

DECEMBER 2014



GREATER MANCHESTER ECOSYSTEM SERVICES PINCH POINTS STUDY

December 2014

**Report compiled by the Greater Manchester Environment Team based
on work commissioned by Greater Manchester Natural Capital Group
with funding from Natural England from:**

The logo for redroseforest features the name 'redroseforest' in a white, lowercase, sans-serif font, centered within a dark red rectangular background.

redroseforest



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EXECUTIVE SUMMARY

The UK Government recognises¹ that a healthy, properly functioning natural environment is the foundation of sustained economic growth, prospering communities and personal wellbeing. And that people and the economy can't flourish without the benefits and services our natural environment provides. These services are known as 'Ecosystem Services' (ESS) and are the benefits people obtain from the natural environment. For example, woodlands have the capacity to slow the flow of water and in riparian locations particularly they can stabilise river beds and banks and so potentially reduce flooding. If that reduction of flooding is considered a benefit to people, perhaps because a new housing development is at risk and the woodland reduces this, then it can be regarded as an ecosystem service.

Background to the study

The value of Greater Manchester's (GM) natural environment and the role it plays in delivering its vision² is well recognised. GM's natural environment and its quality therefore underpins delivery of the vision as well as being central to the development of a new model for sustainable economic growth which provides:

'a more connected, talented and greener city region where all our residents are able to contribute to and benefit from sustained prosperity and enjoy a good quality of life'.

However GM needed to better understand how and where the delivery of sustainable jobs, growth and supporting infrastructure benefited from and contributed to the quality of its natural environment and the ecosystem services this provided. This study was therefore commissioned by Greater Manchester Combined Authority (GMCA) with financial support from Natural England to:

- Identify GM's 'priority' ESS;
- Start to understand, and map the location of these 'priority ESS';
- Begin to identify the specific Ecosystem Services **pinch points**³ associate with these within Greater Manchester; and
- Start to map out the key **interventions**⁴ that are required to overcome pinches.

¹ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/228842/8082.pdf

² http://www.agma.gov.uk/cms_media/files/gm_strategy_stronger_together_full_report2.pdf

³ **Pinch points** are the issues which are critical to delivering the priority ESS and supporting Greater Manchester's investment for growth and/or redevelopment. Pinch points can be spatial (e.g. physical barriers to accessing an ESS such as rivers for recreation) or functional (e.g. absence of appropriate supply chains).

⁴ **Interventions** are the actions that can alleviate these pinch points and provide solutions at a strategic scale

The study also sets out general conclusions and the recommended next steps needed to ensure GM's natural environment and the ESS this provides continues to support its wider strategic objectives and priorities.

Identifying GM's 'Priority' Ecosystem Services

A 'long list' of ESS was developed⁵. Whilst many of these exist and operate in GM, they are not all as important as each other.

In order to identify the 'Priority ESS' for GM the 'long list' was considered in terms of their contribution to the delivery of the Greater Manchester Strategy *Stronger Together* and of the Greater Manchester Climate Change Strategy objectives. Also considered was their contribution to National and EU policy drivers.

The ESS long list was filtered against the contribution these could make to strategic objectives in GM (within the Greater Manchester Strategy and Climate Change Strategy) and other national and EU strategic objectives. As a result the following 8 'priority' ESS for GM were identified as having strong contributions to delivery of GM strategic objectives and wider policy drivers:

- Local and commercial food production
- Surface water and fluvial flood management
- Carbon storage and sequestration
- Cooling of Urban Heat Island
- Water quality management
- Habitat and Wildlife corridor provision
- Public recreation and Venue for green travel routes
- Visual and Aesthetic impacts

An assessment of the conflicts and synergies between these priorities was also undertaken and this found that, other than for local and commercial food production, most of GM's priority ESS's are complementary. The potential incompatibility between the local and commercial food production and the other Priority ESS, particularly if local food production was substantially increased, is a result of the possible damaging effects food production can have on the wider natural environment and therefore other ESS.

However, this assessment has provided confidence that, other than potentially for food, an integrated approach to managing GM's natural assets of can be taken which will deliver a multifunctional landscape and other ecosystem service benefits.

⁵ See Appendix 1 – the long list is based on the Common International Classification of Ecosystem Services (CICES) V4.3 <http://cices.eu/>

Understanding and mapping GM's 'Priority' ESS

The challenges for this project (and many other ESS mapping projects) is how to analyse, understand and present (map) the large amounts of data, from many disparate datasets and at different resolutions, that could potentially be used for GM's Priority ESS identified above.

The approach which was used is one which developed a **logical framework**⁶ for each priority ESS to help understand how that ESS works. This has also been used to identify a mapping proposal for each priority ESS, including production of provisional map to help visualise the service.

Figure 1 below provides an overarching GM priority ESS summary map to aid visualisation of the extent and spatial location of the Priority ESS within GM. This was produced by combining priority areas for the 8 ESS to give a provisional indication of the most important areas in GM for ESS

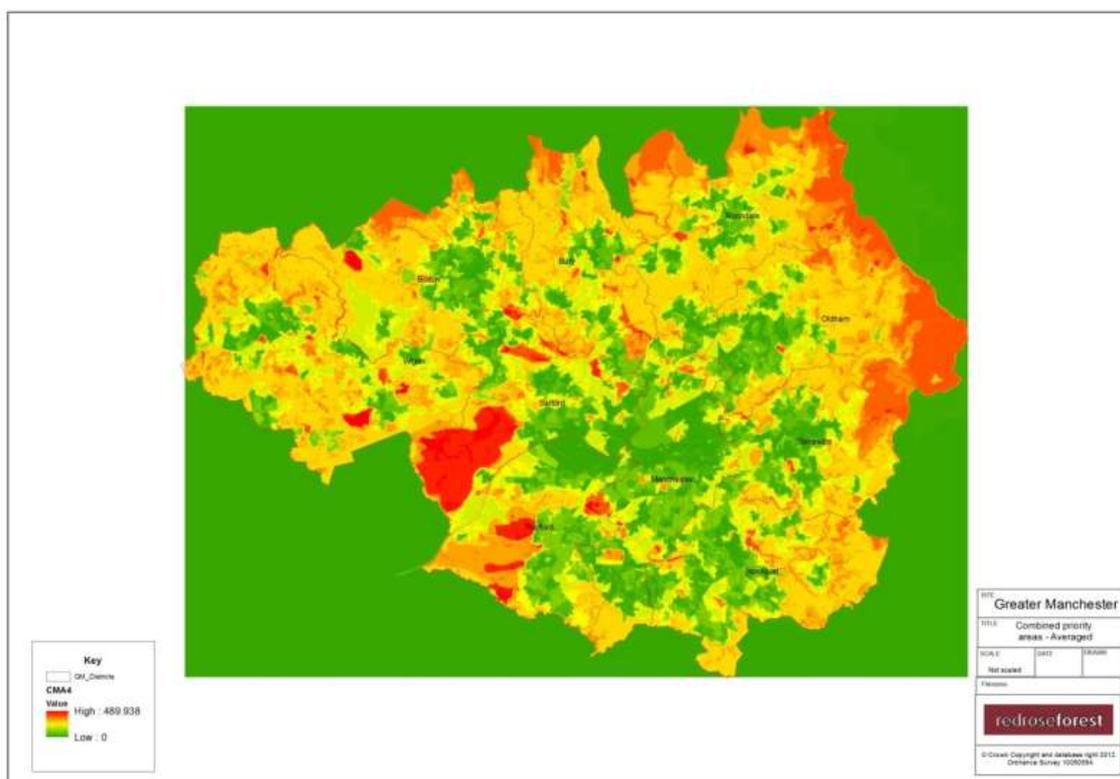


Figure 1 – showing combined spatial extent of GM's 'priority' ESS

⁶ Full details of the logical frameworks produced for each priority ESS (and provisional map) is included in appendix 3 which is available as a separate file due to its size.

Identifying the ‘pinches’ within GM’s priority ESS’

The study has, through understanding and mapping GM’s ‘priority’ ESS, started to identify the key ‘pinches’ for each ESS. These represent the issues, spatial or otherwise, which are critical to that ESS, which would need to be addressed for the services that ESS provides to GM to be maximised. These pinches have been summarised in the table below:

<p>Local and commercial food production</p> <ul style="list-style-type: none"> • We need to improve the function of local markets in supplying food from GM to GM if this service is to be maximised. However, a significant shift from ‘horsiculture’ to food production would be needed to achieve major benefits for bulk food production • Other interventions such as supporting market gardening, education and training would, unless at very large scale, have limited impact on bulk food production but could improve healthy eating habits or increase environmental awareness more generally.
<p>Surface water and fluvial flood management</p> <ul style="list-style-type: none"> • We need to maximise the flood management function of all our greenspaces, but especially in Floodzone 3. • We also need to increase retrofitting of green infrastructure and/or amending landform to provide water storage/infiltration (esp. areas of surface water risk or vulnerable populations/businesses)
<p>Carbon storage and sequestration</p> <ul style="list-style-type: none"> • We must preserve and enhance our existing peat (particularly the deepest reserves) and, if rewetting is not feasible, we should consider closed land cover such as grazing or woodland to reduce oxidisation. • Appropriately managing our non-peat soils, including maintaining/increasing tree cover and active woodland management could make a significant contribution to the GM Carbon balance
<p>Cooling of urban heat island</p> <ul style="list-style-type: none"> • Retrofitting a mixture of GI measures including trees over hard surfaces (for shading as well as evaporative cooling) is crucial for lowering the UHI effect, particularly in GM’s town centres. • We need to open up (also known as day lighting) waterways to maximise their cooling effect • GI surrounding our urban areas needs to be protected and enhanced so it provide sources of cooled air which can be drawn into the centres
<p>Water quality management</p> <ul style="list-style-type: none"> • We need to naturalise our river channels (including the tributaries of our main rivers), provide reedbed or other forms of natural filtration and appropriately protect and manage our wetlands to maximise their ability to capture and retain waterborne pollution. • We also need to sensitively manage our upland and mosslands to maximise the major positive impacts on water quality, esp. sediments and dissolved carbon they can have • GI retrofitting will be important in tackling diffuse urban pollution, esp. in areas of high air pollution or road film deposition

<p>Habitat and wildlife corridor provision</p> <ul style="list-style-type: none"> • We need to work with private and public landowners to reverse the decline in levels of habitat management and take opportunities to connect up our ecological networks, particularly in the river valleys which are our most substantial connected network • Private gardens are a major wildlife resource, and so influencing their management could have significant wildlife and ESS benefits • We need to work with those planning investments in growth, development and infrastructure to identify where key green infrastructure could be lost to development and therefore needs protecting or where opportunities exist for new assets to be created through sensitive development,
<p>Public recreation and venue for green travel routes</p> <ul style="list-style-type: none"> • We need to maximise and increase the cross linkages and flexibility of our already extensive existing network of green recreational/active travel routes, including river valleys, canals and National Cycle Network • But in doing this, new mechanisms for resourcing green space provision and its management, increasing the range of stakeholders contributing to it, is needed if we are to ensure continued/increasing use of GM's public greenspaces for recreation and active travel.
<p>Visual and aesthetic impacts</p> <ul style="list-style-type: none"> • We need to maximise the role GI retrofitting, esp. into areas of deprivation, plays in improving aesthetics and quality of place. • In doing this we must increase levels of GI provision, particularly street and forest scale trees and open spaces, within our regeneration and economic growth priority areas. • We should take the opportunity to ensure new SUDS and water management infrastructure is designed and managed as landscape features, not just engineering ones, with biodiversity exploited to help combat any health risks from standing water

Mapping the necessary interventions in GM's natural assets

The 'pinches' outlined above represent the issues which would need to be addressed if we were to maximise the services and level of service to GM from each of the identified priority ESS.

However, multiple ESS can be provided in one type of green space/natural habitat. It is therefore useful to consider these in terms of the sorts of interventions which would be needed within the major categories of GM's natural environment assets. The table below summarises the high level strategic activities / action which would be needed to maximise ESS benefits. An indication has also been made of the relative level of contribution (on a scale of 1-3) the intervention will have to each of the 8 priority ESS. Those which have the potential for the greatest contribution, both in terms of number of ESS impacted or the scale of benefit which is potentially achievable if actions were developed and delivered around particular interventions.

These therefore represent the greatest return on investment and potential benefit, from a priority ESS point of view, of developing and delivering actions around that particular intervention. However, this does not imply a priority order based on deliverability or other factors.

GM Natural Environment categories	FOOD	FLOOD	CARBON	COOLING	WATER QUALITY	BIODIVERSITY	RECREATION/ ACTIVE TRAVEL	AESTHETIC
PUBLIC GREENSPACES: Better-managed, more multifunctional formal and informal public greenspaces	✓ ✓	✓ ✓ ✓	✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓
RIVERS AND CANALS: A more natural river network, with fewer culverted sections and greater capacity to store floodwaters. Canals that act as corridors for people and wildlife, that provide climate change adaptation, and support economic activity		✓ ✓		✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓
RIVER VALLEYS: An integrated approach to managing the public greenspaces and private land in GM's river valley network, with better linkages through them for people and wildlife	✓	✓ ✓ ✓	✓		✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓
TREES AND WOODLANDS: More and better-managed woodlands and more trees in town centres, along transport corridors and in neighbourhoods where they are lacking	✓	✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓
MOSSLANDS AND MOORLANDS: Mosslands and moorlands that are better managed to retain and filter water and protect their carbon stores		✓ ✓ ✓	✓ ✓ ✓		✓ ✓	✓ ✓ ✓	✓	✓
URBAN GREEN INFRASTRUCTURE RETROFITTING: More street trees, soft landscaping, green roofs and walls, permeable surfaces and sustainable drainage built into the fabric of our urban areas		✓ ✓		✓ ✓ ✓	✓ ✓	✓ ✓		✓ ✓ ✓
PRIVATE GARDENS: Gardens with a greater proportion of permeable surfaces and more wildlife-friendly gardening practices	✓	✓			✓	✓ ✓		✓

Conclusions and Next Steps

This study represents the first stage in the process of GM's ecosystem service assessment. It has started the process of understanding and mapping the most important ESS in GM and helping us to identify key issues we will need to consider and address if we are to maximise the benefits these ESS could provide to GM and delivery of its strategic priorities. In doing this it has provided:

- A consistent and replicable framework and mapping approach for GM's ESS and made first steps in pulling together datasets and producing initial visualisation mapping around the 'priority' ESS
- Identified and, in some cases more importantly confirmed, the set of 'pinches' or issues which affect GM's priority ESS. This it has given us more confidence that we know and understand the interventions needed to overcome the pinches and the relative priority we might give to developing actions to target ESS improvements towards particular types of GM's natural environment assets.
- It has also identified or clarified which of GM's natural environment assets, particularly our public greenspaces, rivers and river valleys, represent the most important areas we should think of targeting the development and delivery of actions to protect and improve our natural environment if we are to take opportunities to maximise the ESS benefits these provide.
- Given us confidence, through the synergies and conflict analysis undertaken as part of this study, that other than potentially for large scale increases in food production within GM for GM, that we have the potential to develop and deliver approaches which will maximise the of our green spaces and the ESS they provide in support of GM's multifunctionality social and economic growth aspirations.

Also, whilst this study did not set out to identify specific detailed proposals (either by habitat or action type or spatial location), it has developed a robust and logical framework (and supporting data sets) within which the subsequent development and resourcing of any subsequent delivery projects can be progressed.

However, recognising the relative infancy of this approach in GM, the public availability of some of the data and the need to more widely engage partners in GM's ESS process, the following next steps are recommended:

- Quality assure the outputs of this study, particularly the data sets and provisional mapping/visualisation outputs, using small expert panels, drawn from GMCA, Local Authorities, Universities and interest groups. These panels should review each Priority ESS logical framework and mapping proposal resulting in a finalised set of agreed data from which final visualisation maps can be produced.
- Assess GM's strategic projects Natural Environment projects, starting with the GMGI Action Plan projects (see fig 2 below), against the finalised priority ESS mapping to ensure proposals address 'pinches' and deliver required interventions for GM's natural environment types which therefore maximise delivery of multiple ecosystem services outcomes
- Similarly assess other economic and environmental investments against ESS assessment and mapping.

- Consider how the process might link to DEFRA’s work explore the potential to better integrate the delivery of biodiversity, water quality and flood risk management objectives⁷. There is also potential to link the approach to the new Countryside Stewardship grant scheme and to the Environment Agency Integrated Environment Programme.
- Consider if other groups or partners if they were interested in other ESS would wish to utilise the outputs of this project to develop a consistent methodology. Possible examples include:

- Biomass for energy
- Soil formation and conservation
- Pollination
- Educational
- Heritage

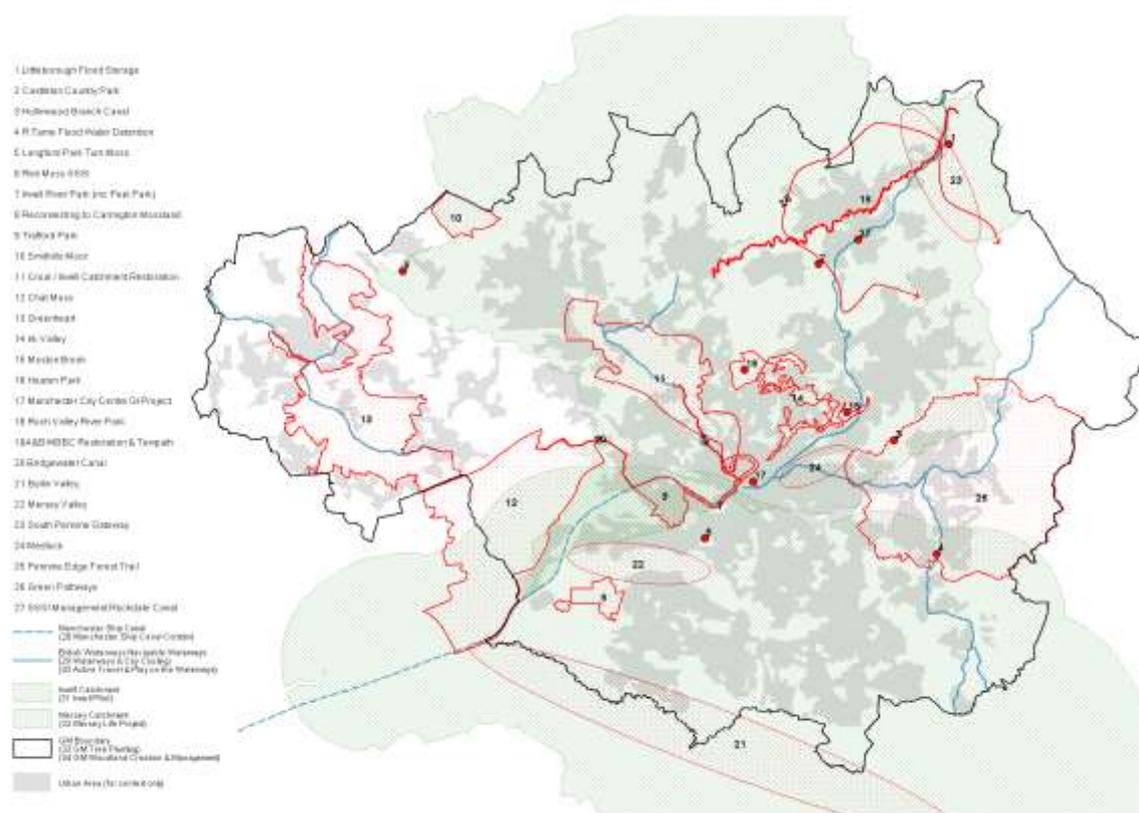


Figure 2 – Greater Manchester Green Infrastructure Plan projects

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1. INTRODUCTION

Purpose of this study

This report was commissioned by Greater Manchester Combined Authority (GMCA) (via Oldham Council), with funding from Natural England. It was to build on existing work that has been undertaken within Greater Manchester and to support the work of the Natural Capital Group, the Local Nature Partnership for greater Manchester. The project has four main aims:

- Identify GM's 'priority' Ecosystem Services (ESS);
- Start to understand, and map the location of these priority ESS;
- Begin to identify the specific Ecosystem Services **pinch points** associate with these within Greater Manchester; and
- Start to map out the key **interventions** that are required to overcome pinches.

Pinch points are the issues that could prevent the priority Ecosystem Services (ESS) supporting Greater Manchester's investment for growth and/or redevelopment. Pinch points can be structural (e.g. physical barriers to accessing an ESS such as rivers for recreation) or functional (e.g. absence of appropriate supply chains). **Interventions** are the actions that can alleviate these pinch points and provide solutions at a strategic scale.

Introduction to Ecosystem Services

Ecosystem Services are generally considered to be the benefits that businesses and people obtain from the natural environment, specifically the ecosystem processes that these deliver.

The Common International Classification of Ecosystem Services (CICES) ⁸ includes a diagram (Fig 1.1) that illustrates the complex interactions which provide benefits to people.

⁸ <http://cices.eu/>

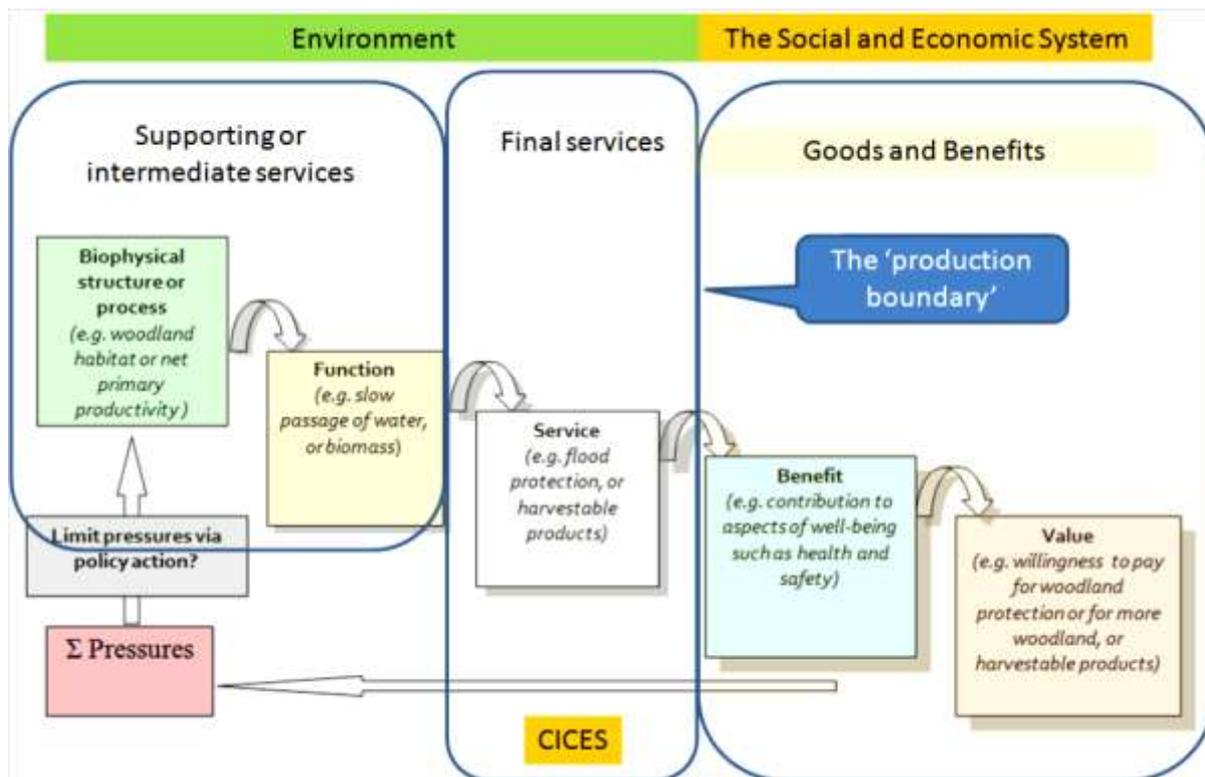


Fig.1.1 The Ecosystem Service Cascade (taken from CICES Report on Consultation⁹)

The diagram shows how the natural environment can provide benefits to people. For example, natural structures such as woodlands have the capacity, or function, to slow the flow of water. This has the potential to reduce flooding. The function of the woodland to slow the flow of water is generally considered a characteristic of the natural environment. However, if the potential to reduce flooding is considered a benefit to people, because a new housing development is at risk of flooding for example, then it can be regarded as an ecosystem service. Such services will be valued differently by different communities depending on their location and priorities.

CICES splits Ecosystem Services into three categories:

- **Provisioning services** - products obtained from ecosystems, including food, fuel, timber, medicines
- **Regulating and maintaining services** - services that are necessary for the production of all other ecosystem services including soil formation, photosynthesis, pollination, and benefits obtained from the regulation of ecosystem processes, including climate regulation, water purification, flood prevention, air quality regulation
- **Cultural services** - non-material benefits people obtain through spiritual enrichment, recreation, aesthetic experiences, tourism

Note: A fuller explanation of the Ecosystem approach is provided in Appendix 2

⁹ http://cices.eu/wp-content/uploads/2012/07/CICES-V43_Revised-Final_Report_29012013.pdf

2. GENERAL FINDINGS

Identifying Greater Manchester's Priority ESS

A 'long list' of ESS was developed, based on the Common International Classification of Ecosystem Services (CICES) V4.3.¹⁰ In practice, CICES V4.3 contains some anomalies and from a GM perspective it does not map perfectly onto GM issues, so some manipulation of terms has been adopted. The long list is shown in Appendix 1.

With input from meetings of the Natural Capital Officers Group and our experience of the development of various GM strategies, each ESS down to the Class level was given a score

- 0= Of no strategic importance for GM
- 1= Of little strategic importance for GM
- 2= Of some strategic importance for GM
- 3= of major strategic importance for GM

From this, eight ESS have been identified as GM Priorities:

- Local and commercial food production
- Surface water and fluvial flood management
- Carbon storage and sequestration
- Cooling of Urban Heat Island
- Water quality management
- Habitat and Wildlife corridor provision
- Visual/Aesthetic
- Public recreation and Venue for green travel routes

Table 2.1 sets out how each of these relates to the strategic context

¹⁰ <http://cices.eu/>

Table 2.1 Key ESS links to Strategic Context

ESS	Greater Manchester Strategy - Strategic Priority	GM Climate Change Strategy - Key Themes	European/ national policy
Local and commercial food production	<ul style="list-style-type: none"> • Seize the economic growth potential of the global drive towards a low carbon economy and increased resource efficiency • Health and social care 	<ul style="list-style-type: none"> • Transport • Sustainable Consumption 	<ul style="list-style-type: none"> • Natural Environment White paper
Surface water and fluvial flood management	<ul style="list-style-type: none"> • Masterplan and deliver the investment necessary in the existing and critical infrastructure required to support growth 	<ul style="list-style-type: none"> • Buildings • Green and Blue Infrastructure 	<ul style="list-style-type: none"> • Flood and Water Management Act 2010
Carbon storage and sequestration	<ul style="list-style-type: none"> • Seize the economic growth potential of the global drive towards a low carbon economy and increased resource efficiency 	<ul style="list-style-type: none"> • Green and Blue Infrastructure 	<ul style="list-style-type: none"> • 2008 Climate Change Act
Cooling of Urban Heat Island	<ul style="list-style-type: none"> • Masterplan and deliver the investment necessary in the existing and critical infrastructure required to support growth • Health and social care 	<ul style="list-style-type: none"> • Buildings • Green and Blue Infrastructure 	<ul style="list-style-type: none"> • 2008 Climate Change Act • National Adaptation Programme
Water quality management	<ul style="list-style-type: none"> • Strengthen the global distinctiveness and world ranking of Manchester as a place to invest, live and visit 		<ul style="list-style-type: none"> • Water Framework Directive
Habitat and Wildlife corridor provision		<ul style="list-style-type: none"> • Green and Blue Infrastructure 	<ul style="list-style-type: none"> • Natural Environment and Rural Communities Act 2006
Public recreation and Venue for green travel routes	<ul style="list-style-type: none"> • Attract and retain talent by creating places where people want to live, through the stimulation of the housing market and delivery of a high quality residential offer • Improve Greater Manchester's connectivity locally, nationally and internationally • Health and social care 	<ul style="list-style-type: none"> • Transport 	<ul style="list-style-type: none"> • Marmot Review
Visual and Aesthetic impacts	<ul style="list-style-type: none"> • Attract and retain talent by creating places where people want to live, through the stimulation of the housing market and delivery of a high quality residential offer • Strengthen the global distinctiveness and world ranking of Manchester as a place to invest, live and visit 		<ul style="list-style-type: none"> • Marmot Review

ESS Synergies and conflicts

Key to the Ecosystems Approach is the understanding that there are complex interactions between ESS, and so it is important to look at how provision of one service impacts on the provision of others. Table 2.2 below attempts to summarise how each Priority ESS interacts with the others. The upper right half of the diagram assesses how the services interact currently. The lower left half assesses how they would interact if ecosystems were managed to maximise each of the services along the top row.

As can be seen, most of the priority ESS for Greater Manchester interact positively with each other, sometimes strongly so. The main exception to this is Local and Commercial Food Production. Many current food production methods have a damaging effect on other ESS, and it will be difficult to substantially increase food production within GM without even greater negative impacts.

However, the main conclusion from this assessment is that most of GM's priority ESS's are complementary. This suggests that an integrated approach to managing the natural assets of the sub-region can deliver a multifunctional landscape with multiple benefits, and that a wide range of stakeholders will have an interest in funding, delivering or supporting this approach.

Table 2.2 Conflicts and Synergies between ESS

- ++ Strongly positive interaction
- + Positive interaction
- 0 Neutral interaction
- Negative interaction
- Strongly negative interaction

	Local and commercial food production	Surface water and fluvial flood management	Carbon storage and sequestration	Cooling of Urban Heat Island	Water quality management	Habitat and Wildlife corridor provision	Public recreation and Venue for green travel routes	Visual/Aesthetic	
Local and commercial food production		-	-	0	- -	0	+	+	CURRENT POSITION
Surface water and fluvial flood management	-		+	+	++	+	+	+	
Carbon storage and sequestration	- -	++		+	+	+	0	+	
Cooling of Urban Heat Island	0	++	+		+	+	+	+	
Water quality management	-	++	+	++		+	0	+	
Habitat and Wildlife corridor provision	-	+	++	++	++		+	++	
Public recreation and Venue for green travel routes	-	0	0	+	++	+		++	
Visual/Aesthetic	-	+	+	++	+	++	++		
IF SERVICE MAXIMISED									

3. DETAILED FINDINGS

Outline of methodology

The challenges for this project (and many other ESS mapping projects) are how to analyse, understand and present the large amounts of data, from many disparate datasets and at different resolutions, which could potentially be used for even the small selection of Priority ESS. The approach we are recommending is one that has developed out of RRF's collaboration with University of Sheffield and other partners on the VALUE+ INTERREG project. This involves

- Developing a **logical framework** for the ESS to help understand how the ESS works
- Using that framework to identify a **mapping proposal** for representing the logical framework spatially, using current data and identifying potential improvements to data or mapping
- Creating a **provisional map** from current data to help visualise the service

Logical Frameworks

Many of the ESS (and Green Infrastructure) Mapping projects to date have concentrated on assembling a great deal of GIS data, typically on the source of the service rather than its beneficiaries, and layering this data for multiple ESS. The resulting maps can be difficult to interpret. The Polyscape study¹¹ in Wales has taken steps forward in combining data on a relatively small set of ESS in a logical structure that arrives at a robust understanding of ESS sources and flows, and also allows conflicts and synergies between ESS to be taken into account.

In this study, we have attempted to create a Logical Framework for each ESS that aims to summarise the broad functioning of that service by breaking it down into standard headings:

Source: The main typologies (Ecosystems, landcover types, designations, etc.) that deliver the ESS in the study area.

Score: Each source is given a score to indicate its relative importance to GM, based on a combination of its geographical scale and its importance for delivering the ESS

Source Trends: What are the general changes happening to the source?

Barriers: What might be stopping this source delivering the ESS to the beneficiaries?

Risks: What are the major issues that might prevent this source from providing the ESS in the future?

Beneficiary: Who or what benefits from this ESS?

¹¹ <http://www.sciencedirect.com/science/article/pii/S0169204612003532>

Beneficiary trends: What are the general changes happening to the beneficiary?

Pinch: Based on all the above, what are there spatial or functional issues that are critical to the delivery of this ESS in the study area?

To help make this process flow better visually, the template presents the Beneficiary Trends above the Beneficiary field, with the Pinch field located centrally.

Mapping Proposal

For each ESS, we took the Logical Framework and used it to set out a mapping proposal, using the fields below:

Source	Datasets used	Rationale	Improvements for future mapping
The sources identified in the Logical framework	What datasets will we use to map this source?	Logic for using this dataset	How could we improve this? e.g additional datasets, more advanced weighting
Beneficiaries			
The beneficiaries identified in the Logical Framework			

For the purposes of this report, only the Source data has been mapped, as it was felt that mapping beneficiary data onto the maps would make the Source data difficult to see easily. In practice, many of the proposed beneficiary datasets are the same for several ESS.

The different datasets for each ESS were then combined (using the Spatial Analyst extension in ArcView GIS) to give an indication of the spatial priority areas.

Finally, the spatial priority areas for the 8 ESS were combined to give a provisional indication of the most important areas in GM for ESS – see Fig 3.1 below. The Logical Frameworks, Mapping Proposals and Provisional Maps for each ESS are included in Appendix 3 – available as a separate file.

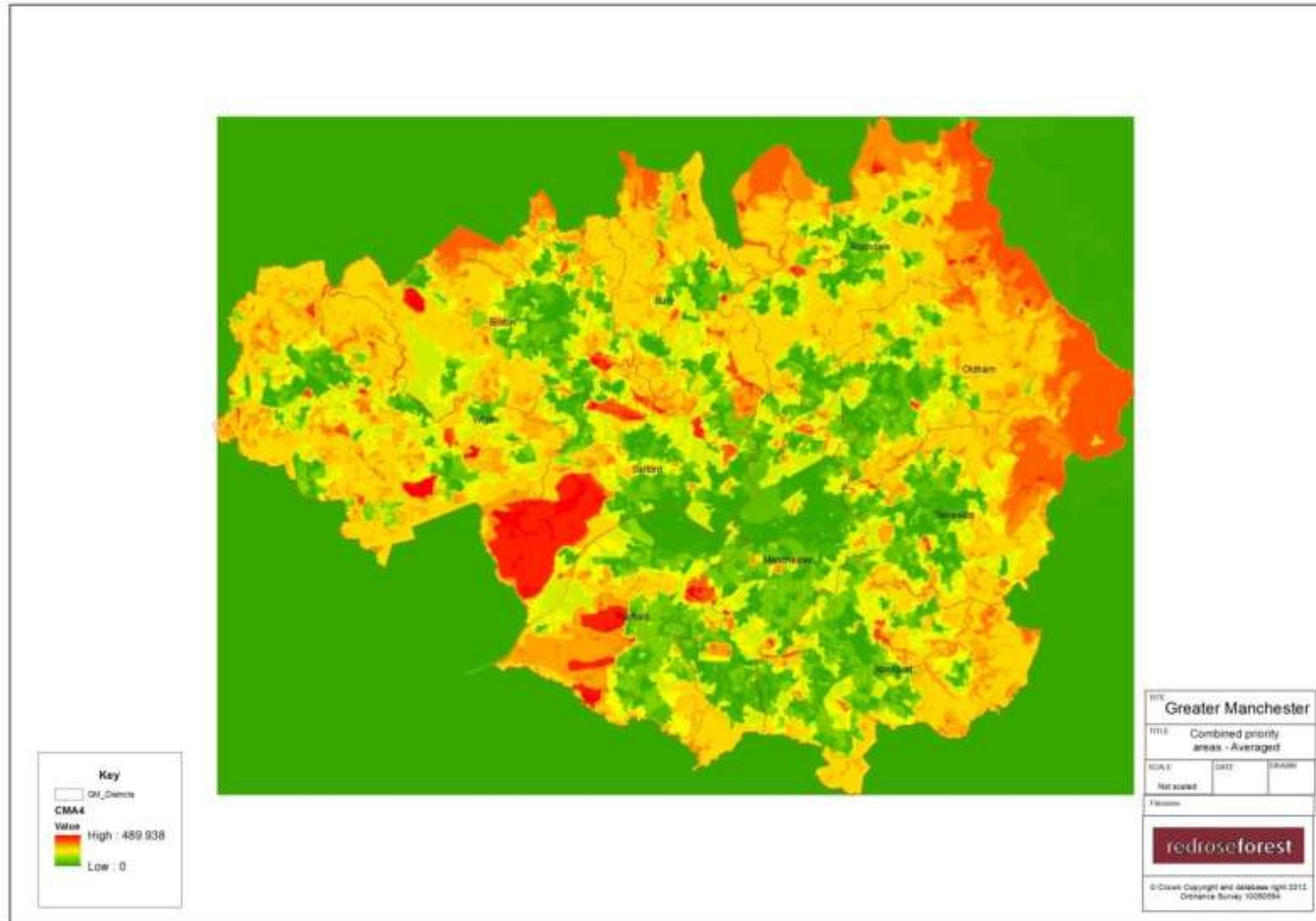


Fig 3.1 Combined map of ESS Priority Mapping

Pinch Points

The study has, through understanding and mapping GM's 'priority' ESS, started to identify the key 'pinches' for each ESS. These represent the issues, spatial or otherwise, which are critical to that ESS. These are the issues which would need to be addressed for the services that ESS provides to GM to be maximised. These pinches have been summarised in the table below:

<p>Local and commercial food production</p> <ul style="list-style-type: none"> • We need to improve the function of local markets in supplying food from GM to GM if this service is to be maximised. However, a significant shift from 'horsiculture' to food production would be needed to achieve major benefits for bulk food production • Other interventions such as supporting market gardening, education and training would, unless at very large scale, have limited impact on bulk food production but could improve healthy eating habits or increase environmental awareness more generally.
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<p>Cooling of urban heat island</p> <ul style="list-style-type: none"> • Retrofitting a mixture of GI measures including trees over hard surfaces (for shading as well as evaporative cooling) is crucial for lowering the UHI effect, particularly in GM's town centres. • We need to open up (also known as day lighting) waterways to maximise their cooling effect • GI surrounding our urban areas needs to be protected and enhanced so it provide sources of cooled air which can be drawn into the centres
<p>Water quality management</p> <ul style="list-style-type: none"> • We need to naturalise our river channels (including the tributaries of our main rivers), provide reed bed or other forms of natural filtration and appropriately protect and manage our wetlands to maximise their ability to capture and retain waterborne pollution. • We also need to sensitively manage our upland and mosslands to maximise the major positive impacts on water quality, esp. sediments and dissolved carbon they can have • GI retrofitting will be important in tackling diffuse urban pollution, esp. in areas of high air pollution or road film deposition

Habitat and wildlife corridor provision

- We need to work with private and public landowners to reverse the decline in levels of habitat management and take opportunities to connect up our ecological networks, particularly in the river valleys which are our most substantial connected network
- Private gardens are a major wildlife resource, and so influencing their management could have significant wildlife and ESS benefits
- We need to work with those planning investments in growth, development and infrastructure to identify where key green infrastructure could be lost to development and therefore needs protecting or where opportunities exist for new assets to be created through sensitive development,

Public recreation and venue for green travel routes

- We need to maximise and increase the cross linkages and flexibility of our already extensive existing network of green recreational/active travel routes, including river valleys, canals and National Cycle Network
- But in doing this, new mechanisms for resourcing green space provision and its management, increasing the range of stakeholders contributing to it, is needed if we are to ensure continued/increasing use of GM's public greenspaces for recreation and active travel.

Visual and aesthetic impacts

- We need to maximise the role GI retrofitting, esp. into areas of deprivation, plays in improving aesthetics and quality of place.
- In doing this we must increase levels of GI provision, particularly street and forest scale trees and open spaces, within our regeneration and economic growth priority areas.
- We should take the opportunity to ensure new SUDS and water management infrastructure is designed and managed as landscape features, not just engineering ones, with biodiversity exploited to help combat any health risks from standing water

Interventions

The ‘pinches’ outlined above represent the issues which would need to be addressed if we were to maximise the services and level of service to GM from each of the identified priority ESS.

However, multiple ESS can be provided in one type of green space/natural habitat. It is therefore useful to consider these in terms of the sorts of interventions which would be needed within the major categories of GM’s natural environment assets. The table below summarises the high level strategic activities / action which would be needed to maximise ESS benefits. An indication has also been made of the relative level of contribution (on a scale of 1-3) the intervention will have to each of the 8 priority ESS. Those which have the potential for the greatest contribution, both in terms of number of ESS impacted or the scale of benefit which is potentially achievable if actions were developed and delivered around particular interventions.

These therefore represent the greatest return on investment and potential benefit, from a priority ESS point of view, of developing and delivering actions around that particular intervention. However, this does not imply a priority order based on deliverability or other factors.

GM Natural Environment categories	FOOD	FLOOD	CARBON	COOLING	WATER QUALITY	BIODIVERSITY	RECREATION/ ACTIVE TRAVEL	AESTHETIC
PUBLIC GREENSPACES: Better-managed, more multifunctional formal and informal public greenspaces	✓ ✓	✓ ✓ ✓	✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓
RIVERS AND CANALS: A more natural river network, with fewer culverted sections and greater capacity to store floodwaters. Canals that act as corridors for people and wildlife, that provide climate change adaptation, and support economic activity		✓ ✓		✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓
RIVER VALLEYS: An integrated approach to managing the public greenspaces and private land in GM’s river valley network, with better linkages through them for people and wildlife	✓	✓ ✓ ✓	✓		✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓
TREES AND WOODLANDS: More and better-managed woodlands and more trees in town centres, along transport corridors and in neighbourhoods where they are lacking	✓	✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓

MOSSLANDS AND MOORLANDS: Mosslands and moorlands that are better managed to retain and filter water and protect their carbon stores		✓ ✓ ✓	✓ ✓ ✓		✓ ✓	✓ ✓ ✓	✓	✓
URBAN GREEN INFRASTRUCTURE RETROFITTING: More street trees, soft landscaping, green roofs and walls, permeable surfaces and sustainable drainage built into the fabric of our urban areas		✓ ✓		✓ ✓ ✓	✓ ✓	✓ ✓		✓ ✓ ✓
PRIVATE GARDENS: Gardens with a greater proportion of permeable surfaces and more wildlife-friendly gardening practices	✓	✓			✓	✓ ✓		✓

Conclusions and Next Steps

This study represents the first stage in the process of GM’s ecosystem service assessment. It has started the process of understanding and mapping the most important ESS in GM and helping us to identify key issues we will need to consider and address if we are to maximise the benefits these ESS could provide to GM and delivery of its strategic priorities. In doing this it has provided:

- A consistent and replicable framework and mapping approach for GM’s ESS and made first steps in pulling data sets and producing initial visualisation mapping around the ‘priority’ ESS
- Identified and, in some cases more importantly confirmed, the set of ‘pinches’ or issues which affect GM’s priority ESS. This it has given us more confidence that we know and understand the interventions needed to overcome the pinches and the relative priority we might give to developing actions to target ESS improvements towards particular types of GM’s natural environment assets.
- It has also identified or clarified which of GM’s natural environment assets, particularly our public greenspaces, rivers and river valleys, represent the most important areas we should think of targeting the development and delivery of actions to protect and improve our natural environment if we are to take opportunities to maximise the ESS benefits these provide.
- Given us confidence, through the synergies and conflict analysis undertaken as part of this study, that other than potentially for large scale increases in food production within GM for GM, that we have the potential to develop and deliver approaches which will maximise the of our green spaces and the ESS they provide in support of GM’s multifunctionality social and economic growth aspirations.

Also, whilst this study did not set out to identify specific detailed proposals (either by habitat or action type or spatial location), it has developed a robust and logical

framework (and supporting data sets) within which the subsequent development and resourcing of any subsequent delivery projects can be progressed.

However, recognising the relative infancy of this approach in GM, the public availability of some of the data and the need to more widely engage partners in GM's ESS process, the following next steps are recommended:

- Quality assure the outputs of this study, particularly the data sets and provisional mapping/visualisation outputs, using small expert panels, drawn from GMCA, Local Authorities, Universities and interest groups. These panels should review each Priority ESS logical framework and mapping proposal resulting in a finalised set of agreed data from which final visualisation maps can be produced.
- Assess GM's strategic projects Natural Environment projects, starting with the GMGI Action Plan projects (see fig2 below), against the finalised priority ESS mapping to ensure proposals address 'pinches' and deliver required interventions for GM's natural environment types which therefore maximise delivery of multiple ecosystem services outcomes
- Similarly assess other economic and environmental investments against ESS assessment and mapping.
- Consider how the process might link to DEFRA's work explore the potential to better integrate the delivery of biodiversity, water quality and flood risk management objectives¹². There is also potential to link the approach to the New England Land Management Scheme (NELMS) and to the Environment Agency Integrated Environment Programme.
- Consider if other groups or partners if they were interested in other ESS would wish to utilise the outputs of this project to develop a consistent methodology. Possible examples include:
 - Biomass for energy
 - Soil formation and conservation
 - Pollination
 - Educational
 - Heritage

¹²

<https://drive.google.com/folderview?id=0B9V3MFss6gRxT2dmZEUySThQdDQ&usp=sharing>

APPENDIX 1 – Greater Manchester’s ESS Long list and prioritisation for GM

Ecosystem service	Division	Group	Class	Priority for provision within GM	GM Priority Service
Provisioning	Nutrition	Biomass	Cultivated crops	3	Local and commercial food production
			Reared animals and their outputs	3	
			Wild plants, algae and their outputs	1	
			Wild animals and their outputs	1	
			Plants and algae from in-situ aquaculture	0	
			Animals from in-situ aquaculture	1	
			Water	Surface water for drinking	2
		Ground water for drinking	1		
	Materials	Biomass	Fibres and other materials from plants, algae and animals for direct use or processing	1	
			Materials from plants, algae and animals for agricultural use	1	
			Genetic materials from all biota	1	
		Water	Surface water for non-drinking purposes	2	
			Ground water for non-drinking purposes	2	
	Energy	Biomass-based energy sources	Plant-based resources	2	
			Animal-based resources	0	
		Mechanical	Animal-based energy	0	

Ecosystem service	Division	Group	Class	Priority for provision within GM	GM Priority Service	
		energy				
Regulation & Maintenance	Mediation of waste, toxics and other nuisances	Mediation by biota	Bio-remediation by micro-organism, algae, plants, and animals	3	Water quality management	
			Filtration/sequestration/storage/accumulation by micro-organisms, algae, plants, and animals	3		
		Mediation by ecosystems	Filtration/sequestration/storage/accumulation by ecosystems	3		
			Dilution by atmosphere, freshwater and marine ecosystems	3		
			Mediation of smell/noise/visual impacts	2		
	Mediation of flows	Mass flows	Mass flows	Mass stabilisation and control of erosion rates	2	
				Buffering and attenuation of mass flows	2	
		Liquid flows	Liquid flows	Hydrological cycle and water flow maintenance	3	Surface water and fluvial flood management
				Flood protection	3	
		Gaseous / air flows	Gaseous / air flows	Storm protection	1	
				Ventilation and transpiration	1	
	Maintenance of physical, chemical, biological conditions	Lifecycle maintenance, habitat and gene pool protection	Lifecycle maintenance, habitat and gene pool protection	Pollination and seed dispersal	2	
				Maintaining nursery populations and habitats	3	Habitat and wildlife corridor provision
		Pest and disease control	Pest control	2		

Ecosystem service	Division	Group	Class	Priority for provision within GM	GM Priority Service
			Disease control	2	
		Soil formation and composition	Weathering processes	2? as not recognised as 3?	
			Decomposition and fixing processes	2? as not recognised as 3?	
		Water conditions	Chemical condition of freshwaters	3	Water quality management
			Chemical condition of salt waters	0	
		Atmospheric composition and climate regulation	Global climate regulation by reduction of greenhouse gas concentrations	3	Carbon sequestration/storage
			Micro and regional climate regulation	3	Cooling of Urban Heat Island
Cultural	Physical and intellectual interactions with ecosystems and land-/seascapes [environmental settings]	Physical and experiential interactions	Experiential use of plants, animals and land-/seascapes in different environmental settings	2	
			Physical use of land-/seascapes in different environmental settings	3	Recreation and active travel
		Intellectual and representative interactions	Scientific	2	
			Educational	2	
			Heritage, cultural	2	
			Entertainment	1	
			Aesthetic	3	Visual/Aesthetic
	Spiritual,	Spiritual	Symbolic	1	

Ecosystem service	Division	Group	Class	Priority for provision within GM	GM Priority Service
	symbolic and other interactions with ecosystems and land-/seascapes [environmental settings]	and/or emblematic			
			Sacred and/or religious	1	
		Other cultural outputs	Existence	2	
	Bequest	2			

Appendix 2 - A Summary of the Ecosystem Approach

The concept of ecosystem services forms part of the ecosystem approach. The ecosystem approach is designed to promote integrated thinking about the environment and a holistic approach to its management.¹³ The approach recognises that nature provides society with many benefits, including food, clean water and opportunities for recreation. It provides a way of thinking about the value of nature and enables us to prioritise the management of our natural assets more effectively by considering 3 key elements:

People

The ecosystem approach recognises that people are an integral component of an ecosystem and puts people at the centre of the management of the natural environment. It encourages the involvement of all stakeholders and provides opportunities for mutual understanding and shared goals. It places people's overall needs and choices at the heart of decision making in ways that have not been possible in the past. Through the concept of ecosystem services the ecosystem approach allows decision makers to better understand and value the social and economic benefits to society alongside other infrastructure needs to better make the case for environmental protection and enhancement.

The ecosystem approach is designed to be flexible and allows for the approach to be adapted to meet specific purposes. The flexibility encourages the concept of 'learning by doing' and the adaptation of the approach in response to changing circumstances or as new knowledge is gathered. This flexibility is essential to enable everyone's understanding and perspectives to be combined over time.

Systems

The ecosystem approach considers how management decisions can maintain these processes and functions to create a resilient natural environment which will continue to provide multiple benefits for people into the future.

To successfully maintain the processes and functions of the natural environment, it is important to recognise that ecosystems interact with other ecosystems and they should not be managed in isolation. The ecosystem approach encourages people to think about the connections with ecosystems beyond boundaries and cooperate with all stakeholders that may have an impact on or depend on the ecosystems.

¹³ Ecosystems Knowledge Network (2013) *Background to an ecosystems approach* [online] Available at: <http://ekn.defra.gov.uk/about/background/>

Value

Recognising the value of the natural environment is one aspect of the ecosystem approach. This does not mean that people should get bogged down in placing monetary values on nature. Valuation of nature's benefits is not purely about placing a monetary value on the natural environment. It also involves understanding what the natural environment means to people. People may hold a particular affection for an aspect of the natural environment for reasons such as their past experiences, the opportunities it provides them for spending time with family or for peace and tranquillity. It is difficult to place a monetary value on such benefits, but this does not make them any less valuable to human wellbeing.

Decision making is often steered by economic factors. Valuation can help natural environment professionals to communicate with different audiences such as economists, and enhance the justification for investment in the natural environment. The concept of valuing ecosystem services allows natural environment professionals to speak a similar language and influence decision making.

Definitions of key concepts

- **Ecosystem** - An ecosystem is 'the dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit'.¹⁴
- **Ecosystem processes** - Ecosystem processes are the product of the interactions between the different plant, animal and micro-organism communities.¹⁵ Examples of such processes include: decomposition; production; nutrient cycling; and fluxes of nutrients and energy.
- **Ecosystem functions** - Ecosystem function is dependent on the interactions in the ecosystem and ecosystem processes. When an ecosystem function has the potential to provide a benefit to people it will be considered an ecosystem service.¹⁶
- **Ecosystem services** - Ecosystem services are 'the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life'.¹⁷
- **Natural capital** - The term 'natural capital' is usually used as an economic metaphor for 'environmental assets'. Such assets, which include forests, soils or

¹⁴ JNCC (n.d.) *Ecosystem*, Available at: <http://jncc.defra.gov.uk/page-6378-theme=default>

¹⁵ UK NEA (n.d.) *Ecosystems*, Available at: <http://uknea.unep-wcmc.org/EcosystemAssessmentConcepts/tabid/98/Default.aspx>

¹⁶ Haines-Young, R. and Potschin, M. (2007): The Ecosystem Concept and the Identification of Ecosystem Goods and Services in the English Policy Context. Review Paper to Defra, Project Code NR0107, 21pp

¹⁷ Daily (1997) *Introduction: What are ecosystem services?*, Available at: http://cmhc.ucsd.edu/content/1/docs/Daily_1.pdf

marine habitats, supply resources to the economy or offer a means for the disposal of wastes. Natural capital can generally be split into four basic categories:

- air
- water (fresh, groundwater and marine)
- land (including soil, space and landscape)
- habitats (including the ecosystems, flora and fauna which they both comprise and support)

The quantity and the quality of natural capital affect the quantity and quality of benefits generated.¹⁸

Background to the Ecosystem Approach

The Convention on Biological Diversity (CBD) first adopted the ecosystem approach in 1995 to provide a primary framework for action under the Convention. The Convention emphasises that the ecosystem approach can be undertaken within the context of other management or conservation approaches or frameworks, such as within protected landscapes, biospheres, through national, local or site-based policies and approaches. It is a framework to use within these contexts, rather than instead of them. The CBD has prepared principles aimed at aiding the implementation of the ecosystem approach¹⁹:

- Principle 1: The objectives of management of land, water and living resources are a matter of societal choices.
- Principle 2: Management should be decentralised to the lowest appropriate level.
- Principle 3: Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.
- Principle 4: 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:
 - Reduce those market distortions that adversely affect biological diversity;
 - Align incentives to promote biodiversity conservation and sustainable use;
 - Internalise costs and benefits in the given ecosystem to the extent feasible.
- Principle 5: Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.
- Principle 6: Ecosystems must be managed within the limits of their functioning.

¹⁸ Natural Capital Initiative (n.d.) *Glossary* [online] Available at:

<http://www.naturalcapitalinitiative.org.uk/glossary>

¹⁹ <http://www.cbd.int/ecosystem/principles.shtml>

- Principle 7: The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.
- Principle 8: Recognising the varying temporal scales and lag-effects that characterise ecosystem processes, objectives for ecosystem management should be set for the long term.
- Principle 9: Management must recognise that change is inevitable.
- Principle 10: The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.
- Principle 11: The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.
- Principle 12: The ecosystem approach should involve all relevant sectors of society and scientific disciplines.

More recently, national policy for planning and the natural environment has emphasised the importance of integrated working that takes account of the benefits of our ecosystems. Ecosystems and their benefits are recognised as essential to ensuring that future land use planning and economic development is sustainable. The Natural Environment White Paper (2011) states that, “sustainable economic growth relies on services provided by the natural environment, often referred to as ‘ecosystem services’.”²⁰ The National Planning Policy Framework (NPPF), published in 2012, recognises that “the planning system should contribute to and enhance the natural and local environment by recognising the wider benefits of ecosystem services.”²¹

The National Ecosystems Assessment

The UK National Ecosystem Assessment (UK NEA) was the first analysis of the UK’s natural environment in terms of the benefits it provides to society and continuing economic prosperity. Part of the Living With Environmental Change (LWEC) initiative, the UK NEA commenced in mid-2009 and reported in June 2011. It was an inclusive process involving many government, academic, NGO and private sector institutions.

Funded by the Department for Environment, Food and Rural Affairs (Defra), the Devolved Administrations and two Research Councils (NERC and ESRC), the driving force for the UK NEA came from the findings of the 2005 Millennium Ecosystem Assessment.

²⁰ Defra (2011) Natural Environment White Paper, The Natural Choice: securing the value of nature Crown Copyright: UK

²¹ Department for Communities and Local Government (2012) National Planning Policy Framework, UK: Crown Copyright

The UK assessment provides a comprehensive picture of past, present and possible future trends in ecosystem services, their values and response options. The UK NEA demonstrates the potential use of ecosystem assessment in decision-making at many levels of governance.

The evidence base, a 1,450 page technical report, underpinning the key messages and findings in the Synthesis was the culmination of the most comprehensive ecosystem assessment undertaken by any nation and involved over 500 natural and social scientists as well as economists.

The UK NEA has influenced **The Natural Choice: securing the value of nature**, the first white paper (in England) on the natural environment in 20 years. The paper stated that *“the Government will support further phase of ground-breaking research..[and] develop practical tools to assist decision-makers in applying the lessons of the NEA.”*

Appendix 3 – GM Priority Ecosystem Service Logical Frameworks, Mapping Proposals and Provisional Mapping

Available as separate file on request.