proxy data with ecosystem services.

Few of the datasets are likely to provide more than a snapshot view of the information in question, with few time series available to allow the analysis of trends, and few with defined targets or other thresholds of change. A more detailed scoping study is required as an initial step in the Stirling demonstration project to determine the extent to which these datasets can be used, and the need for additional qualitative work (e.g. through stakeholder involvement) or survey work. In addition, the data available for the Stirling area reveals the need for some detailed pilot work to understand the efficacy of a range of approaches to integrating and analysing the information available.

4. OPTIONS FOR DELIVERY

4.1 Introduction

This part of the report draws on the review of projects using an ecosystems approach, the analysis of available datasets and methods of stakeholder engagement to explore options for delivery of the Stirling Ecosystems Approach Demonstration Project. It explores the following themes:

- selection and definition of ecosystem services;
- data;
- analysis;
- scenarios;
- purpose of stakeholder engagement;
- stakeholder selection;
- engagement methods.

For each of these themes, the chapter outlines the main options identified from the review work, provides a summary of the principal advantages and disadvantages and draws preliminary (colour coded) conclusions in relation to each. This section also evaluates options in terms of the key outcomes defined for the project, and against the key risk for the project. The latter include:

- the availability of high quality, up-to-date data covering all relevant ecosystem services at an appropriate scale and format;
- the successful engagement of a representative sample of people across all the stakeholder groups;
- the successful engagement with these groups across a series of technical issues, concepts and exercises;
- the successful building of consensus within and between different types of stakeholder, and between local and national policy levels.

Tabular information is backed by descriptive text.

4.2 Selection and definition of ecosystem services

One of the key questions is which ecosystem services should be included in the study. Some studies focus on quite a narrow range of services, designed to reflect the policy focus of the project in question, the characteristics of the study area or available information. Others adopt a classification based on the Millennium Assessment approach, while a third group expand or refine these to ensure their relevance to stakeholders and the study area. A number of projects identify broader social and economic benefits derived from ecosystem services. Some also distinguish between the supply of services and the demand for, or consumption of services. Table 3 sets out an evaluation of the key options for the Stirling Ecosystems Approach Demonstration Project, highlighting key advantages and disadvantages, and assessing each against key criteria and the key risks identified for the project. The main points for each option are summarised below.

- The option of basing the selection of **a narrow range of ecosystem services** on the key management decisions would provide a simple approach, but could omit some important local services and sensitivities. This could conflict with a collaborative approach to stakeholder engagement, suggesting that discussions

would be quite narrowly defined. This could make recruiting a broad range of stakeholders and maintaining their involvement more difficult. It might therefore be difficult to build wider consensus around the study findings. While this kind of approach would limit the resources needed for the project, and the timescales involved, it might limit the demonstration value of the approach for areas with different issues. A focused approach would, however, allow analysis in greater depth and rigour. The limited focus of this option, and the risks around more limited stakeholder engagement lead us to conclude that this option would not help deliver the two key outcomes defined for the demonstration project.

- The option of **basing the selection of ecosystem services on the ecosystem and land use characteristics of the study area** provides a focused approach which should ensure that the study is tailored to reflect local issues. This will assist in narrowing the range of datasets that are required, and should help ensure that a representative spread of stakeholders can be engaged with the work, but that they are not burdened with analysis of ecosystems which are not relevant to the area. Ensuring that this broad range of interests is involved should help achieve the objective of identifying priority actions based on a measure of consensus. Tailoring the approach to the characteristics of the study area will help ensure that costs associated with data assembly and analysis are proportionate to the outputs. This is a reasonably pragmatic approach since it focuses on what is relevant rather than providing a comprehensive analysis of all ecosystem services. The approach would provide transferable lessons, though the detail, including the range of ecosystem services included in the study, would be specific to the Stirling project. This is the option that we consider most likely to meet the key outcomes defined for the demonstration project.

- The option of selecting **ecosystem services based on the availability of good information** represents a pragmatic approach, but could be very restrictive by excluding consideration of important services provided by the study area. This could make recruiting a broad range of stakeholders and maintaining their involvement more difficult. It might therefore be difficult to build wider consensus around the study findings. While this kind of approach would limit the resources needed for the project, the timescales involved and the risk associated with gaps in data, it could run into problems in identifying and fully evaluating priority actions. We conclude that this option would not meet the key outcomes defined for the demonstration project and might not provide a model which could be used effectively elsewhere.

- The option of using the **full 'suite' of ecosystem services**, for example as defined by the Millennium Assessment, would provide the most comprehensive approach, but could result in quite onerous requirements to analyse services with little relevance for the study area. It could raise unnecessary data requirements. This could have implications for costs and timescales, and could make stakeholder engagement less focused and relevant to people's interests. This in turn could result in people falling away from the project as it progressed. This approach could be considered as placing too much weight on rigour at the expense of developing and implementing a method that is pragmatic and resource efficient. We conclude that this approach would not meet the key outcomes defined for the demonstration project.

- The option of **expanding the standard suite of ecosystem services to include additional social and economic services** (such as employment or health) could bring benefits in making the process more relevant to local stakeholders. Methodologically, this could complicate the approach by blurring the distinction between different types of service, for example, defining 'cultural employment services' derived from 'provisioning services' provided by farmland or woodland. Several studies have addressed this issue by separately mapping out the social

and economic benefits derived from different ecosystem services. We conclude that there is value in drawing out a fuller range of social and economic benefits, but that this should be carried out as a further stage, once relevant 'standard' ecosystem services have been identified. This will help make the approach relevant to stakeholders and allow a fuller analysis of the benefits provided by nature but should do this in a way that is reasonably practical, avoiding unnecessary complexity.

We therefore conclude that an approach which focuses on those ecosystem services most relevant to the ecosystems and ecosystem functions within the study area, but which distinguishes between services and socio-economic benefits, may be most appropriate.

This implies a scoping process, similar to that undertaken in the East of England pilots based on identification of ecosystems, their functions and the services they provide. It might also favour the kind of network analysis approach used in the Thames Green Grid project.

It may be helpful to distinguish between the supply of services from ecosystems within the study area and the demand for these services (or the beneficiaries of these services) which may occur within the study area, within the broader area (e.g. Stirlingshire) or more widely. There may also be potential demand which could be realised, for example, by raising awareness of the availability of local produce (food provisioning) or recreation opportunities. There is a further, temporal dimension, with both the supply of and demand for ecosystem services changing as a result of changes within the study area (e.g. land management, development, recreation provision, or climate change) or more broadly (e.g. wider societal changes). Understanding the current (realised and potential) pattern of supply and demand will help identify stakeholders to involve in the study. Consideration of how these patterns may change can help inform the development of scenarios (see below), including a 'do nothing' baseline.

Table 3: Options - selection and definition of ecosystem services

	Options for the selection and definition of ecosystem services					
	Selection of narrow range of ecosystem services relating to key management decisions	Selection of those ecosystem services most clearly provided by the study area	Selection of those ecosystem services where good information is available	Adoption of standard 'MA' based suite of ecosystem services	Expansion of standard suite to include additional social and economic services	Identification of separate range of social, cultural and economic benefits derived from ecosystem services
+	Simple and focused approach	Pragmatic, based on analysis of local ecosystems	Pragmatic, based on analysis of available information	Most likely to be comparable with other studies	More comprehensive and relevant to local stakeholders (e.g. health, employment, etc.)	Possible clearer flow from function through services to socio-economic benefits
-	May omit locally important sensitivities Limited value in piloting the approach		May prove unnecessarily restrictive	Lack of tailoring to local circum-stances, possible underplay of social and economic benefits	Risk of blurring between services and benefits	
KEY CRITERIA						
Potential cost						
Timescale/ programme						
Transferability elsewhere						
Pragmatism vs rigour						
RISKS						
Data availability						
Representative stakeholders						
Engagement process						
Consensus building						
SUMMARY						
=						
EXAMPLES						
e.g.	Cambrian Mountains Otmoor Glasgow drainage	East of England projects	Otmoor based on existing datasets	Few studies seem to maintain a standard set of MA ecosystem services	East of England projects	North East Scotland project Thames Green Grid

4.3 Data

Assembling an information base with which to map and potentially quantify ecosystem services has been a challenge faced by most projects reviewed in the study. The following options reflect the imperfect and incomplete nature of baseline data. Table 4 sets out an evaluation of the key options for the Stirling Ecosystems Approach Demonstration Project, highlighting key advantages and disadvantages, and assessing each against key criteria and the key risks identified for the project. The main points for each option are summarised below.

- The option of **confining analysis to high quality datasets** would support a rigorous approach but is unrealistic given the incomplete and in places dated nature of datasets for the study area. This approach might highlight the need for additional work to bring the evidence base up to standard, with implications for costs and programme. This approach could be considered as placing too much weight on rigour at the expense of developing and implementing a method that is pragmatic and resource efficient. Depending on the constraints created by available data, this could hinder stakeholder engagement. Gaps in data could make analysis and decision-making difficult, hindering the ability to influence action on the ground and making it less likely the approach would be used elsewhere. We therefore conclude that this option would not meet the key outcomes defined for the demonstration project.

- The option of **making best use of existing datasets** whilst highlighting key gaps and inadequacies is a more pragmatic approach, but could still result in significant data deficiencies which would hinder analysis, stakeholder engagement, decision-making and the identification of actions on the ground. While the approach would be transferable, concerns about the quality of outputs might discourage its use elsewhere. We conclude that this option would not meet the key outcomes defined for the demonstration project.
- The option of **supplementing existing datasets with qualitative information** based on expert and wider stakeholder knowledge would provide a practical approach to addressing shortcomings in existing information. It could also provide a key focus for stakeholder involvement early in the project, underlining the value of people's engagement with the process, and tapping into sources of local or expert knowledge. It could also allow analysis at more detailed scales not supported by existing datasets (e.g. with respect to individual land holdings or sites such as Flanders Moss). The source and status of different data would need to be clearly stated, and there is a risk that there might be a lack of agreement among participating stakeholders. This option would be resource and time efficient and while the actual outputs might not be transferable, the principle of filling gaps with qualitative information would be. Depending on the nature of gaps in baseline information, we conclude that this option could be most effective in helping to achieve the key outcomes defined for the demonstration project.
- The option of **supplementing existing datasets with bespoke surveys** may be necessary where there are significant gaps in baseline information and where stakeholder engagement is not likely to provide suitably robust data. This would provide good information, tailored to the aims of the project and the study area, but would incur additional costs and could have implications for the project timescale. Definition of new data collection could be considered with the involvement of stakeholders, and there could be a role for their involvement in data collection and analysis. This would emphasise the value of their involvement in the project. Careful design would be needed to avoid producing 'one-off' information, with the aim to define approaches that could be used in other projects based on an ecosystems approach. We conclude that the option of carrying out additional survey work should be evaluated during the early stages of the project, based on consideration of the significance of data gaps, the cost and programme implications and the scope for stakeholder involvement in defining and possibly conducting survey work. It is likely that this would produce methodological lessons for other projects and could help support identification of priority actions within the project area.

Table 4: Options - data

	Options for the use of data			
	Limit analysis to datasets which are up to date, at the correct scale and include baseline, trend and target information	Make best use of existing datasets, highlight key gaps and inadequacies	Supplement existing datasets with qualitative information based on expert and wider stakeholder knowledge	Supplement existing datasets with bespoke surveys
+	Rigorous approach	Pragmatic	Pragmatic and provides a good initial focus for stakeholder engagement Would allow analysis to drill down into more detail	Potential for good information tailored to the study aims and study area
-	Unrealistic given the dated and incomplete nature of available datasets	Gaps in data may hinder analysis and weaken study findings	May be differing views Lack of quantification	Time and cost implications Limits the value of the study in developing a repeatable approach (but could build the case for a standardised approach)
KEY CRITERIA				
Potential cost				
Timescale/ programme				
Transferability elsewhere				
Pragmatism vs rigour				
RISKS				
Data availability				
Representative stakeholders				
Engagement process				
Consensus building				
SUMMARY				
=				
EXAMPLES				
e.g.	No projects achieved this level of rigour	North East Scotland – data problems prevent successful conclusion	SNH Climate Conversations	Few examples from the studies reviewed

Most studies have found that available datasets are imperfect, with issues including purpose, scale, age and coverage. Where data are available, they usually provide a baseline picture, but do not often cover trends or targets. Several projects have pointed to the need for a more standardised approach, tailored to the needs of an ecosystems approach, and there is acknowledgement that this may happen over time as this approach becomes more embedded.

We conclude that there is a need for a pragmatic and transparent approach, using and qualifying existing data where appropriate, but also supplementing this with qualitative information derived from stakeholder engagement. This will provide a clear focus for stakeholder engagement, although it may reveal differing views and opinions.

There may be some benefit in carrying out additional surveys where there are information gaps relating to key ecosystem services, though this is likely to have time and cost implications, and may limit the transferability of the current approach.

4.4 Analysis

There are a range of options relating to the nature and complexity of data analysis to identify, map and potentially quantify ecosystem services. Table 5 sets out an evaluation of the key options for the Stirling Ecosystems Approach Demonstration Project, highlighting key advantages and disadvantages, and assessing each against key criteria and the key risks identified for the project. The main points for each option are summarised below.

- The option of using **network analysis** can help improve understanding and communicate the links from particular ecosystems or land uses to different ecosystem services in a simple and comprehensible way, complementing the use of spatial analysis of where such services are provided. The approach can also be used to map out the links from ecosystem services to socio-economic benefits such as employment or health and well-being. The approach can be used to indicate the scale or significance of links from ecosystem to services to socio-economic benefits. This should support stakeholder engagement and consensus building. The method is cost and time efficient. Since it does not provide a spatial analysis, it does, however, need to be accompanied by GIS-based mapping. We conclude that this form of analysis could help deliver the key outcomes of the demonstration project.
- The option of carrying out **GIS mapping** is common to most similar studies based on an ecosystems approach. It provides a powerful means of mapping the distribution of different land uses and ecosystems and analysing the pattern of ecosystem service provision. This can support engagement with stakeholders, bringing the discussion to life. Inevitably, it depends on the availability of adequate information and the definition of assumptions relating to the provision of ecosystem services associated with different ecosystems (e.g. the rate of carbon sequestration from woodland, or the use of core paths by local communities for recreation). GIS can be used to combine 'layers' for different ecosystem services, though this can raise questions about the relative importance of different services. We conclude that this form of analysis could help deliver the key outcomes of the demonstration project, provided data issues and assumptions are clearly stated.
- The option of **Bayesian and other forms of statistical analysis** can be used to combine different spatial datasets and model the effects of land use changes on the range of ecosystems that deliver ecosystem services. These kinds of approaches are complex, depend on relatively good baseline information and can integrate quantitative and financial evaluation. We have reservations about moving to this level of complexity given the quality of baseline information, questions about the relative importance/scale of different ecosystem services and an observation from a number of projects that too much sophistication can in fact discourage effective stakeholder engagement (potentially compounding the challenges presented by the novelty of the wider approach for many people). Effective analysis of this kind could be demanding in terms of cost and programme timescales.
- The option of **valuing ecosystem services** is designed to place services on a level playing field and to demonstrate the economic contribution derived from nature. There are a range of methods, with considerable research underway in this area. Some services (e.g. food production) are more straightforward to measure and value than others (e.g. inspiration or primary production). This would represent an additional level of analysis which would add to the costs and timescales of the project, and which might not support consensus building among stakeholders. One option would be to carry out an evaluation of services derived from the study area and an assessment of how they would be affected by different policy or land management futures, as a further study, following on from the demonstration project. Alternatively, there could be some scope to attempt a quantification of perhaps a subset of ecosystem services, or perhaps the socio-economic benefits derived from them. We conclude that the option of valuing ecosystem services is not essential to achieving the key outcomes defined for the demonstration project. It could be considered as an additional layer of analysis.

Table 5: Options - complexity of analysis

	Options for the analysis of ecosystem services			
	Network analysis, mapping out the range of services provided by different 'ecosystems' within the study area	GIS mapping	Bayesian analysis to combine different spatial datasets	Quantification and valuation of ecosystem services
+	Can help understanding of the links from ecosystems to services to benefits.	Powerful means of analysing the supply of ecosystem services based on the location of key ecosystems and land uses	Potentially helpful way of modelling the provision of services and the effects of different policy or land management futures	Can help add weight to the importance of ecosystem services, and thus to the ecosystems that provide them
-	Does not have a spatial dimension	Depends on adequate spatial data and clear expression of assumptions relating to the association between land uses/ecosystems and the provision of services	Evidence that complexity of analysis can discourage stakeholder engagement May involve assumptions and can underplay the complexity of relationships between ecosystems and services	Some services easier to measure and value than others
KEY CRITERIA				
Potential cost				
Timescale/ programme				
Transferability elsewhere				
Pragmatism vs rigour				
RISKS				
Data availability				
Representative stakeholders				
Engagement process				
Consensus building				
SUMMARY				
=				
EXAMPLES				
e.g.	Thames Green Grid	Thames Green Grid Parrett Catchment	Defra pilot project review	Eftec forests study

We conclude that an approach based on a combination of network analysis and GIS based mapping of ecosystems/land uses and associated services would provide a pragmatic and cost effective method for analysing ecosystem services derived from the study area, as well as supporting stakeholder engagement. This approach is most likely to help meet the key outcomes of the demonstration project, informing the identification of priority actions designed to increase provision of ecosystem services and establish a method which is practical and can be applied elsewhere.

We are concerned that more complex statistical analysis could discourage stakeholder engagement as well as raising methodological concerns about data, assumptions and weighting. There could be a role for some valuation of ecosystem service provision, either as a separate follow-on project, or focused on a subset of more easily measurable services.

4.5 Scenarios

Most projects reviewed use some form of scenario analysis to gauge the effects of different policy or management options on the provision of ecosystem services. Table 6 sets out an evaluation of the key options for the Stirling Ecosystems Approach Demonstration Project, highlighting key advantages and disadvantages, and assessing each against key criteria and the key risks identified for the project. The main points for each option are summarised below.

- An option which includes **no use of scenarios** would not explore the ecosystem implications of future policy and management objectives. While the analysis would be relatively straightforward, confined to the baseline provision of services, the omission of scenario work would mean that the direct and indirect effects of different policy or management options on the provision of services could not be considered in a comprehensive way. The review of other ecosystems approach projects suggests that the definition and analysis of scenarios can be a powerful means of engaging with stakeholders and working towards consensus on priority actions or recommendations. We conclude against an approach that does not include some use of scenarios to examine the provision of ecosystem services under different policy or management futures.

- An option based on the **testing of existing policy options** would helpfully explore the implications of the current policy framework, but would not consider how this might develop either in response to a better understanding of the provision of ecosystem services, or to reflect local perspectives. We conclude that this option would not meet the key outcome of delivering improved benefits from nature, nor would it fully integrate local perspectives with existing or future public policy objectives.

- An option based on **testing real policy options** would provide a potentially powerful way of exploring the implications of different policy and management options or emphases – individually and in combination. Stakeholders could be involved in defining and evaluating the scenarios. Inevitably this kind of approach would involve assumptions about how different policy options might play out on the ground (e.g. where might new woodland be created, how much and of what kind?), but this could be clearly stated and informed by knowledge and information about the study area (e.g. mapping being undertaken as part of the forestry and woodland strategy preparation). We conclude that, depending on the range of policy options included in this part of the work, this use of scenarios could provide a powerful means of engaging with stakeholders, informing the identification of priority actions and balancing policy objectives and local perspectives.

- An option which includes the use of **theoretical socio-economic scenarios** (e.g. those associated with UKCIP02 climate change projections) can be helpful in testing the extent to which the project findings stand up under very different political and socio-economic futures. They can appear abstract and may complicate the process of stakeholder engagement. We conclude that they would be helpful in testing the sensitivity of the project findings, but that this should be a qualitative process, undertaken as a technical exercise in parallel with the development and evaluation of the study scenarios.

- An option which builds in **future climate change** in the form of scenarios derived from the UKCP09 Climate Change Projections will help ensure that the identification of priority actions is informed by the best available information on how factors influencing the provision and consumption of ecosystem services derived from the study area may change in the future. Inclusion of this information within the study scenarios will provide another dimension to the stakeholder engagement, increasing understanding of how climate change may affect the area, and highlighting the current and future importance of services relating to mitigation and adaptation activities. Our experience suggests this can help build consensus around the implementation of public policy at a local level. We conclude that this will establish good practice that can be used elsewhere, and will help ensure that priority actions are fully informed and realistic.

Table 6: Options - use of scenarios

	Options for the use of scenarios				
	No use of scenarios	Testing of existing policy options	Scenarios based on real policy options	'Theoretical' socio-economic scenarios	Inclusion of climate change scenarios
+	Simple analysis of the current provision of ecosystem services	Effective way of testing the implementation of LBAP, FWS, SRDP, etc	Potentially powerful way of exploring the implications of different policy and management options or emphases – individually and in combination Stakeholders can play a role in shaping scenarios	Can be used to 'sensitivity test' the project findings	Helps ensure that projected climate changes are built into analysis, depending on the timescale for scenario work
-	No analysis of the effects of different policy or management futures Scenarios provide a good tool for stakeholder engagement	Would not explore alternative policy of management futures Would not allow stakeholders to help shape scenarios		Can appear as being abstract May not be helpful in shaping policy	
KEY CRITERIA					
Potential cost					
Timescale/ programme					
Transferability elsewhere					
Rigour					
RISKS					
Data availability					
Representative stakeholders					
Engagement process					
Consensus building					
SUMMARY					
=					
EXAMPLES					
e.g.	All projects reviewed used some form of scenario or policy option analysis	East of England : Marston Vale	Parrett catchment North East Scotland		North East Scotland

The review of past studies found widespread use of scenarios to explore the implications of different policy or management futures**. Our view is that they can be most valuable when used to test the effects of different policy emphases (individually or cumulatively) on the provision of ecosystem services (and socio-economic benefits).** Such scenarios could include the 'do-nothing' scenario (based on the implementation of existing policies) and different policy emphases (such as food production, flood management, carbon reduction, woodland expansion) or based on the policy objectives of initiatives such as the Central Scotland Green Network. Stakeholders could be involved in the identification and subsequent evaluation of these scenarios.

Depending on the timescale for such scenarios, there may be value in factoring in wider contextual changes. At the very least, these should include information from the UKCP09 climate change projections. There may also be a case for using wider socio-economic scenarios to explore how outcomes could change under different national 'policy' futures. A number of such suites of scenarios exist and we understand there are discussions about developing a Scotland specific set of scenarios to ensure read-across between different studies and projects (Mike Smith, pers. comm.)[4]. We suggest that the use of these kinds of

[4] Mike Smith, Forest Research, private communication, March 2012

scenario should ideally be limited to testing the project specific scenarios, and could probably take the form of a qualitative commentary rather than a more complex quantitative analysis.

4.6 Purpose of stakeholder engagement

Most projects reflect the principle of engaging stakeholders within an ecosystems approach, though there are considerable differences in the purpose or objectives of such engagement. Table 7 sets out an evaluation of the key options for the Stirling Ecosystems Approach Demonstration Project, highlighting key advantages and disadvantages, and assessing each against key criteria and the key risks identified for the project. None of these options is mutually conclusive and we conclude that a collaborative approach, based on a combination of all these purposes, provides the most effective means of meeting the key outcomes defined for the demonstration project.

Evidence from other projects confirms the significant value that stakeholders can contribute to the studies based on an ecosystems approach. Several projects highlight the importance of clearly communicating the purpose of stakeholder engagement (including ensuring the benefits to participants are highlighted). While projects have involved stakeholders at different stages in the process, we conclude there are good reasons for such involvement throughout the process, from the point of confirming the study area to the consideration of choices and trade-offs and the setting of recommendations for policy development or decision-making. This level of engagement will help build ownership and engagement with the process as well as tapping into local sources of knowledge which may be particularly valuable if the baseline data is incomplete. It also reflects the principles of an ecosystems approach defined by the Convention on Biological Diversity described in Section 2 of this report.

It is important, however, to note a number of provisos. Firstly, several studies note that effective engagement requires a significant investment of time and resources for preparation, organisation, facilitation and reporting. Secondly, experience suggests that while stakeholder engagement can help build consensus by mapping out relationships and interdependencies more clearly, it will not always achieve total agreement, sometimes revealing differences between stakeholders, or tensions with national policy priorities. Thirdly, some studies found that some stakeholders find it easier to contribute in relation to some types of ecosystem services than others.

These issues suggest that **stakeholder engagement should be seen as a contributor to an ecosystems approach alongside the more technical and policy dimensions of the work, rather than as a primary driver for policy development and decision-making**.

Table 7: Options - purpose of stakeholder engagement

	Options for the role of stakeholders					
	Confirm study area	Help fill gaps in baseline evidence	Identify and evaluate ecosystem services	Develop scenarios	Evaluate scenarios – choices and trade-offs	Inform policy and land management decisions
+	This can be helpful in defining the area that a community identifies as its patch and can set this alongside the views of other 'technical' stakeholders	Can tap into sources of local knowledge Can underline the importance of stakeholder involvement Can help fill gaps in knowledge	Provides a valuable input to the analysis of ecosystem services, feeding in alongside the technical analysis (network analysis, GIS mapping, etc.)	Provides a valuable input to the identification of policy and management options that have local resonance	This can provide a key focus for stakeholder engagement, and can add value to the project as a whole Can help build consensus by demonstrating implications of different options	Clarity is needed on the extent to which decisions are being driven or informed by stakeholder engagement
-	May be less helpful for larger study areas involving several communities May have implications for data collection and for the read-across with key policy documents or mechanisms	May reveal divergent views on the provision or importance of different ecosystem services – though better to identify earlier rather than later in the process Information will need clear attribution	May reveal divergent views on the provision or importance of different ecosystem services – though better to identify earlier rather than later in the process	Needs to be accompanied by identification of options based on existing and potential policy priorities	May not achieve full consensus, with possible differences between different types of stakeholder and between national policy and local priorities	May not achieve consensus May be differences between national policy and local priorities Use to inform rather than determine decisions?
KEY CRITERIA						
Potential cost						
Timescale/ programme						
Transferability elsewhere						
Rigour						
RISKS						
Data availability						
Representative stakeholders						
Engagement process						
Consensus building						
SUMMARY						
=						
EXAMPLES						
e.g.	Thames Green Grid SNH Climate Conversations	SNH Climate conversations	East of England – Cambridgeshire Fens	Parrett catchment	Cambrian Mountains	Suggested as means of resolving conflict in North East Scotland project

4.7 Which stakeholders?

There are also differences in the types of stakeholders who can be involved. Table 8 reviews the potential involvement of a range of different types of stakeholder in the Stirling Ecosystems Approach Demonstration Project, highlighting key advantages and disadvantages, and assessing each against key criteria and the key risks identified for the project. Involving all these stakeholders is central to the identification of priority actions which integrate and balance public policy objectives and local perspectives. We therefore conclude that all should be engaged within the process.

Building on the approach adopted in the Parrett Catchment project which defined stakeholders quite broadly and placed them into a number of categories, **we suggest distinguishing between 'strategic policy and decision-makers', 'front-line deliverers',**

land managers, communities within the study area and beneficiaries or consumers of ecosystem services from outside the study area.

There are very good reasons to involve the first four of these groups at key points in the project, although a number of key issues have been identified including:

- time and scheduling issues which may affect the involvement of key policy and decision-makers and, depending on the time of year, land managers;
- the challenges of securing a representative selection of people from local communities in terms of age, social group, interest and location;
- the importance of ensuring that engagement extends beyond the 'usual suspects', highlighted by several studies.

Previous sections have suggested distinguishing between the supply of ecosystem services and the demand or consumption of such services. Some of this demand for ecosystem services is likely to be found outside the study area, for example by residents in Stirling benefiting from the regulation of river flows, visitors enjoying recreation within the area or, at a broader level, the global benefits of carbon sequestration and storage. Ideally, the project would identify and include stakeholders representing these types of demand for ecosystem services. However, there are practical issues in identifying and involving such stakeholders, particularly as distance from the study area increases and the strength of the link diminishes. One option would be to target specific groups (e.g. visitors or residents of Stirling) and tailor engagement methods around them, but to use 'policy' stakeholders to represent more distance or higher level services occurring outside the study area.

Table 8: Options - types of stakeholders

	Strategic decision-makers (e.g. agency and local authority policy staff)	**Front-line deliverers** (e.g. forestry officers, rangers, area officers, access staff, NNR managers)	**Land managers**	**Study area residents**	**Beneficiaries of ecosystem services from outside the study area**
+	Critical to have policy makers and decision-makers involved in the study, providing the policy interface	Critical to have this group involved, to contribute to analysis of ecosystem services and assist in the development of scenarios	Critical to have this group involved, to contribute to analysis of ecosystem services and assist in the development and evaluation of scenarios	Critical to have this group involved, to contribute to analysis of ecosystem services and the development and evaluation of scenarios	Potentially valuable to include 'downstream' stakeholders and groups such as visitors to the study area, representing 'demand' for ecosystem services from outside the study area.
-	Time demands Scheduling relative to public engagement		Time demands	Achieving a representative cross section – ages, social groups, interests, communities	Difficulties in identifying reps from all such beneficiaries – perhaps focus on local level? Harder sell required in terms of securing their involvement
KEY CRITERIA					
Potential cost					
Timescale/ programme					
Transferability elsewhere					
Rigour					
RISKS					
Data availability					
Representative stakeholders					
Engagement process					
Consensus building					
SUMMARY					
=					
EXAMPLES					
e.g.	Parrett Catchment East of England – Marston Vale	Parrett Catchment Otmoor	Cambrian Mountains Otmoor	Otmoor SNH Climate Conversations Sciencewise pilots	East of England – Marston Vale Otmoor

4.8 Engagement methods

The most common forms of engagement are shown in Table 9, below.

Table 9: Stakeholder engagement methods

Method	Explanation	Pros and Cons
Questionnaire	Formalised set of questions sent out to respondents, e.g. by mail, telephone or internet.	Limits active involvement of stakeholders to responding to questions and suggestions. Little opportunity for dialogue. Enables access to large samples of individuals.
Delphi Survey	Reiterative survey with feedback loop.	Reiterative nature of survey and opportunity to give and receive feedback provides basis for indirect dialogue between participants. Can be time-consuming….
Focus Groups	Small invited groups usually selected to represent specific stakeholder groups who meet once or a few times at the behest of the organiser.	Enables active and wide-ranging discussion, which allows participants to have formative role in assessment. Can be time-consuming and difficulties can arise in ensuring fair representation of stakeholder groups and balanced debate among participants.
Citizens' Panel	Relatively large, demographically representative panel who are surveyed regularly and may meet – to elicit advice.	Provides sustained dialogue with a large group of individuals but difficulties arise in ensuring representation and maintaining membership and can be costly to sustain.
Stakeholder Partnership	Long-standing group of individuals representing different stakeholders who meet on a relatively frequent basis to discuss and advise on policy and decision-making issues.	Permanency of groups helps to build deeper insight and trust and give continuity of stakeholder input. Members may become detached from stakeholders they represent, and inequalities within the group may become permanently established, biasing the process.

It may be appropriate to consider using different methods to engage different stakeholders. For example, web-based questionnaires could be used to enable those from outside the area to participate in the engagement while seeking to establish stakeholder focus group(s) within the area.

As noted, there is the potential to involve stakeholders in a 'staged' process that reflects the 'steps' in an ecosystems approach. This could involve the establishment of a focus group or panel of stakeholders from across the area and across different stakeholder types that met several times to 'work through' the process. It is thought that this approach would be most likely to be able to allow for and deliver the ingredients for good practice that have been identified.

Decisions would need to be made about the breadth of stakeholder involvement within the area and how best to make that 'representative' of a cross section of interests. This could include a spread of geography, community, age and, in particular, interest (with land

manager, community, recreation, environment, heritage, business and 'front-line deliverers' interests all represented).

There is also an interesting decision to be made about the extent of participation of strategic and policy experts. In previous engagement processes their involvement has been beneficial but has also sometimes been limited to some but not all focus group meetings.

In view of the pros and cons of this approach we would highlight the need for careful facilitation of focus group meetings to ensure balanced debate among participants.

5. PREFFERED APPROACH

5.1 Introduction

This section of the report maps out a preferred approach for the Stirling Ecosystems Approach Demonstration Project.

5.2 Approach

The study should base the inclusion of ecosystem services on the characteristics of the study area. An initial scoping exercise would identify the principal ecosystems (including land uses) and the main ecosystem services associated with these (high, medium, low, none).

The study should differentiate between the supply of services from within the study area, and the consumption or demand for services that may occur within, or outside, the study area. It may be necessary to distinguish between beneficiaries of ecosystem services at local, strategic and global scales, and between services which are currently provided or have potential to be provided given certain actions or interventions.

Consideration should be given to the separate identification of socio-economic benefits flowing from ecosystem services.

5.2.1 Data and analysis

Once the range of relevant ecosystem services has been identified, metadata should be analysed to determine which areas have good information, which areas have data deficiencies, and which areas lack information altogether. An assessment at this stage will need to consider how significant such gaps and deficiencies are, whether they can be addressed through qualitative or proxy data, or whether new survey information is required. From an initial assessment of data for the area, we anticipate that there will be data gaps and issues particularly in relation to:

- the function and health of ecosystems providing services;
- the regulating effects of ecosystems at the macro scale (i.e. beyond individual point monitoring data);
- effectively measuring, or developing proxies for, more nebulous cultural and spiritual responses;
- the ability of data to be incorporated within Bayesian belief networks for modelling purposes; and
- the ability of metrics to contribute to valuation of ecosystem services.

The decision to carry out new survey work should be evaluated in terms of the significance of the data gap, the time, cost and replicability of any survey work.

Network analysis should be used to explore the linkages from different ecosystems and land uses to ecosystem services and socio-economic benefits. This should consider the strength and significance of different links. This type of analysis could be used to evaluate the influence of different policy drivers, land management activities or other ‘pressures’ affecting ecosystems in the study area.
GIS analysis should be used to explore the spatial patterns associated with the supply of different ecosystem services. Assumptions and scoring classifications will be needed to guide this process.

Depending on the time horizon for the project, climate change projections should be factored into the analysis of ecosystem services.

It may be appropriate to carry out some quantification and valuation of a limited number of ecosystem services – principally in terms of provisioning services.

Scenarios should be used to explore different land use policy emphases. These should be defined in discussion with stakeholders, but should focus around key areas where policy intervention could have an influence in the future. These could include the influence of national policy drivers such as those outlined in Section 3, including policies to mitigate and adapt to climate change, promote integrated land management, improve water quality, or address flood risk, together with broader initiatives such as the Central Scotland Green Network which embrace many of these objectives in an integrated way. Scenarios could also be used to explore options less constrained by existing policies, and should provide an opportunity for local stakeholders to contribute to the definition of possible futures.

A number of scenarios would then be worked up with illustrative maps and graphics to show what they might mean for the study area. For example, if the focus of a scenario was on woodland expansion, the aim would be to illustrate the type, form and location of new woodlands in line with relevant forestry and woodland frameworks. If the focus was on sustainable flood management, it might highlight areas of moorland restoration, the recreation of natural floodplains and areas of new woodland planting. The illustrative nature of these scenarios would need to be emphasised to avoid giving the impression that measures were being imposed on land owners and managers. Stakeholder discussions would provide an opportunity to identify more 'concrete' options, but the emphasis would probably need to remain on the types and broad locations of different actions, unless key land owners and managers were present and in agreement.

Working with stakeholders, each scenario would be evaluated in terms of the like effect on the provision of ecosystem services when compared with the existing baseline. This would identify those services which would increase, remain unchanged or decrease under the scenario in question. The discussion would then move on to consider how negative effects could be reduced and benefits increased, exploring opportunities for multi-benefit solutions as well as the potential need to balance benefits in one area with disbenefits in others. Work on individual scenarios would be used to inform the development of an integrated vision for the area, designed to limit trade-offs and maximise synergies.

Broader projections and socio-economic scenarios should be used to sensitivity test the provision of ecosystem services (baseline+climate change) and each of the scenarios (scenario+climate, change+socio-economic scenarios). This should be a qualitative analysis, producing a commentary, rather than a more detailed and quantitative assessment. This would help determine the extent to which the findings of the project could be affected by changes in the way that society, its economy and political systems develop in the future.

5.2.2 Engagement

The study should adopt a collaborative approach to the way that stakeholders are involved in the study. Different types of stakeholder should be identified, and an engagement strategy developed for each.

Potential groups could include policy and decision-makers (e.g. agency and local authority officers), front-line deliverers (e.g. area staff, rangers, NNR managers, etc.), land managers (agriculture, woodland, moorland), study area residents and external visitors and consumers of ecosystem services. Building on the findings from the review, these stakeholder groups could be identified as follows:

- policy and decision-makers, together with front-line deliverers, should be identified in discussion with the project partners;
- land managers should be identified with the involvement of NFUS and Scottish Land and Estates, and through existing community networks and organisations;
- local residents should be identified through existing community networks and organisations. This group should include local non-land based businesses, particularly those with an involvement in recreation and tourism;
- key visitor and recreation sites should be used to reach visitors to the area;

- we propose that external beneficiaries of ecosystem services should be represented by policy and decision-makers.

Lists of stakeholders to engage with can be compiled with the assistance of local access officers, community learning and development officers, community planning officers and local Community Trusts as well as other 'front-line staff'. We would note that Community Trusts in the area that have compiled their own Action Plans and will have as part of that process held up to 20 stakeholder meetings with a range of interests including land managers, recreation users, tourism businesses, environmental groups, heritage groups and outdoor recreation groups.

The key principle should be to convene a number of focus group meetings in the study area that relate to the steps in the ecosystems approach. There is a question about whether these should be:

- separate focus groups for the different stakeholders leading to joint meetings of different stakeholders once initial separate meetings have been held;

- multi-stakeholder focus groups that work collectively through the process together from the start.

On balance, **our recommendation would be to use multi stakeholder focus groups from the start as this would be most likely to build collaborative working and joint understanding**.

There are not, as far as we can identify, any unifying networks or forums for the Carse area – despite the commonality of the landscape and heritage – and this work would be an opportunity to create a forum that may have a future resonance and purpose for the collective and integrated management of the area. This potential emerged in previous work in the Carse of Gowrie (Land Use Consultants, 2011) with a number of disparate communities and interests realising the opportunity that might come from working together at this 'landscape scale'.

Joint focus group meetings should aim to have around 30 people attending a series of meetings to work through the process. This should involve representatives from the different stakeholder groups that also reflect a spread of communities, age groups and gender within the study area.

The focus group approach could be complemented by web-based support that enables input from other stakeholder interests from outside the area. It may be possible to develop some of these additional methods following discussion with the locally convened focus groups – thereby involving the stakeholders in expanding the engagement process themselves.

An early task should be the development of a vocabulary more suited to engagement with communities, land managers and other stakeholders within the study area. A key objective should be to demonstrate the relevance of the work to each of the stakeholder groups. The involvement of non-agency stakeholders should be recognised in the status afforded to the stakeholder group (e.g. reference to 'Future landscapes panel' or similar), provision for a limited amount of catering (e.g. soup and sandwiches) ahead of each meeting, and either rewards such as book tokens or a raffle of local produce.

Stakeholders should be involved in defining the study area, confirming and evaluating the provision of ecosystem services, helping to fill gaps where baseline data is deficient, helping to define the range of policy and land management scenarios included in the study, the evaluation of these scenarios and discussions about the key trade-offs and land management policy decisions relating to the area.

There are opportunities to build additional qualitative data collection – particularly in relation to social values of ecosystems – into any programme of consultation. However, a clear

understanding of the potential value added from these metrics should be established to determine whether the costs involved will be met by the quality and usefulness of data returned.

The process should be mindful of the opportunities for action research arising out of the stakeholder engagement process. This emerged as a potential outcome from the Carse of Gowrie study and would need to be supported. The involvement of 'front-line delivery' stakeholders will assist in making this connection. There may also be an expectation for continued involvement and support of agencies in delivering the desired outcomes identified by the project.

While the aim should be to develop consensus, it is possible that this will not be achieved fully and that policy development will need to be informed by rather than being driven by the process of stakeholder engagement.

5.3 Preliminary project process

This section maps out a proposed process for the Stirling demonstration project, indicating how the technical and stakeholder components of the work will be combined. The process is based around five meetings of a stakeholder group over a period of six or more months. Key steps in the process would comprise:

- preparation
- recruiting stakeholders
- stakeholder meeting 1 : **land uses and benefits**
- analysis between stakeholder meetings 1 and 2
- stakeholder meeting 2: **current benefits and beneficiaries**
- analysis between stakeholder meetings 2 and 3
- stakeholder meeting 3: **winds of change**
- analysis between stakeholder meetings 3 and 4
- stakeholder meeting 4: **scenarios**
- analysis between stakeholder meetings 4 and 5
- stakeholder meeting 5: **action!**
- analysis and reporting after stakeholder meeting 5
- final presentation meeting

Each of these steps is described below.

5.3.1 Preparation

The preparatory phase of the project would comprise four main groups of tasks:

- **Client partnership and appointment of project team**
  - establishing project partnership and steering group;
  - confirming aims, objectives and key outcomes from the study;
  - preparation of study brief, identification, appointment and tasking of project team.

- **Preliminary technical analysis**
  - mapping of preliminary study area;
  - preliminary identification/scoping of key ecosystems, functions, services – mapping and network analysis;
  - preliminary analysis of the current or potential influence of key policy drivers and land management activities on ecosystems;
  - data review and preliminary mapping against scoped ES;

- evaluation of potential gaps or inadequacies in baseline information and prioritization of areas for additional qualitative and quantitative data collection.

- **Communications and stakeholder engagement process design**
  - communications strategy – agreeing non-technical terminology and descriptions for scoped ES, publicity methods, distribution of interim and study findings, role of Scotland environment web;
  - identification of stakeholders informed by understanding of the area, policy drivers and key issues;
  - invitation and follow up, using existing community, land management, business and policy networks as appropriate wherever possible.

- **Evaluation**
  - review and evaluation of preparation stage, including agreement of project partners around methodology and identification of stakeholders.

5.3.2 Recruiting stakeholders

It is likely that a number of different routes will be used to identify and recruit stakeholders to participate in the study. This will distinguish between the following types of stakeholder:

- **policy and decision-makers**, together with front-line deliverers, should be identified in discussion with the project partners;
- **land managers** should be identified with the involvement of NFUS and Scottish Land and Estates, and through existing community networks and organisations;
- **local residents** should be identified through existing community networks and organisations. This group should include local non-land based businesses, particularly those with an involvement in recreation and tourism. The aim should be to secure the involvement of a good cross section of local people, based on factors such as gender, age, income, occupation and interest;
- key visitor and recreation sites should be used to reach **visitors** to the area. Local recreation user groups should also be involved.

We propose that other external beneficiaries of ecosystem services should be represented by policy and decision-makers.

As noted above, we recommend that a number of 'incentives' are used to encourage the engagement of non-agency participants. This should include:

- giving the stakeholder group a title such as 'panel' or 'advisory group' to emphasise its status and importance in influencing the way the study area is managed in the future (the rest of this section refers to the 'stakeholder panel');
- acknowledging participation in the form of book tokens or other form of reward;
- offering to cover travelling expenses incurred in attending meetings;
- providing soup and sandwich catering before each meeting to allow people to come straight from work, and to provide a time for informal discussion and capacity building.

Invitations to join the stakeholder panel should cover the following:

- introduction to the study;
- why it's being carried out;

- what the outcomes will be;
- why we want people's involvement;
- the geographic area that will be covered;
- details of meetings (when and where);
- contacts and links to further information (Scotland environment web/project website).

The take-up of invitations should be monitored closely and additional effort applied where there appears to be under-representation of particular groups or segments of the population.

5.3.3 Stakeholder Meeting 1: Land uses and benefits

The first stakeholder panel meeting would focus on exploring the range of ecosystems and land uses present within the study area, and working with stakeholders to identify the benefits that they provide. The meeting would be divided into four main steps, described below.

- **Introduction and welcome**
  - A short, non-technical introduction to the project, its anticipated outcomes, the role of the stakeholder panel, and the programme of panel meetings; round the room introductions.
- **The study area, its land uses and benefits it provides**
  - A short review of the study area and its boundaries, to ensure it reflects local stakeholders' views on a logical and definable area;
  - A discussion about the land uses present within the study area. This would be informed by mapped information on land cover and land use;
  - An unstructured discussion at table level about the reasons why the area is important to stakeholders.
- **Introduction to a benefits based approach**
  - Introduction to the idea of land uses/ecosystems, services and socio-economic benefits;
  - Benefit mapping – the relevant ecosystem services would be divided up and allocated to different tables. Each would be asked to rank the list of services in terms of those they consider most significant, and then to map which parts of the study area are most important in providing the service in question. The discussion would be supported by mapped information on recreation provision, woodland cover, cultural heritage, habitats, watercourses and flood risk, etc. Information would be recorded on a series of blank base maps. Completed maps could be pinned up for inspection at the end of the meeting.
- **Conclusion**
  - A short plenary discussion rounding up the findings from each table;
  - Next steps – taster for the next meeting;
  - Feedback forms to record participants' views on the meeting.

5.3.4 Analysis between Stakeholder Meetings 1 and 2

A number of tasks would be carried out between the first and second meetings. The aim would be to review the process to date and undertake any corrective action necessary,

analyse information gathered during the first meeting and prepare information to support discussions in the second meeting. Key tasks would be as described below.

- **Review and evaluate the first stakeholder meeting** in terms of attendance, representation, engagement with the tasks and discussion and information from feedback forms;
- **Prepare maps summarising stakeholder analysis of benefit**, by ecosystem service, ecosystem service category and in combination (to highlight areas producing the greatest range of benefits). Upload to Scotland Environment Web or project website;
- **Prepare 'technical' maps of benefit provision**, based on GIS mapping of datasets relevant to each scoped ES. Consider uploading to Scotland Environment Web or project website;
- Identify **gaps, areas of dis/agreement, areas to explore further** with stakeholders. Depending on the nature of information gaps this could include scoping out the requirement for any issue specific discussion groups 'offline' from the main stakeholder panel meetings;
- **Preliminary network analysis** for key land uses/ecosystems, based on the stakeholder and technical mapping exercises. Consider uploading to Scotland Environment Web or project website;
- **Preliminary analysis of 'demand' for ES** based on geographic areas and current and potential demand. Consider uploading to Scotland Environment Web or project website.

5.3.5 Stakeholder Meeting 2: Current benefits and beneficiaries

The second panel meeting would aim to reach consensus on the current benefits derived from the study area, agree how any gaps in knowledge should be addressed and explore the current and potential demand for these services. The meeting would comprise five main steps, described below.

- **Brief introduction and recap**
- **Agreeing a definitive set of current benefits**
  - Feedback on ES mapping from Meeting 1 – by ecosystem service, ecosystem service category and in combination. Maps would be pinned up for inspection before the meeting, and each would be reviewed briefly in a presentation;
  - Comparison with technical analysis – by ecosystem service, ecosystem service category and in combination. Maps would be pinned up for inspection before the meeting, and each would be reviewed briefly in a presentation;
  - Agreeing 'definitive' mapping and evaluation of the significance of service provision. This would take the form of table discussions, informed by wall posters and network analysis diagrams for key services.
- **Filling the gaps**
  - Discussion about nature of information gaps (topic, scale/detail, significance etc.) and areas of disagreement and how best to resolve (e.g. through separate subject area discussion group covering agriculture or recreation) and consideration of benefit specific valuation work, or work at a more detailed level for specific land holdings or sites such as Flanders Moss.

- **Who benefits?**
    - Table based discussion distinguishing between 'types' of ES consumer, location of the consumption, current and potential demand, and the significance of the ES provided by the study area. This could be followed by an interactive 'post-it' session with participants recording the pattern of 'consumption' for each of the relevant ecosystem services provided by the study area.
- **Conclusion**
    - A short plenary discussion rounding up the findings from each table;
    - Next steps – taster for the next meeting;
    - Feedback forms to record participants' views on the meeting.

5.3.6 Analysis between Stakeholder Meetings 2 and 3

A number of tasks would be carried out between the second and third meetings. The aim would be to review the process to date and undertake any corrective action necessary, analyse information gathered during the second meeting and prepare information to support discussions in the third meeting. Key tasks would be as described below.

- **Review and evaluate the second stakeholder meeting** in terms of attendance, representation, engagement with the tasks and discussion and information from feedback forms;
- Facilitate and record any **subject area discussions** as required to fill gaps or address areas of uncertainty or disagreement. Upload findings to Scotland Environment Web or project website;
- **Finalise mapping of services** provided by the study area noting any remaining areas of uncertainty or gaps in the evidence base. Upload to Scotland Environment Web or project website;
- **Finalised evaluation of the significance of ES** provided by the study area based on stakeholder and technical analysis (using a simple categorisation of none, low, medium, high is recommended). Upload to Scotland Environment Web or project website;
- **Finalised analysis of 'demand' for ES** based on stakeholder and technical analysis. Upload to Scotland Environment Web or project website.

5.3.7 Stakeholder Meeting 3: Winds of change

The third stakeholder panel meeting would move on from the definition of the current benefits derived from the study area to consider how the patterns of benefits could change in the future. This discussion would explore the effects of different kinds of change and would conclude with an introduction to the scenarios that would be explored in the fourth meeting. The meeting would comprise four main elements, described below.

- **Brief introduction and recap**
    - Benefit mapping, evaluation and 'demand'. Information would be pinned up for inspection before the meeting and reviewed briefly in a presentation.
- **Drivers of change**
    - How has the way land in the study area is managed changed over the past 50 years? What are the reasons for this and what effect would this have had on the benefits we get from the area? Table based facilitated discussion;

- What are likely to be the main drivers for future change? How might these changes affect the benefits we get from the area? Are there things we could do to support positive changes and reduce negative impacts on benefits? Themed, table based facilitated discussion – initially open, for the most part structured around key policy drivers;
- Plenary discussion with feedback from tables, facilitated to draw out the main influences on the area, the key effects on the provision of benefits (by type, positive and negative) and the scope to minimise negatives, enhance positives and achieve win-win synergies.

- **Introduction to scenarios**
  - Overview of the purpose of scenarios;
  - Brief description of four potential scenarios;
  - Discussion, informed by the previous meeting item (drivers of change), to confirm, modify or redefine these scenarios.
- **Conclusion**
  - Next steps – taster for the next meeting;
  - Feedback forms to record participants' views on the meeting.

5.3.8 Analysis between Stakeholder Meetings 3 and 4

A number of tasks would be carried out between the third and fourth meetings. The aim would be to review the process to date and undertake any corrective action necessary, analyse information gathered during the third meeting and prepare information to support discussions in the fourth meeting. Key tasks would be as described below.

- **Review and evaluate the third stakeholder meeting** – attendance, representation, engagement, feedback;
- **Preparation of four alternative scenarios**:
  - preparation of scenario description;
  - mapping;
  - preliminary analysis of how the supply of ES from the study area would be affected;
  - preliminary analysis of the effects of this change on the 'demand' for ES;
  - sensitivity testing against socio-economic scenarios.
- **Consider uploading to Scotland Environment Web or project website**

5.3.9 Stakeholder Meeting 4: Scenarios

The fourth stakeholder panel meeting would focus on the evaluation of how the provision of ecosystem services could change under the four alternative scenarios. The meeting would comprise four main elements, described below.

- **Brief introduction and recap**
  - ES mapping, evaluation, 'demand' and drivers. Information would be pinned up for inspection before the meeting and reviewed briefly in a presentation.
- **Scenarios**
  - Introduction to the four scenarios – allocation of one scenario per table;

- Group discussions
    - Discussion 1 – how has the provision of ES changed – major, minor, none, positive or negative?
    - Discussion 2 – who would be affected and how?
    - Discussion 3 – what could we do to maximise the benefits and minimise the impacts?
- Feedback from tables.

- **Visions and nightmares**
    - Facilitated discussion to draw out which aspects of the scenarios people would like to see realised and which aspects they would not like to see, with the aim of building a consensus vision for the future management of the study area.
- **Conclusion**
    - Next steps – taster for the next meeting;
    - Feedback forms to record participants' views on the meeting.

5.3.10 Analysis between Stakeholder Meetings 4 and 5

A number of tasks would be carried out between the fourth and fifth meetings. The aim would be to review the process to date and undertake any corrective action necessary, analyse information gathered during the fourth meeting and prepare information to support discussions in the fifth meeting. Key tasks would be as described below.

- **Review and evaluate the fourth stakeholder meeting** – attendance, representation, engagement, feedback;
- Use information gathered from the fourth meeting to **work up a vision for the area's future**:
    - Description, including structured definition of changes in land management and the pattern of land uses/ecosystems;
    - Mapping;
    - Analysis of effects on ES provision;
    - Analysis of effects on ES demand;
    - Preliminary identification of trade-offs, decision points.
- Preliminary **analysis against current policy and land management drivers** and anticipated changes
    - Aspects that could be delivered relatively easily;
    - Aspects that would need policy to change;
    - Aspects that would need land management practice to change;
    - Aspects that would need other kinds of change.
- Upload to Scotland Environment Web or project website.

5.3.11 Stakeholder Meeting 5: Action!

The final stakeholder panel meeting would review and explore what the vision might mean in practice. It would aim to identify and address areas of disagreement and define the kinds of activity needed to move from vision to reality. The meeting would comprise four main elements, described below.

- **Brief introduction and recap**
    - ES mapping, evaluation, 'demand', drivers and scenario analysis. Information would be pinned up for inspection before the meeting and reviewed briefly in a presentation.
- **A vision for the future**
    - Presentation of the vision for area's future;
    - Group discussions (participants grouped by broad area of interest)
        - Discussion 1 - What does this mean for my area of interest (strengths, weaknesses, opportunities and threats)?
        - Discussion 2 – What are the key barriers to realising the vision – policy, practice, awareness, knowledge…?
    - Feedback – winners, losers, opportunities, barriers.
- **Realising the vision – towards an action plan**
    - Group discussion - what needs to happen?
        - Refining the vision;
        - Influencing policy;
        - Action and implementation on the ground;
        - Partnerships, capacity, information.
- **Conclusion**
    - Next steps – how the results of the work will be reported, how the findings will be used on the ground;
    - Process review and wash-up – what worked, what could be better?
    - Feedback forms to record participants' views on the meeting.

5.3.12 Analysis and reporting after Stakeholder Meeting 5

A number of tasks would be needed to draw the study to a conclusion, including:

- refinement of **vision;**
- finalised analysis of **effects on ES supply and demand** and opportunities to mitigate negatives, maximise positives, develop synergies and win-win solutions;
- **identification of key actions** for the study area in the categories of policy (feedback to national and regional policy, expression of policy at a local level), implementation (measures on the ground), capacity/partnership;
- **evaluation of the project** against key measures of success;
- **methodological findings** and guidance for similar studies elsewhere;
- **reporting** – technical and summary reports, potential use of Scotland environment web to host the reports and showcase the approach.

5.3.13 Final presentation meeting

A final meeting would provide an opportunity for all participants, and possibly the wider community, to discuss the finalised vision and actions. The meeting would also map out responsibility for key actions amongst the different stakeholder groups, including policy and decision-makers, front-line deliverers, land managers and the wider public. This will provide a vital step from planning to local ownership and implementation.

5.4 Evaluation

Evaluation is an important component of any study of this kind, but is particularly important for a demonstration project where the effectiveness of the approach in achieving its aims should influence the way it is applied elsewhere.

It is sensible to distinguish between two aspects of evaluation:

- firstly, ongoing methodological evaluation during the course of the project, with the findings being used to mitigate any issues as they arise;
- secondly, evaluating success in achieving the key outcomes that have been defined for the project.

5.4.1 Ongoing evaluation

Evaluation during the course of the project will help identify any issues that arise reflecting the relatively novel approach of the work and uncertainties associated with stakeholder engagement.

This should be designed to record key lessons for other projects based on an ecosystems approach (reflecting the Stirling project's role as a demonstration project), but also to inform refinement or modification of the project methodology as it progresses. There should be a strong link from the project risk assessment to the evaluation framework so any anticipated (and unanticipated) issues can be identified at an early stage and corrective or mitigating actions implemented as necessary.

Key areas of risk are likely to include:

- the availability of high-quality, up-to-date data covering all relevant ecosystem services at an appropriate scale and format;
- the successful engagement of a representative sample of people across all the stakeholder groups;
- the successful engagement with these groups across a series of technical issues, concepts and exercises;
- the successful building of consensus within and between different types of stakeholder, and between local and national policy levels.

Key elements of the evaluation should include:

Table 10: Ongoing project evaluation and mitigation

Measure	Success	Mitigation
Degree of agreement among technical partners on purpose, study area and stakeholders	Agreement on purpose, study area and key stakeholder groups	Do not initiate study until areas of disagreement resolved
Success in recruiting representative samples from each stakeholder group	Good representation achieved from each group	Further effort identifying suitable stakeholders –will depend on which groups are under-represented Methodological conclusions
Quality of baseline data	Comprehensive, up-to-date information at the correct scale, corresponding to key ecosystems and services	Qualitative assessment to fill gaps New survey work Expert inputs Stakeholder task groups Methodological conclusions
Comprehensiveness of scoping	Subset of key land uses and ecosystem services agreed	Methodological refinement to inform application elsewhere
Stakeholder engagement on network analysis	Stakeholders conversant with the links from land uses to services to socio-economic benefits	Methodological refinement to inform application elsewhere
Clarity of driver mapping	Clear analysis of the links between policy drivers and ecosystem services, and land management activities and ecosystem services	Methodological refinement to inform application elsewhere
Stakeholder engagement across all relevant services	Stakeholders able to provide inputs in terms of all four main categories of service	Technical analysis to support and supplement stakeholder engagement Methodological conclusions
Stakeholder engagement on scenario development	Stakeholders able to provide inputs in terms of defining realistic scenarios	Technical analysis to support and supplement definition of scenarios Methodological conclusions
Reality and relevance of socio-economic scenarios	Socio-economic scenarios recognisable and the results of their application relevant to the project	Methodological refinement to inform application elsewhere
Stakeholder engagement on scenarios	Stakeholders able to provide inputs in terms of evaluating	Technical analysis to support and supplement

Measure	Success	Mitigation
	scenarios	evaluation of scenarios Methodological conclusions
Success in building consensus within and between stakeholder groups, and between local and national policy levels	No areas of disagreement on key recommendations	Clear statement of areas of agreement and disagreement Further stakeholder discussion Methodological conclusions
Clarity of recommendations	Clear recommendations on how the study area should be managed to enhance provision of ecosystem services	Further stakeholder discussion Methodological conclusions

5.4.2 Evaluation of project outcomes

Evaluation of the project as a whole should focus around the key outcomes and more detailed objectives defined for the project. We suggest that this evaluation should take the form of a series of questions focusing on each objective and outcome in turn. The answers to these questions can be used to validate the project outputs, and to refine the approach for use in other studies elsewhere in Scotland. The evaluation should be carried out by the project steering group, in discussion with the consultant team, drawing on information gathered from stakeholders during the process. Proposed evaluation questions are described below:

- Did the project identify and engage successfully with stakeholders who benefit from, and manage, the environment in the area including land managers, local communities, visitors and other interests? Which groups proved more difficult to engage with? Were there issues of numbers, representativeness, continuity or ability to engage with aspects of the process? How might this be improved in the future?
- Did the project successfully identify and map baseline ecosystems? Was there agreement between stakeholder and technical perspectives?
- Did the project successfully identify the links between public policy objectives, land management and the provision of ecosystem services? Was there agreement between stakeholder and technical perspectives?
- Did the project successfully identify the ecosystem services derived from the study area environment and 'consumed' within the study area and more broadly? Was there agreement between stakeholder and technical perspectives? How were any information gaps or disagreements resolved?
- Did the project successfully evaluate or prioritise the provision of ecosystem services within the study area? Was there agreement between stakeholder and technical perspectives? How were any differences resolved?
- Did the project assess the current and potential capacity of the study area environment to provide ecosystem services, identifying key barriers to delivery? Was there agreement between stakeholder and technical perspectives? How were any differences resolved?
- Did the project successfully explore options for future change, including through the use of scenarios, identifying the implications for ecosystem service provision at different scales?

- How successful was the work with local stakeholders to define and evaluate scenarios? Did this identify positive and negative effects, trade-offs and potential synergies? What problems were encountered and how were they resolved?
- Did the project successfully build consensus around a preferred scenario? What was the nature of any disagreements and how significant were these?
- Did the project identify mechanisms, opportunities and barriers affecting the implementation of the preferred scenario?
- What were the views of different types of stakeholders on the relevance of the study, the process of engagement and the recommendations flowing from the work?

Taking account of the above evaluation criteria, how successful was the project in meeting key outcomes? Questions would include the following:

- Was the project successful in raising awareness of the benefits provided by the environment of the study area?
- Did the project successfully integrate and balance public policy objectives and local perspectives? What tensions or areas of disagreement were identified? Is there potential to address these by changes in policy, interpretation of policy locally, or in the way the areas are managed?
- Did the project identify specific priority actions which will deliver improved benefits from nature?
- Did the project establish a practical and realistic methodology capable of application in other locations?
- How successful was the use of the Scotland Environment Web in providing spatial information, receiving spatial information, hosting project materials and publicising the study findings?

5.5 Programme

Table 11 sets out a preliminary project programme, based on the approach set out above. It suggests a 40 week programme (not allowing for breaks). There could be benefits in extending the programme with an additional week between each workshop, and additional time for reporting and review at the end of the process.

Table 11: Preliminary project programme

	Study weeks																																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Preparation																																								
Briefing																																								
Preliminary technical analysis																																								
Communications																																								
Process evaluation																																								
Stakeholder recruitment																																								
Stakeholder meeting 1																																								
Organisation																																								
Preparation																																								
Meeting																																								
Analysis																																								
Process evaluation																																								
Analysis of workshop 1 results																																								
Preparation for workshop 2																																								
Stakeholder meeting 2																																								
Organisation																																								
Meeting																																								
Analysis																																								
Process evaluation																																								
Analysis of workshop 2 results																																								
Topic area discussions																																								
Topic area survey/analysis																																								
Preparation for workshop 3																																								
Stakeholder meeting 3																																								
Organisation																																								
Meeting																																								
Analysis																																								
Process evaluation																																								
Analysis of workshop 3 results																																								
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Analysis and reporting																																								
Process evaluation																																								
Analysis of workshop 5 results																																								
Stakeholder report																																								
Technical report																																								
Project evaluation																																								
Methodological report																																								
Final presentation meeting																																								
Project steering group																																								

5.6 Outline costs

Table 12 sets out an initial estimate of time inputs and associated costs for the work defined above. It does not include the cost of any additional surveys that are judged necessary, VAT or expenses which would include printing, venue hire, catering and travel and subsistence.

Table 12: Time inputs and costs

	Project director	Project team leader	Team member	GIS specialist	Consultation specialist	TOTAL
Preparation						
Briefing	0.5	0.5			0.5	**1.5**
Preliminary technical analysis	0.5	3	3	5		**11.5**
Communications		1			1	**2**
Process evaluation		0.5				**0.5**
Stakeholder recruitment					5	**5**
Stakeholder meeting 1						
Organisation					1.5	**1.5**
Preparation	0.5	1				**1.5**
Meeting	0.5	0.5			1	**2**
Analysis						
Process evaluation					0.5	**0.5**
Analysis of workshop 1 results	0.25	1	2	1.5		**4.75**
Preparation for workshop 2	0.5	1	2	2	0.5	**6**
Stakeholder meeting 2						
Organisation					0.5	**0.5**
Meeting	0.5	0.5			1	**2**
Analysis						
Process evaluation					0.5	**0.5**
Analysis of workshop 2 results	0.25	1	2	1.5		**4.75**
Topic area discussions		3			3	**6**
Topic area survey/analysis						**0**
Preparation for workshop 3	0.5	1	2	2	0.5	**6**
Stakeholder meeting 3						
Organisation					0.5	**0.5**
Meeting	0.5	0.5			1	**2**
Analysis						
Process evaluation					0.5	**0.5**
Analysis of workshop 3 results	0.25	1	2	1.5		**4.75**
Preparation for workshop 4	0.5	1	2	2	0.5	**6**
Stakeholder meeting 4						
Organisation					0.5	**0.5**
Meeting	0.5	0.5			1	**2**
Analysis						
Process evaluation					0.5	**0.5**
Analysis of workshop 4 results	0.25	1	2	1.5		**4.75**
Preparation for workshop 5	0.5	1	2	2	0.5	**6**
Stakeholder meeting 5						
Organisation					0.5	**0.5**
Meeting	0.5	0.5			1	**2**
Analysis and reporting						
Process evaluation					0.5	**0.5**
Analysis of workshop 5 results	0.25	1	2	1.5		**4.75**
Stakeholder report	0.25	1			2	**3.25**
Technical report	0.5	5				**5.5**
Project evaluation	0.25	0.25			0.25	**0.75**
Methodological report		1.5			1.5	**3**
Final presentation meeting	0.5	0.5			1	**2**
Project steering group	4	4			4	**12**
Total days	**12.75**	**32.75**	**21**	**20.5**	**31.25**	**118.25**
Rate £						
Total £						

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ANNEX 1: ECOSYSTEMS SERVICES

The following table provides an initial, partially non-technical description of ecosystem services based on an expansion of the suite of services defined by the Millennium Assessment.

Ecosystem services	Description
Supporting services	
Soil formation	The formation of the soil resource within UK ecosystems
Primary production	The assimilation or accumulation of energy and nutrients by organisms within UK ecosystems
Nutrient cycling	The assimilation, accumulation and cycling of the nutrients essential to life within UK ecosystems (including nitrogen and phosphorus)
Water cycling	The cycling of the water resource within UK ecosystems
Provisioning services	
Food	The provision of food products derived *directly* or *indirectly* from UK ecosystems, through agriculture or collection from the wild.
Fibre	The provision of fibres from UK ecosystems, including wood, coppice products, hemp, animal skins, wool, roofing thatch and reed.
Fuel	The provision of fuels from UK ecosystems, *directly* through the use of biomass as fuel and *indirectly* through conversion of biomass products to biofuels and via anaerobic digestion
Genetic resources	The provision of genetic resources from UK ecosystems for animal and plant breeding and biotechnology through active current use in breeding programmes and as a gene bank for potential future usage.
Biochemicals, natural medicines, and pharmaceuticals	The provision of biochemicals, natural medicines, and pharmaceuticals from UK ecosystems both from agricultural and wild harvested species
Ornamental	The provision of ornamental items from UK ecosystems (fauna, flora, inorganic); plants, flowers, skins, shells, rocks, sands and gravels
Water	The provision of water from UK ecosystems
Regulating services	
Air quality regulation	The regulation of air quality by UK ecosystems where the extent, condition and configuration of ecosystems influence air quality levels through the generation of chemicals and particles to the atmosphere and the interception of natural and human origin chemicals and particles
Climate regulation	Global – The regulation of greenhouse gasses where functioning UK ecosystems capture, store and release carbon from, and to, the atmosphere Regional – The regulation of regional climates where the extent, condition and configuration of UK ecosystems influence local precipitation and temperature levels

Ecosystem services	Description
	Site – The regulation of climate at the site scale where structurally complex UK ecosystems influence climate parameters at properties, dwellings and on agricultural landholdings
Flood hazard regulation	The regulation of the potential flood hazard to human property or business interests (including farmland and horticulture) or other ecosystem services by UK ecosystems where ecosystem extent, condition and configuration influence the timing and magnitude of flood events or storm damage through the interception of precipitation, run-off, tidal flow and the regulation of infiltration rates, aquifer recharge and water-table levels.
Erosion hazard regulation	The regulation of the potential erosion hazard to human property, business interests and ecosystem services (including soils, farmland, horticulture) by UK ecosystems where ecosystem extent, condition and configuration influence the timing and magnitude of erosion levels through the regulation of the erosive effect of water flow, wind and wave action.
Soil quality regulation	The regulation of soil quality by UK ecosystems where the extent and condition of ecosystems influence current or potential future soil quality levels
Water quality regulation	The regulation of water quality by UK ecosystems where the extent, condition and configuration of ecosystems influence water quality through the origin and amelioration of chemicals and particles affecting water quality.
Toxic hazard regulation	The regulation of toxic hazard presence by UK ecosystems through the decomposition, modification, removal, fixation or burial of toxic substances
Noise regulation	The regulation of noise pollution levels by UK ecosystems where the extent, condition and configuration of ecosystems modify noise levels
Disease regulation	The regulation of disease by UK ecosystems, where the extent, condition, and configuration of ecosystems influence the occurrence and abundance of pathogens and disease vectors
Pest regulation	The regulation of pest outbreaks of crops and livestock by UK ecosystems, where the extent, condition and configuration of ecosystems influence the occurrence, frequency and intensity of pest outbreaks
Pollination	The regulation of production levels of agricultural, ornamental and native flora species by UK ecosystems through the effects of ecosystem extent, condition and configuration on the presence and abundance of natural pollinators
Cultural services	
Community development	The community development service provided by UK ecosystems where the extent, condition or configuration of ecosystems contributes towards community development through increased social cohesion, job opportunities and local pride
Spiritual services	The spiritual experience provided by UK ecosystems, where the extent, condition or configuration of ecosystems, at locations where they are accessed or viewed, contributes to spiritual experiences.
Religious	The religious experience provided by UK ecosystems, where the extent, condition or configuration of ecosystems at locations where they are accessed or viewed, contributes to religious experiences
Education	The education service provided by UK ecosystems, where the extent, condition and configuration of ecosystems provide education opportunities both directly through fieldwork activities and indirectly through contribution to the wider body of

Ecosystem services	Description
	knowledge
Inspirational	The inspirational experience provided by UK ecosystems, where the extent, condition or configuration of ecosystems, at locations where they are accessed or viewed, contributes inspiration to works of art
Aesthetic	The aesthetic experience provided by UK ecosystems, where the extent, condition or configuration of ecosystems, at locations where they are accessed or viewed, contributes to aesthetic experiences
Sense of place	The sense of place provided by UK ecosystems, where the extent, condition or configuration of ecosystems, at locations where they are accessed or viewed, contributes to the recognisable, characteristic and unique identity of a locality
Cultural heritage	The cultural heritage service provided by UK ecosystems, where the extent, condition and configuration of ecosystems contribute to the creation, expression, preservation, or public understanding of the UK's past and present cultural heritage
Recreation	The recreation experience provided by UK ecosystems, where the extent, condition or configuration of ecosystems, at locations where they are accessed or viewed, contributes recreation opportunities
Tourism	The tourism experience provided by UK ecosystems, where the extent, condition or configuration of ecosystems, at locations where they are accessed or viewed, contributes to tourists' travel choices

ANNEX 2: INITIAL REVIEW OF DATASETS

Ecosystem services	Ecosystems/Natural assets	Ecosystem function	Primary and secondary state indicators	Datasets	Potential applications and issues	Status B=baseline T=time series available X=link to targets
Provisioning						
Food	Grassland	Growth of biomass	Carcass production in study area kg/yr	SGRIP Agricultural Parish outputs	May not be available as primary spatial data. Indications on conversion of plant to animal biomass; indication of local ecosystem productivity in a national context	**T**
			Milk production l/yr	Scottish Agricultural Census	Not available spatially	**T**
			Area of land managed as pasture/for silage	Land Cover of Scotland; Scottish Agricultural Census	Compare with diffuse pollution data from SEPA monitoring – understanding impacts on ecosystem function (LCS data relatively old)	**B** **T(census)**
			Cereal and oilseed rape production	SG Cereal and Oilseed Rape harvest in Scotland; JHI Land Capability for Agriculture	Capability provides a measure of potential productivity of soil resource – use to examine relationship between soils, production and other services	**T**
Fresh water	Water courses and water bodies		Available surface water	SEPA Water bodies (river and lochs)		**B**

				SEPA surface water abstraction licences	Use of service; understanding impacts on downstream functions	**B/T**
			Water quality	SEPA Water body classification and monitoring	Understanding changes in water body status/service delivery as a result of enhancement work (e.g. through RBMP actions) or new development/land uses	**B/T/X**
			Groundwater reserves	BGS Aquifer productivity	Comparison with groundwater abstraction/status data to monitor change	**B/T?**
				SEPA groundwater abstraction licences	As above	**B/T**
Fibre – timber	Woodland	Growth of biomass	Total timber produced	(May not be accurate data – reliance on FCS production forecasts?/info from processors)	Not necessarily monitoring changes in service delivery – just activity in the sector?	**T**
			Woodland managed for timber production	National Forest Inventory; National Inventory of Woodland and Trees; WGS/SFGS	Other than softwood forests, difficult to determine area in active management for timber	**B**
Fibre – wool	Grassland		Wool production	Scottish Agricultural Census	Not available spatially	**T**
Fuel – wood	Woodland		Woodland managed for wood fuel production	[data not readily available]		
			Short rotation coppice/short rotation forestry	SRDP? [data not readily available]		

Other raw materials	Minerals		Outstanding minerals permissions	Stirling Council mineral permissions	Comparison with ground and surface water information to determine effects on service delivery/health	**B/T**
			Potential for minerals extraction	BGS bedrock and superficial geology; Stirling Council areas of search for minerals	Coincidence with key ecosystem components	**B**
Renewable energy	Wind		Operational wind turbines	SNH Wind farm database		**B/T** (if iteration is recorded)
			Wind speed	Former DTI wind speed database		
	Watercourses		Operational hydro schemes	SEPA licensing	Use in parallel with monitoring data to determine impacts on downstream service delivery	**T**
Regulating						
Air quality regulation	Intensive farming systems	Ammonium production	Airborne ammonium levels	DEFRA Ammonia emissions; SEPA/Scottish Government Ambient Air Quality	Point data? Limited applications to wider area	**T**
Climate regulation	All ecosystems	GHG emissions	GHG emissions from land use and land use change	SG Scottish Greenhouse Gas Emissions; GHG from agriculture/forestry	Not available as spatial data – national figures only?	
	All ecosystems	Soil carbon storage	Soil carbon	JHI Soils data	Soil formation/vulnerability; Coincidence with data on development, etc., to	**B**

					determine potential carbon loss/water retention capacity, etc.	
	Woodland	Carbon sequestration	Carbon in trees	FCS/FR carbon uptake estimates	Not available spatially – could be applied to NFI data for rough calculations on C sequestered in particular woodlands	
Flood mitigation	All ecosystems	Water storage	Water storage capacity	[data not readily available – estimates possible from existing flood/LiDAR data?]		
			Water retention capacity	JHI Hydrology of soil types(?); Peat soils	Generalisations	
Water quality regulation	All ecosystems		Quality of water	SEPA water body classification and monitoring; Scottish Pollutant Release Inventory	Combine with land use/management/development data to understand effects on service delivery over time; Understanding effects of particular ecosystem service 'consumers' on downstream delivery	**B/T**
Erosion regulation	All ecosystems	Soil stabilisation and water infiltration		OS DTM (slope calculations); land cover – identifying areas of susceptibility		
Pollination				???		
Biological regulation				???		

Supporting						
Gene pool	Semi-natural habitats and those supporting rare/scarce species managed in favourable conditions		Natural biodiversity; Habitat integrity	NVC SSSI Ramsar SAC SPA Ancient Woodland/NWSS	Proxy data for key ecosystem health	**B**
			Changes in the state of habitats supporting rare/scarce species	SSSI monitoring	Baseline monitoring information on ecosystem health (ability to support key populations); Integration with other data to understand impacts	**B/T**
				Priority species; IHN for potential connectivity		
Nutrient cycling	All ecosystems	Nutrient cycling capacity	Soil quality	JHI Land capability and soils data		
Biodiversity				NVC SSSI Ramsar SAC SPA Ancient Woodland/NWSS SSSI monitoring Priority species; IHN for potential connectivity	Baseline monitoring information on ecosystem health (ability to support key populations); Integration with other data to understand impacts; Monitoring changes to connectivity/fragmentation; Integration with other services - role of biodiversity (or management for biodiversity(in assisting delivery of other services	
Cultural						
Aesthetic: appreciation of landscapes and scenic values (other than specific recreational activities)	All ecosystems	(Landscape values: sense of place/ calm/inspiration, etc.)	Number/area of landscape features with stated appreciation	National Nature Reserve SG Scottish Noise Map Public attitudes to landscape surveys Stirling Council Local Landscape Designations	Baseline for monitoring change	**B**

Recreational (opportunities for tourism and recreational activities)	All ecosystems		Number of visitor facilities	VisitScotland	Baseline for monitoring change, in conjunction with implications of change to other services for cultural values	
				NNR visitor facilities		
				FES visitor infrastructure		
				Core Path Network		
				HS Properties in Care		
				NTS properties		
				SWT facilities		
				Country Parks		
Cultural heritage and identity	Woodland			(Semi-natural) ancient woodland	Baseline for monitoring change	**B**
				NWSS		
				Heritage tree database		
				Inventory of Gardens and Designed Landscapes		
				Historic Land-use Assessment (HLA)		
	Historic landscape structure, field patterns and settlements			Historic Land-use Assessment		
				Landscape Character Assessment		
				Conservation Areas		
	Visible heritage assets			HS SM		
				HS Listed Buildings		
				Inventory of Gardens and Designed Landscapes		
				National Monuments Record		
				Stirling Council SMR		
Spiritual and religious inspiration	All ecosystems	Landscapes that inspire through emotional responses	Presence of landscapes and assets with spiritual value	HS SM		
				HS Properties in Care		
				Historic Land-use Assessment (extract current/relict ritual and funerary areas and		

				religious foundations)		
Education and science			Features with special educational and scientific value	SSSI	Baseline for monitoring changes to designated/special interest	**B**
				RIGS		
				HS SM		
				RCAHMS; CANMORE/HLA		
				Stirling Council SMR		
				Published papers		

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