AN ECOLOGICAL FRAMEWORK FOR GREATER MANCHESTER

Frame-work **def. a support used as a basis for something being constructed**

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SUMMARY

The main mechanisms currently operated through the land use planning system for nature conservation include the identification, designation and protection of sites assessed as being of high nature conservation value and the protection of species considered to be particularly threatened . These mechanisms, although successful in their own right, have not been effective in preventing some significant declines in habitats and species in the wider landscape. National and sub-regional policies now require that innovative new approaches to nature conservation be adopted involving habitat creation, repair and maintenance in the wider landscape and the establishment of connections between areas of important habitat. One of these required new approaches is the development of Ecological Frameworks. An Ecological Framework is a spatial model developed using the principles of landscape ecology to inform and guide habitat creation and repair. This document summarises the work undertaken so far to develop an Ecological Framework for Greater Manchester.

The guiding principles used in the development of the Ecological Framework for Greater Manchester were that the Framework should be as inclusive as possible and, at least in part, be capable of implementation through the land-use planning system.

Analysis of the extent and distribution of habitats and land uses in Greater Manchester has shown that although the sub-region is biologically diverse, habitats generally occur in small patches and can be fragmented. Linking and buffering these habitat patches to form a properly interconnected habitat network may be difficult. An alternative approach is proposed that identifies broad areas sharing similar ecological and land-use characteristics, rather than concentrating on the recreation and connection of selected habitat types. Following this approach 'Biodiversity Opportunity Areas' have been identified. Suggestions are put forward as to the best policy mechanisms, actions and interventions to use to achieve effective habitat creation and repair in each of the identified Opportunity Areas.

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An Ecological Framework for Greater Manchester

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1.1 Nature Conservation and the Land-use Planning System

Currently the conservation of biodiversity is predominantly effected through the land use planning system largely by the identification, designation and protection of sites with existing substantive nature conservation value, and the protection of a relatively small list of species identified as being particularly threatened. Planning policies protect designated sites from inappropriate development or, if there are considered to be overriding reasons for development of the site to take place, seek mitigation to reduce the impact of the development or compensation for any habitat losses that cannot be mitigated.

There is a hierarchy of protected sites, ranging through sites designated for their international value, sites designated for their national value and sites designated for their sub-regional or local value. The degree of protection offered to an individual site varies depending on the designation; generally the higher the 'status' of the site, the higher the degree of protection that is offered.

The protection of designated sites for nature conservation value through the land use planning system has been very effective in preventing harmful development and inappropriate management of these important sites. It is rare for inappropriate development to be permitted on designated sites, and even in cases where development is allowed for overriding reasons mitigation and compensation measures are invariably implemented to safeguard nature conservation value.

However, the system of protecting designated sites has not been effective in preventing significant declines in habitats and species in the wider landscape. In England in the past twenty years 71% of butterfly species, 56% of bird species and 28% of plant species have either suffered significant declines or have become extinct. There are a number of reasons for the apparent lack of effectiveness of designated sites in preventing these declines:

- Many of the designated sites are small and fragmented. The movement of many types of species between these sites is restricted. This means that important species can easily be lost from sites but cannot be easily replaced. The small size of many sites also leads to pronounced 'edge effects' where the boundaries of sites suffer encroachment and degradation from surrounding land uses.

- Designated sites can only ever cover a relatively small proportion of the landscape, and most species are found outside of designated sites where they experience lower levels of protection and inappropriate land management practices.

- People view nature conservation as being 'taken care of' in designated sites and therefore putting less effort into nature conservation in the wider landscape.

- The designated sites can only be properly protected from damaging operations that can be controlled through the land-use planning system. Other damaging

operations (for example farming and forestry practices) cannot be properly prevented from causing harm to sites through the land use planning system, although it is recognised that the effects of these operations can be moderated through other mechanisms.

- Many of the designated sites themselves are not managed appropriately for their nature conservation interest.

An additional factor to consider when assessing the limitations of the designated site system for nature conservation is climate change. Climate change is now causing, and will increasingly cause in future, changes to distributions of species. If species are unable to move between areas they will be put at greater risk of decline and extinction. If species movement is to be facilitated to enable adaptation to climate change the 'permeability' of the landscape as whole must be improved. This improvement must be achieved against a background of increasing urbanisation.

The land-use planning system has for some time recognised and protected 'habitat corridors' and 'stepping stones' in the wider landscape to facilitate species movement, but the ecological function of these corridors and stepping stones has in many cases not been properly tested. The figures presented above for species declines would indicate that currently identified corridors and stepping stones are inadequate. If nature conservation efforts through the land-use planning system are to be made more effective in the future, mechanisms must be developed that encourage **habitat repair** and **habitat creation** in the wider landscape and facilitate **connections** between areas of semi-natural habitat. These measures should enable species to at least maintain current population levels and at best increase their populations. To this end national, regional and local targets are being set for the expansion of habitat areas and species populations and ranges. Ambitious policies in the North West Regional Spatial Strategy (RSS) call upon local authorities to achieve a 'step-change increase in biodiversity resources' rather than simply conserving existing resources.

1.2 New Approaches to Nature Conservation

In the UK a number of initiatives are developing that seek to address some of the above issues and provide mechanisms for implementing habitat creation, repair and connection. The most important of these are:

1.2.1 Biodiversity Action Plans (BAPS)

BAPS are Plans that identify a list of habitats and species considered as priorities for nature conservation and then set out a list of necessary actions for their effective conservation. There is a National BAP for the UK and a range of regional, sub-regional and local BAPS. The Greater Manchester Biodiversity Action Plan (GMBAP) was first published in 2003 and is currently being updated as part of a planned five-year review. The GMBAP is prepared and implemented by the GM Biodiversity Project.

One of the barriers to the successful implementation of both the UK and the GM BAP is that there has never been accurate spatial information concerning the extent and distribution of priority habitats and species available from which realistic targets could be set and the success of the Plan monitored. The development of an Ecological

Framework for Greater Manchester has enabled the collection of new spatial information that will help to implement and monitor the Greater Manchester BAP.

1.2.2 Green Infrastructure and the Ecosystem Approach

Increasingly, strategic, holistic approaches are being taken to the creation, protection and management of greenspace. These approaches recognise that green spaces can deliver multi-functional benefits and should not be seen as 'single use' spaces. For example, a nature reserve can also be used as a recreational space, as a flood defence mechanism or as a carbon store. Multiple-function greenspaces together make up the 'Green Infrastructure' of a particular area or locality. By taking a Green Infrastructure approach to the creation, enhancement and management of greenspace wildlife will benefit, since many spaces (and particularly urban spaces) can be improved for wildlife as part of a strategy for maximising greenspace multi-functionality. An Ecological Framework can be viewed as an element of a wider Green Infrastructure strategy, since a Framework can be used to inform the creation and management of green space.

The various functions performed by an area of greenspace can be referred to as 'ecosystem services' and by maximising the services delivered by an area of greenspace it can be said that the wider ecosystem will benefit – this is the 'Ecosystem Approach'. The Ecosystem Approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. Application of the ecosystem approach is based on appropriate scientific methodologies focused on levels of biological organisation which encompass the essential processes, functions and interactions among organisms and their environment. An important point is that this approach recognises that humans, with their cultural diversity, are an integral component of ecosystems. The Ecological Framework attempts to include people and their actions, particularly in relation to development, as a mechanism for implementing the Framework.

1.2.3 Ecological Networks and Ecological Frameworks

These emerging models use the principles of landscape ecology to identify priority areas for habitat creation and repair. The basic idea is to identify sites and areas considered to have the best potential for the creation, repair and connection of important habitats and then to encourage appropriate nature conservation efforts in these areas through various mechanisms, including the land-use planning system. The terms 'network' and 'framework' are sometimes used as if they were interchangeable, but this report recognises a distinction between the terms. **Ecological Networks** concentrate on buffering and linking existing sites considered important for nature conservation to form a physical network of large, interconnected sites. Network models make the reasonable assumption that the best places to create new areas of habitat are in places adjacent to or close to existing areas of good quality habitat, because geo-morphological and climatic factors will be more likely to support the creation of similar habitat types, and because species movement will be more likely to be facilitated between areas of existing and new habitat. An **Ecological Framework** does not place the same emphasis on buffering and linking important sites, concentrating rather on the provision of an informed Framework for nature conservation actions in the wider landscape.

In some Regions Ecological Networks/Frameworks have been designed primarily as the spatial representations of Biodiversity Action Plans. The extent and distribution of Priority habitats for conservation have been mapped and it is suggested that measures for habitat creation and repair are prioritised adjacent to or close to these existing habitat patches. In effect the Action Plans tell you *what* habitats to conserve and *how* to do it, while the Network/Framework tells you *where* best to repair and create these habitats. Guidance in the NW Regional Spatial Strategy recommends that Ecological Frameworks in the North West Region are used to inform and underpin efforts to repair and enhance priority habitats identified in BAPS.

Ecological Frameworks are often described as 'functional' or 'coherent'. This simply means that they have been informed by ecological and spatial context so that efforts for habitat creation and repair can be properly informed and targeted. For example, although tree planting could be described as habitat creation it would not be appropriate to plant trees on areas of peat soils better suited for the restoration or creation of wetland habitats.

It is very important to recognise that an Ecological Framework for Greater Manchester is meant to *complement* the existing system of protected nature conservation sites rather than *replacing* it. The principles of habitat creation and repair are in their infancy and we simply do not know how to go about recreating many important habitat types and be certain as to the outcome. Planting trees will not recreate an ancient woodland overnight, and it is impossible to restore peat bog vegetation in areas where the peat soils have been lost. Newly created areas of habitat are no substitute for protecting existing important, long-established habitat areas. An Ecological Framework should therefore be considered as an *additional* mechanism for the conservation of biodiversity in the wider landscape and not as a *replacement* for existing mechanisms. Indeed, the existing mechanisms for implementing nature conservation could be seen as important elements of the Framework as a whole.

In particular, the GM Ecological Framework does not replace currently identified **wildlife corridors, green gaps or stepping stones** as currently identified in land-use plans. These areas will have value as existing habitats and as connections between habitats.

2 The Policy Background

Policy EM1 of the North West Regional Spatial Strategy (RSS) states that:

'Plans, strategies, proposals and schemes should seek to deliver a 'step-change' increase in the region's biodiversity resources by contributing to the delivery of national, regional and local biodiversity objectives and targets for maintaining, restoring and expanding habitats and species populations. This should be done through protecting, enhancing, expanding and linking areas for wildlife within and between the locations of highest biodiversity resources, including statutory and local wildlife sites, and encouraging the conservation and expansion of the ecological fabric elsewhere'.

and

'Local authorities should develop functional ecological frameworks that will address habitat fragmentation and species isolation, identifying and targeting opportunities for habitat expansion and reconnection'

An indicative 'Biodiversity Opportunity Diagram' for the North West has been prepared as part of RSS, identifying broad areas of habitat creation potential in the North West of England. This diagram does not identify individual habitat types, but rather suggests areas in which similar policies, actions and interventions may apply. Policy EM 1 states that local authorities should develop a more detailed representation of this spatial information for use in their Local Development Frameworks. The Greater Manchester Ecological Framework broadly follows this approach and provides the more detailed representation of this spatial information as required by Policy and guidance. However, the technical guidance prepared to support RSS recommends that habitat expansion and reconnection should be targeted on habitats identified as 'priority' habitats for conservation in Biodiversity Action Plans. The Greater Manchester Ecological Framework does not exclusively target priority habitats .

3 Scale

It is often stated that ecological networks and frameworks should be developed at 'the landscape scale', but what exactly constitutes a 'landscape scale' is poorly defined.

Although Policy EM1 of the RSS calls upon local authorities to develop functional Ecological Frameworks, it also makes reference to the need for cross-boundary working in the interests of ecological coherence (because habitats and species do not recognise administrative boundaries). In addition, Natural England recommends that Ecological Frameworks should be developed at a sub-regional scale so that they can be designed to facilitate the implementation of Biodiversity Action Plans, which are prepared at sub-regional scales.

In Greater Manchester the advantages in developing an Ecological Framework at a sub-regional scale are -

- An Ecological Framework will be more ecologically robust if developed at a relatively large scale, providing that geo-morphological and climatic factors are properly taken into account. Most of Greater Manchester is included within the 'Urban Mersey

Basin' Natural Area as defined by Natural England, and as such the majority of the area to be included in a GM Ecological framework will support similar geo-morphological and climatic factors.

- The main information base concerning the habitats and species of Greater Manchester is held at a sub-regional level by the Greater Manchester Ecology Unit and others, rather than being held at district level.
- The local Biodiversity Action Plan has been prepared at a sub-regional scale.
- There may be cost savings for districts in developing a cross-boundary Framework rather than developing individual local frameworks.
- Since implementation of the Framework may in part rely on developers being required to make a contribution to habitat creation and repair there are advantages in developing a consistent approach to nature conservation policies across Greater Manchester (creating a level playing field).

In 2006 the Chief Planning Officers Group of the Association of Greater Manchester Authorities commissioned the Greater Manchester Ecology Unit (GMEU) to undertake the necessary research work involved in developing a coherent Ecological Framework at a Greater Manchester scale. GMEU has worked in partnership with the Urban Nature Group of the University of Salford, the University of Manchester and the Red Rose Forest, with support from the district authorities of GM, to progress the project.

Since the scale of ecological networks and frameworks is not prescribed by best practice, the development of a sub-regional Ecological Framework model does not preclude the development of smaller scale ecological networks and or frameworks that may operate at district or local level. In fact, the development of smaller scale networks and/or frameworks will form valuable elements of the wider Ecological Framework.

4 Aims

The development of an Ecological Framework for Greater Manchester has three main Aims

1 To conserve and enhance biological diversity in Greater Manchester by informing and underpinning efforts to repair, create and connect habitats.

2 To promote the need for pro-active nature conservation in Greater Manchester, including habitat creation and repair.

3 To contribute to national and sub-regional land-use planning obligations and contribute to the requirement in Policy EM1 of RSS to achieve a step change increase in biodiversity resources.

5 Guiding Principles

From the start of the process, the development of an Ecological Framework for Greater Manchester considered possible future mechanisms for the implementation of the Framework. It was recognised that a Framework based entirely on ecological principles and information without consideration of the practical mechanisms for implementation would be less likely to be implemented on the ground.

An analysis was undertaken of the most likely mechanisms available to facilitate implementation of an Ecological Framework. The conclusion was that habitat creation, repair and connection will be most likely implemented in Greater Manchester through the following mechanisms -

- Obligations placed on new development for the enhancement and creation of greenspace.
- Changes to the management of existing areas of greenspace (predominantly publicly managed greenspace).
- Land regeneration schemes (for example Newlands).
- Influencing the behaviour and perceptions of the general population (particularly for the management of gardens).

The spatial implication of the use of the above mechanisms is that the Ecological Framework should be as inclusive as possible, and include areas of planned development and areas of dense population, since some of the above mechanisms were considered more likely to operate in such areas.

The guiding principles behind the development of the Ecological Framework for Greater Manchester, bearing in mind the analysis summarised above, are -

- The Framework should be ecologically robust and coherent.
- The Framework should be easily understood by planners, developers and decision makers.

- The Framework should be seen as a way to complement and inform development rather than as a constraint on development.
- Necessary measures to implement the Framework should be easily understood and not unnecessarily difficult or expensive to implement.
- Measures to implement the Framework should be applicable across wide geographic areas and be as inclusive as possible. No areas of the conurbation should be considered as entirely unable to support elements of an Ecological Framework, so that opportunities for enhancing biodiversity can be maximised.
- The Framework should be flexible in approach so that opportunities for biodiversity enhancement could be maximised and local circumstances accommodated.

6 Methodology

6.1 The Context of Greater Manchester

The 'conventional' approach to the development of functional ecological networks seeks to identify core nodes of a network (usually the existing system of designated sites) and then seeks to expand these core sites and link together sites of similar ecological function. This approach is illustrated in Fig 1.

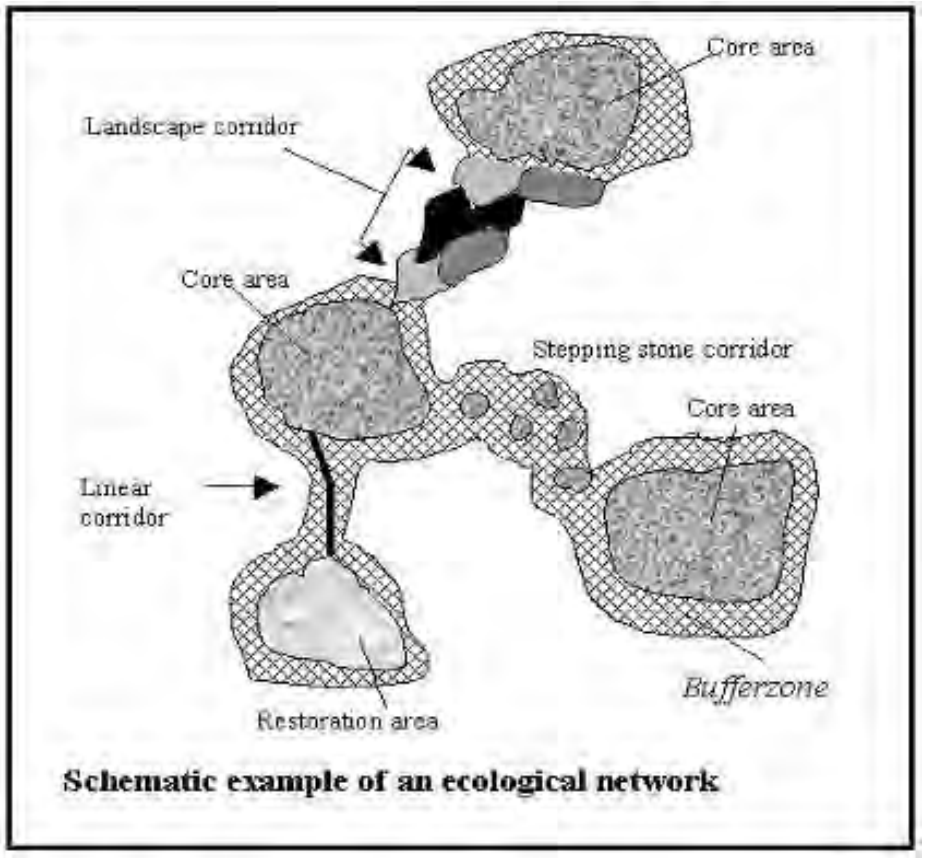

Fig 1 A 'conventional' ecological network model (*Bouwma et al 2002*)

A spatial analysis of Greater Manchester has shown that developing such a 'conventional' landscape-scale ecological network model in the GM sub-region is likely to be difficult, except at the fringes of the conurbation. This is illustrated in Fig 2, which shows the distribution of core nodes (designated sites incorporating priority habitat types) that would need to form the basis of such a network.

It can be seen that the node sites are generally small and very fragmented, except for moorland blocks on the fringes of the conurbation in the west and south Pennines and some woodland blocks along river valleys. There are large areas where there are no node sites at all, particularly in built up urban centres.

Analysis of the known extent and distribution of certain priority habitats for conservation as identified in national and local biodiversity action plans indicates that these follow a

similar pattern; that is, priority habitats generally occur in small patches and are fragmented, except for the upland habitats on the fringes of the sub-region.

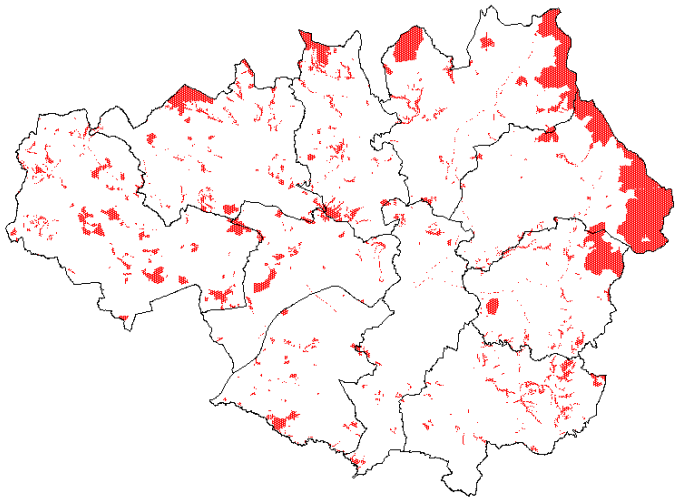

Fig 2 Shows the generally fragmented character of designated nature conservation sites in GM (but with contiguous upland habitat blocks at the fringes)

Many maps showing the extent and distribution of designated nature conservation sites in the UK will show a similar fragmented pattern. When assessing where to attempt to link and expand these habitat patches it is very important to consider the land use *between* and *around* the habitat patches. In Greater Manchester, development pressure on land use is intense, and has been for more than two centuries. Greater Manchester is classified as more than 50% urban; it has a population of more than 2.5 million people and is criss-crossed with major infrastructure links. There are very many land owners and very many land uses. The land area is dominated by built structures across large areas. In addition, the underlying soil substrate can vary greatly, often across small distances, a result of rapidly changing intensive land use over a long period of time. In the future pressures on land use are likely, if anything, to become even more intense.

Put simply, common sense would suggest that the rapid and intense development seen in urban areas, policies encouraging the concentration of development in urban centres and fragmentation of land ownership and land use all represent significant barriers to the creation of large, un-fragmented networks of semi-natural habitat or for the establishment of protective buffer zones around designated areas. Work undertaken in the development of the Greater Manchester Ecological Framework has confirmed that this is indeed the case across much of the conurbation. It has been concluded that developing a true network of large, connected areas of semi-natural habitat to form a 'conventional' ecological network would likely be inappropriate across all of Greater Manchester and at a Greater Manchester scale.

This does not mean, however, that habitat repair, habitat creation and greater habitat connectivity is impossible or without merit in Greater Manchester as a whole, nor that

nature conservation efforts should be exclusively concentrated in selected areas where the creation of coherent, conventional ecological networks are considered to be more achievable. Parts of Greater Manchester do in fact lend themselves to the creation of smaller-scale ecological networks, for example the Mosslands of Salford and Wigan, the Moorlands of Rochdale and Oldham and the Woodlands of Stockport, and aspirations to create coherent ecological networks in these areas are well-established and are described in other strategies and policies. Examples include the North West Wetlands Network, an established strategy to enhance important wetland habitats in Salford, Wigan and Warrington. The moorland blocks to the north and north west represent the Pennine Fringe and extend into Lancashire, Derbyshire and Yorkshire, where unfragmented upland habitat blocks are more extensive. These areas are therefore included in larger ecological networks being developed to the north west and the north. Such plans are consistent with the development of an Ecological Framework which informs and underpins regional, sub-regional and local priorities.

There is in fact great biological diversity in Greater Manchester, ironically partly resulting from the very varied land uses that have caused habitat fragmentation. So while intense urbanisation and industrialisation may have minimised the *natural* diversity of cities, human activity has at the same time created a very wide spectrum of different land-uses and environments across a relatively small area. There may not be very many large un-fragmented blocks of semi-natural habitats remaining, but there are small areas of many different types of habitat supporting small populations of a very wide variety of species, including priority habitats and species. The list of protected and priority habitats and species found in Greater Manchester is long and impressive, and includes peregrine falcons, great crested newts, seven species of bat, water voles, barn owls, kingfishers, little ringed plovers and badgers. Parts of Greater Manchester have bucked national trends by increasing recorded numbers and types of habitats and species, a result of changing land uses and pro-active initiatives to improve the quality of land, water and air. Thanks to far-sighted strategic planning initiatives implemented over the last thirty years greenspace penetrates into the heart of the conurbation along the main river valleys and in a wide variety of well-managed public and private greenspaces. Environmental improvements have been achieved against a background of almost unprecedented economic regeneration in the sub-region, demonstrating that economic development and environmental improvement need not be mutually exclusive.

Very built up urban areas are also capable of supporting important wildlife. In fact, the assumption that the urban matrix is generally ecologically hostile and impermeable to species movement is open to question. According to a land-use analysis carried out by Gill (2006) every type of land use in Greater Manchester contains at least 20% vegetated areas; it would appear that there is a significant quantity of ‘hidden greenspace’ within the conurbation. One of the conditions for ‘ecological matrix utility’ (that is, the facilitation of dispersal) for many invertebrates, animals and birds is the presence or absence of vegetation, so the data reported by Gill challenges the perception of impermeability. Although direct environmental linkages between habitat patches of similar character are undoubtedly important in aiding the dispersal of certain species, habitat ‘stepping stones’ can be just as valuable for many species in urban areas, particularly invertebrates and birds.

Recent research undertaken by Sheffield University on urban and suburban gardens has also demonstrated that areas of urban greenspace that do not support ‘native’ or

'priority' habitats or species or large blocks of semi-natural habitat can nevertheless be rich in biodiversity. There is now significant evidence that *niche diversity* (vertical and horizontal structure and temporal diversity) is often of significant importance in determining the species diversity of urban and suburban areas.

There are also good social and economic reasons for practising habitat creation and repair in the areas where most people live and work. In general, people tend to be healthier and happier if they have access to greenspaces close to home. If people lose touch with the natural environment in their everyday lives then support for nature conservation in the wider UK landscape may be compromised.

The **conclusion** is that although the creation of a single large-scale ecological *network* focussing on selected priority habitats and species and applicable across all of Greater Manchester may not be achievable, it ought to be possible to apply sound ecological principles to conserve and enhance biodiversity, and by so doing achieve the 'step change' in biodiversity resources required by RSS throughout the sub-region, by developing a set of principles to guide habitat creation, repair and management that, if applied appropriately, would serve to develop a coherent Ecological Framework for Greater Manchester as a whole. The wider Ecological Framework is perfectly capable of incorporating smaller-scale, coherent Ecological Networks.

6.2 Spatial Analysis

The Ecological Framework Model has been developed using readily available data sources that were consistent across Greater Manchester and were capable of analysis across large areas.

The main data sets used were as follows

1 The Urban Morphology Types (UMTs) developed by the Centre for Urban and Regional Ecology at the University of Manchester. The UMTs are compatible with the categories used in the National Land Use database.

2 The Land Cover Map which presents the spatial distribution of 19 broad habitat types present in Greater Manchester.

3 The Topography layer of Ordnance Survey MasterMap data for Greater Manchester, presenting land use with a high degree of spatial accuracy.

4 Spatial distribution of designated nature conservation sites across Greater Manchester, including –

- Sites of Special Scientific Interest (SSSIs)
- Sites of Biological Importance (SBIs)
- Local Nature Reserves (LNRs)
- Ancient Woodland

5 Spatial distribution of the most important sites for birds and great crested newts across Greater Manchester.

6 National Grid of 1km^2 squares.

Phase 1 habitat maps were not readily available in digitised format for comprehensive analysis and the dataset was not complete for GM. These maps were not therefore generally used in the overall spatial analysis, but partial analysis of the up-to-date habitat maps that were available for certain districts confirmed the following –

- That Greater Manchester supports a wide variety of habitats, including priority habitats.
- That these habitats are often present in small areas and establishing connections between habitat patches would be difficult.

This partial analysis helped to inform the overall approach taken in the development of the Framework to concentrate on broad areas of similar ecological function rather than working to identify specific linkages between similar habitat patches.

Generally species information was not used in the spatial analysis because the available information concerning species distributions was sparse. Datasets concerning the distribution of great crested newts were used because they were regarded as the most reliable and comprehensive available species datasets for GM suitable for spatial analysis, and because they showed a high degree of correlation with information concerning land use used in the analysis.

These datasets were analysed using GIS tools to identify *coherent patterns of ecological function* (areas sharing similar ecological characteristics) within Greater Manchester. The analysis basically identified areas of similar ecological potential, habitat diversity and land use. An important factor taken into consideration was the degree of 'naturalness' of the landscape, measures by taking into account datasets concerning designated sites and greenspace cover. Details of the methodology used in the spatial analysis are presented in Appendix 1.

This approach allows for the application of broad principles of habitat creation and repair, but does not accurately specify which specific habitat to recreate where. A broadly similar approach is taken in the technical guidance concerning Ecological Frameworks supporting the RSS, and the results should be taken as an extension of the broad principles applied in this guidance. The approach has ecological validity but is also considered more capable of practical implementation, in part because with our current level of knowledge about restoration ecology it is in fact not possible to attempt the recreation of most habitat types and be certain as to the outcome. To set specific aims for the creation of, say, a particular type of woodland at a particular site may be difficult, but the principles of how to go about planning for habitat creation and repair in a particular area will be applicable to all sites.

Extending this practical approach, and in addition to the above datasets used in the spatial analysis, districts were asked to put forward any sites or areas within their administrative boundaries considered most suitable for implementing habitat creation and repair. In the language of the RSS these are areas which could provide 'opportunities for large and visionary habitat creation projects'.

7 Summary of Results

From this analysis six distinct elements of a Greater Manchester Ecological Framework have currently been identified. These elements are henceforward referred to as **'Biodiversity Opportunity Areas'.**

1. **Most Natural Areas;** greenspaces where the largest blocks of natural and semi-natural habitat remain (generally at the fringes of the conurbation or along main river valleys).

2. **Private Gardens**; areas where gardens are the predominant biodiversity resource (generally in suburban areas).

3. **Habitat Mosaics**; areas of high habitat diversity across relatively small areas .

4. **Locally Specific**; areas where there is currently a deficiency of biodiversity resource and/or a high degree of fragmentation, including highly urbanised areas and areas of intensive farmland where no predominant principles present themselves and **locally specific actions** for habitat creation and repair would be most applicable.

5. **Species Hotspots**; smaller areas/sites regarded as important for the creation of relatively small scale habitat networks for great crested newts.

6. **District nominated sites**; individual sites considered to have the most potential for large scale and visionary habitat creation and repair.

In each Biodiversity Opportunity Area different policy initiatives and nature conservation measures will apply, but all the areas taken together will comprise the Ecological Framework.

The Biodiversity Opportunity Areas do not necessarily comprise areas of similar habitat types. That is, the Most Natural Areas may support a number of different habitat types (for example moorland, grassland and woodland). Biodiversity Opportunity Areas are in general defined by the **policies** and **actions** for habitat creation and repair that will apply in these areas rather than by the habitat types which they support.

All of the Biodiversity Opportunity Areas should be considered to have equal potential for carrying out habitat creation and repair; that is, there are no areas of Greater Manchester where habitat creation and repair is regarded as impossible. Even in very densely built up urban areas there will be opportunities for enhancing biodiversity. Any initiative for habitat creation or repair undertaken anywhere in Greater Manchester could be considered to contribute the creation of the Ecological Framework.

8 Using the Spatial Analysis

The maps that follow showing the distribution of the Biodiversity Opportunity Areas, although in part representations of reality in that they do indicate areas that share similar ecological characteristics, are also maps of *potential* and *probability.* The Biodiversity Opportunity Areas represent areas where it is most probable that following certain policies or carrying out certain actions will have the best chance of achieving effective nature conservation, but as areas of probability the boundaries are not fixed.

It is therefore recommended that the boundaries of the different Biodiversity Opportunity Areas are not treated as fixed Policy boundaries. Further, they should not necessarily be treated as areas of constrained development. In fact, since one of the mechanisms identified for implementing the Ecological Framework is to require new developments to incorporate new nature conservation elements, parts of the Framework may only be capable of implementation by allowing appropriate development to come forward.

Rather, Policies in Plans should refer to the general need for land use and development to contribute to habitat creation and repair, with the Ecological Framework used as a general guide to inform decisions as to *which* actions are best to apply *where*.

In terms of the land-use planning system it is anticipated that the GM Ecological framework will be used to inform development proposals where the planning authority has decided that it is appropriate to seek greenspace or ecological enhancements as part of a particular development. The Framework does not make recommendations as to what scale, type or location of development should be subject to such a requirement.

The Ecological Framework can be used by developers, landscape architects and greenspace developers and managers to inform plans and proposals for the creation, development and management of Green Infrastructure wherever this occurs. It does this by identifying the ecological context of broad areas of Greater Manchester. When a development scheme is being considered the location of the development site within a particular Biodiversity opportunity Area should be considered. For example, Green Infrastructure development proposals coming forward on a site within a ‘Habitat Mosaic’ Biodiversity Opportunity Area should aim to provide a range of different habitat types and ecological niches, whereas a development proposal within a ‘Most Natural Area’ Biodiversity opportunity Area should aim to provide a single block of a habitat type in keeping with the dominant habitat in the locality. Similarly a development proposal within a ‘Species Hotspot’ should aim to provide for the habitat requirements of a particular species.

The spatial information has been developed using the best available Greater Manchester wide datasets and the results are therefore presented at a Greater Manchester scale. It is recommended that they are therefore best used and interpreted at this broad scale rather than at a district or local level (the obvious exception to this is the district-nominated sites). The maps presented in this document are generated from GIS generated digital maps.

9 The Biodiversity Opportunity Areas

9.1 MOST NATURAL AREAS

These are the areas of Greater Manchester supporting the best remaining examples of semi-natural habitats. They could be described as 'areas least modified by human influence'.

Predominantly, these areas support **either** upland habitats (moors, bogs and grassland) **or** lowland broadleaved woodland. Priority habitats for conservation as identified in Biodiversity Action Plans are concentrated in these areas, and the Most Natural Areas support the greatest concentration of designated sites for nature conservation. They can be regarded as the 'core areas' for wildlife or the '**critical ecological infrastructure'** of Greater Manchester. The spatial distribution of the most natural areas is shown in Fig 1. These areas cover about 12%of the area of Greater Manchester, predominantly in the upland areas of Rochdale and Oldham and along some of the main River Valleys running into and across the conurbation. It is important to note that the upland habitat blocks are contiguous with similar, larger habitat areas in Lancashire, Yorkshire and Derbyshire (the green patches don't stop at the GM border shown).

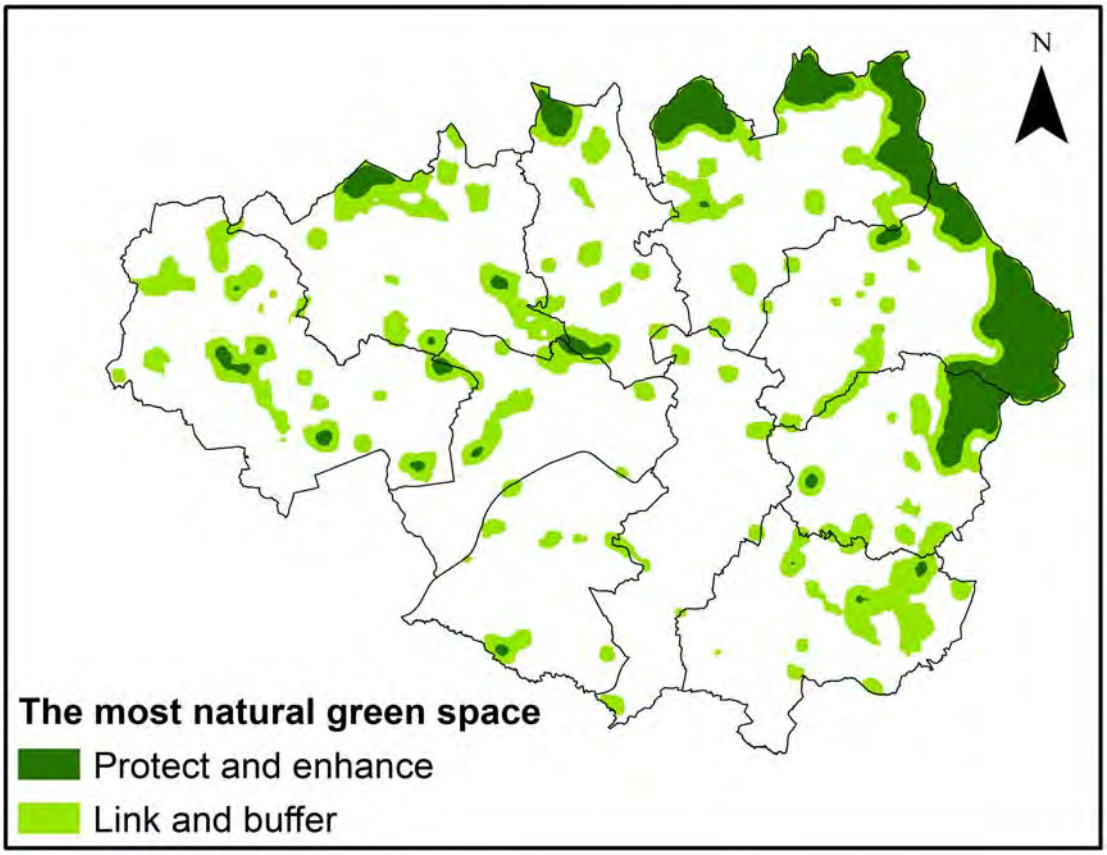

Fig 3 The 'most natural' Biodiversity Opportunity Areas

The Most Natural Areas predominantly support upland habitats and broadleaved woodland along river valleys

Because these areas contain the largest un-fragmented blocks of semi-natural habitat (and priority habitats) in Greater Manchester they could be said to form the 'essential' elements of the Ecological Framework. A case could be made that these areas alone constitute the major areas for the creation of a GM Ecological Framework. However, to do this would effectively exclude very large areas of Greater Manchester (indeed most of some entire districts) from an inclusive Ecological Framework and would represent a missed opportunity to achieve the step change in biodiversity required by RSS. In particular, the datasets used for the identification of 'Most Natural Areas' do not

In these areas policies, actions, interventions and management should follow established practice for the creation of Ecological Networks. The emphasis in these areas should be on the management, buffering and linking of existing areas of valuable habitat rather than on new habitat creation.

Recommended Actions

- Nature conservation land-use designations in these areas should be confirmed and designated sites protected from inappropriate development.
- Appropriate management of these areas, particularly within designated sites, should be encouraged and facilitated.
- The creation of buffer zones around designated sites should be encouraged and facilitated
- The creation of linkages between valuable habitat areas should be encouraged and facilitated.
- Cross-boundary nature conservation initiatives must be properly planned and co-ordinated

Development within these areas, and in areas adjacent to them, need not necessarily be entirely prohibited, but any development proposal should be required to take into account the landscape and ecological context.

9.2 GARDENS

Numerous studies over many years have demonstrated that private gardens are very important reservoirs of biodiversity in urban and suburban areas. Research undertaken as part of the development of the Greater Manchester Ecological Framework has shown that this is true of large areas of Greater Manchester. Private garden spaces and public suburban parks are by far the most important greenspaces supporting biodiversity in many parts of the conurbation, and particularly in south Manchester, Stockport and Trafford. Although it is understood that can be difficult for the land-use planning system to influence the management of private gardens, and that certain national land-use policies serve actually to promote built development of gardens, any Ecological Framework developing in an area like Greater Manchester must take account of garden spaces if it is to be regarded as properly coherent and inclusive.

The spatial distribution of the most important areas of garden space is shown in Fig 2. Gardens constitute about 15% of the area of Greater Manchester

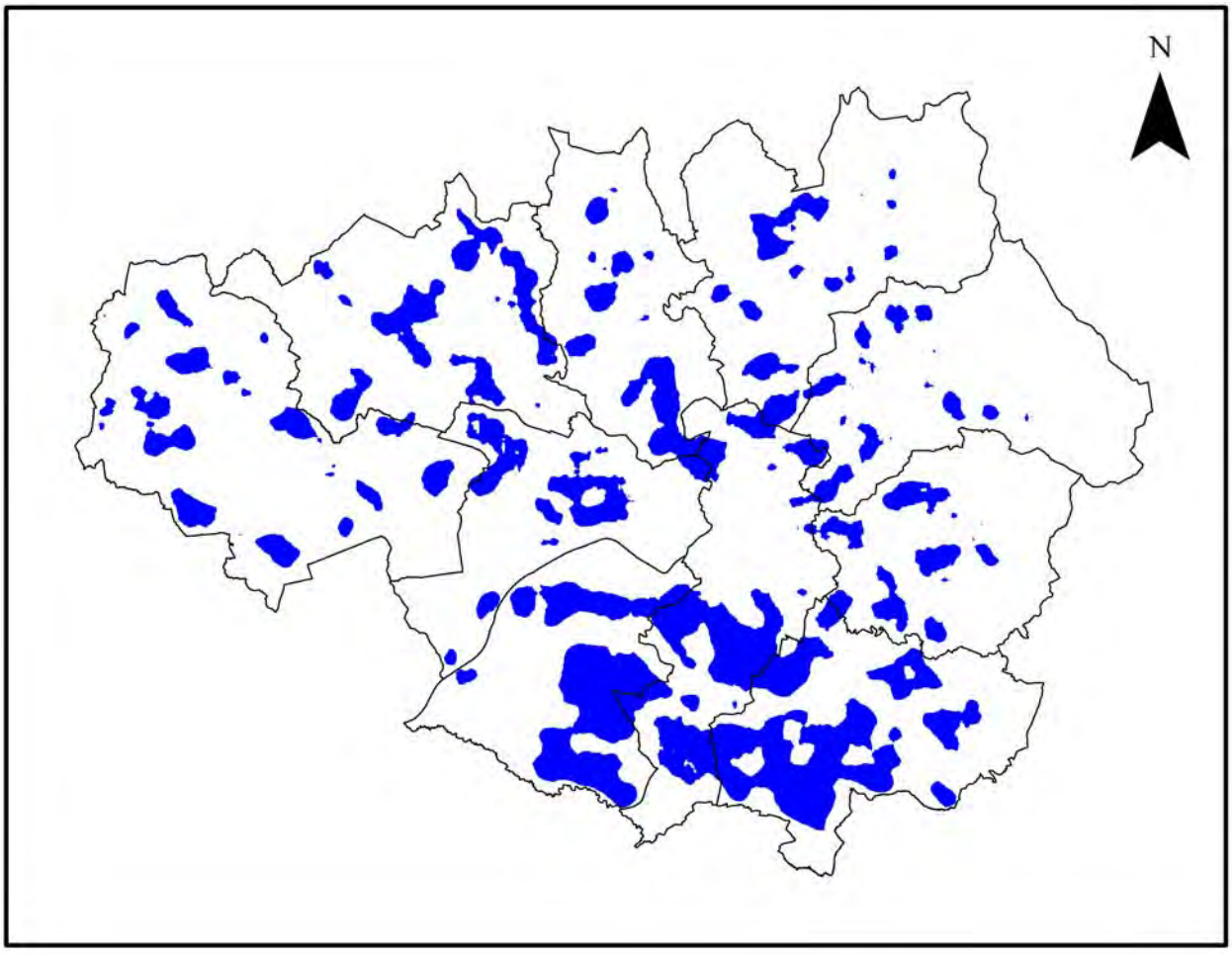

Fig 4 Garden Spaces Biodiversity Opportunity Areas

Recommended Actions

- The maintenance of large continuous garden spaces should be encouraged.
- Garden spaces should be incorporated into new developments and/or provision of public greenspace within developments should be required.
- Other policies should promote the importance of gardens for biodiversity and discourage inappropriate management (for example paving of gardens).
- Local plans, policies and strategies should make reference to the biodiversity value of gardens and allotments.
- Gardens should be promoted locally as important biodiversity resources and advice should be made available about how best to manage gardens for wildlife.

9.3 HABITAT MOSIACS

Urban areas are often characterised by a diverse mosaic of relict habitats and designed spaces juxtaposed in combinations that rarely occur in nature. As such they support a wide variety of species, many of which are becoming increasingly rare in the wider countryside. There is now considerable evidence that habitat diversity within cities is of very great importance in determining species richness, and there is a strong correlation between land-use heterogeneity and species richness. In Greater Manchester, habitat mosaics are strongly associated with the most important sites for birds. These mosaic areas often overlap with or are adjacent to the Most Natural Areas, and therefore complement these areas. Contrary, then, to more conventional ecological network models it is important in these areas to maintain habitat variety, even if this variety is contained in a relatively small geographic area, rather than to seek the establishment of a larger area of uniform habitat.

The spatial distribution of the most important areas supporting habitat mosaics is shown in Fig 5. Because of the way that the available data has been analysed this information is presented as 1km grid squares. Areas of high habitat diversity are most likely to occur in these squares.

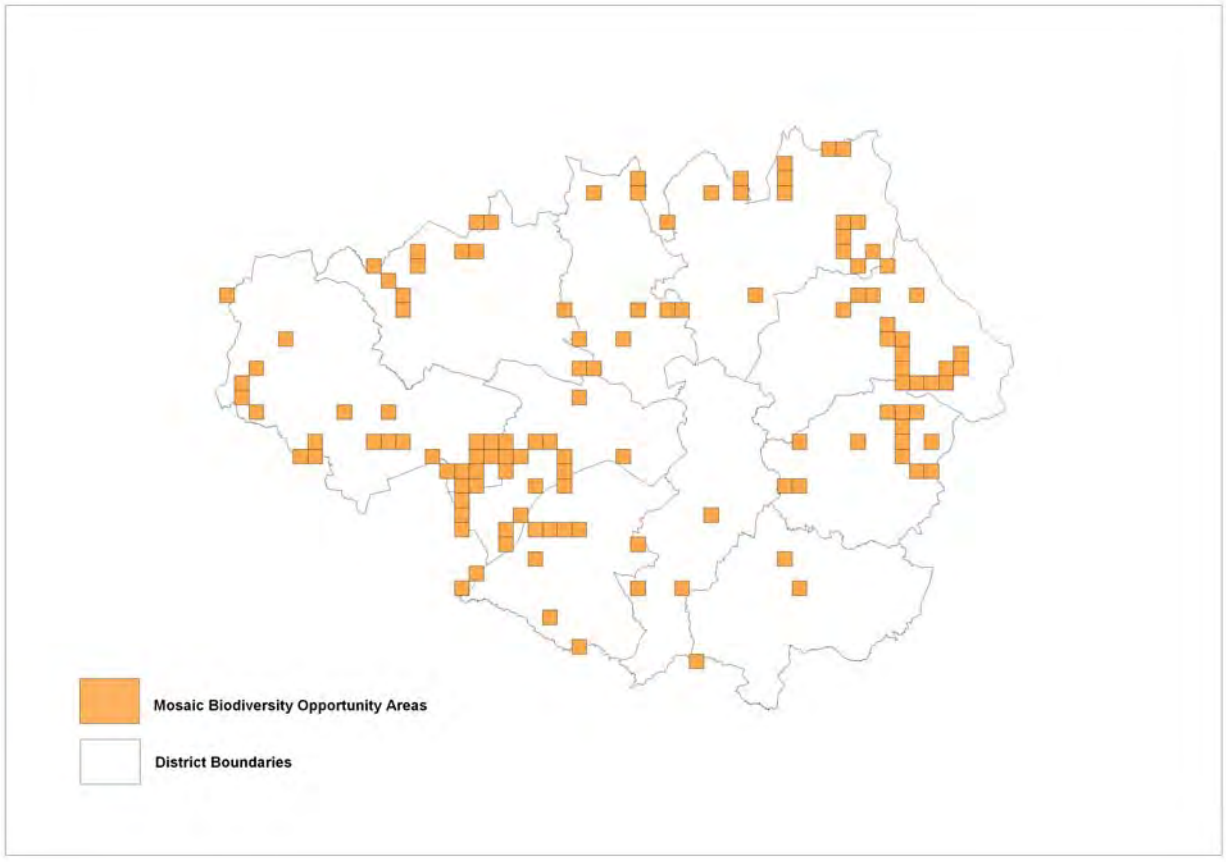

Fig 5 Habitat Mosaics Biodiversity Opportunity Area

Recommended Actions:

- Encourage mixed land-uses rather than single-use zoning.
- Encourage developers to incorporate a range of landscaping measures within larger developments rather than uniform landscaping schemes..
- Encourage cooperative and participatory management of adjacent green space managed by different landowners / users.

9.4 LOCALLY SPECIFIC ACTIONS

In these areas there is currently an apparent deficiency of biodiversity resources, and the areas lack sufficient ecological context to be able to be too prescriptive about preferred habitat creation and repair measures. In these circumstances habitat creation and repair should be encouraged, but can be more opportunistic and creative than in areas with more robust ecological context.

These areas make up a high proportion of the land area of Greater Manchester and therefore cannot be ignored if an Ecological Framework is to be made really coherent and inclusive.

These areas tend to fall into two broad land-use categories; they are either very urbanised areas or areas of agricultural intensification. Recommended Actions differ for each of these categories.

Recommended Actions for very built up areas

In very urbanised areas biodiversity interest is found across a range of greenspaces including urban parks, school grounds, roadside verges, cemeteries and churchyards and vacant previously developed land. These greenspace areas can often be enhanced for biodiversity by relatively simple changes to existing management regimes and actions can be focussed on these changes. There are often concerns that changing the management of urban green spaces to encourage wildlife can be somewhat 'out of context' and therefore be perceived as neglect rather than active management. However, research has shown that such spaces do not need to be managed to conform to 'conventional' habitat classifications in order to be valuable for wildlife; what is important is to provide *niche diversity*, for example by -

- Creating a range of vertical and horizontal structures.
- Creating a range of different exposure conditions.
- Creating temporal variation.
- Creating a range of hydrological conditions.

It is therefore perfectly possible to take local context into account while also contributing to biodiversity enhancement. For example a formal urban park can be made better for wildlife and still retain its formal character.

In areas currently lacking any type of greenspace it is possible to introduce innovative biodiversity enhancement measures. Examples include creating Green Roofs, Green Walls / Balconies, Pocket Parks and installing bird and bat nesting boxes. Policies should not therefore ignore the need for biodiversity enhancement in these areas, but should encourage innovative solutions and Actions.

Recommended Actions for Intensively Managed Farmland

In these areas when considering habitat creation and repair it is very important to consider local context, particularly in terms of physical environmental factors. For example, in areas supporting peat soils and high water tables it may be appropriate to attempt lowland raised bog restoration, whereas in areas of high water tables but with mineral soils fen habitats would be more appropriate.

Where it would be difficult to establish blocks of habitat on farmland it can be important to encourage appropriate management of boundary features such as hedgerows and ditches.

9.5 Species Hotspots

Certain smaller places within Greater Manchester have been identified as important areas and sites for habitat creation and repair that will benefit a specific species - great crested newts. Although the Framework as a whole has not been designed using species distribution data it was considered that the inclusion of sites for great crested newts could be justified for the reasons outlines below.

These Biodiversity Opportunity Areas are known as 'species hotspots' and are shown in Fig 5. At these sites policies encouraging relatively specific nature conservation measures applying to the specific requirements of great crested newts should be applied.

It is possible that areas of Greater Manchester could in future be identified for habitat creation and repair benefiting other specific species, should reliable data for other species be collected.

Great Crested Newts

Great Crested Newts are one of the 'big three' species recorded in Greater Manchester that are offered the highest degree of legal protection (the others are bats and floating water plantain). They are classed as European Protected Species (EPS) because they are listed under the terms of the European Habitats Directive. Penalties for harming or disturbing great crested newts or damaging their habitats are severe. As a consequence, surveys for great crested newts are often undertaken and their distribution and ecology is therefore relatively well understood. Great crested newts are a species that benefits greatly from the creation of ecological networks. They often use a number of ponds within a particular area for breeding and therefore maintaining and creating terrestrial links between these ponds is important for the survival of the species. Since successful conservation of great crested newts requires the creation of interconnected ponds and terrestrial habitat the repair and creation of habitat for newts will also benefit other species.

Further, developers are often required to offer mitigation and/or compensation for disturbance caused to great crested newts, so one of the identified mechanisms for implementing the GM Ecological Framework (developer obligations) applies strongly to great crested newts. It was therefore considered useful to include known 'hotspots' for great crested newts as part of the Ecological Framework.

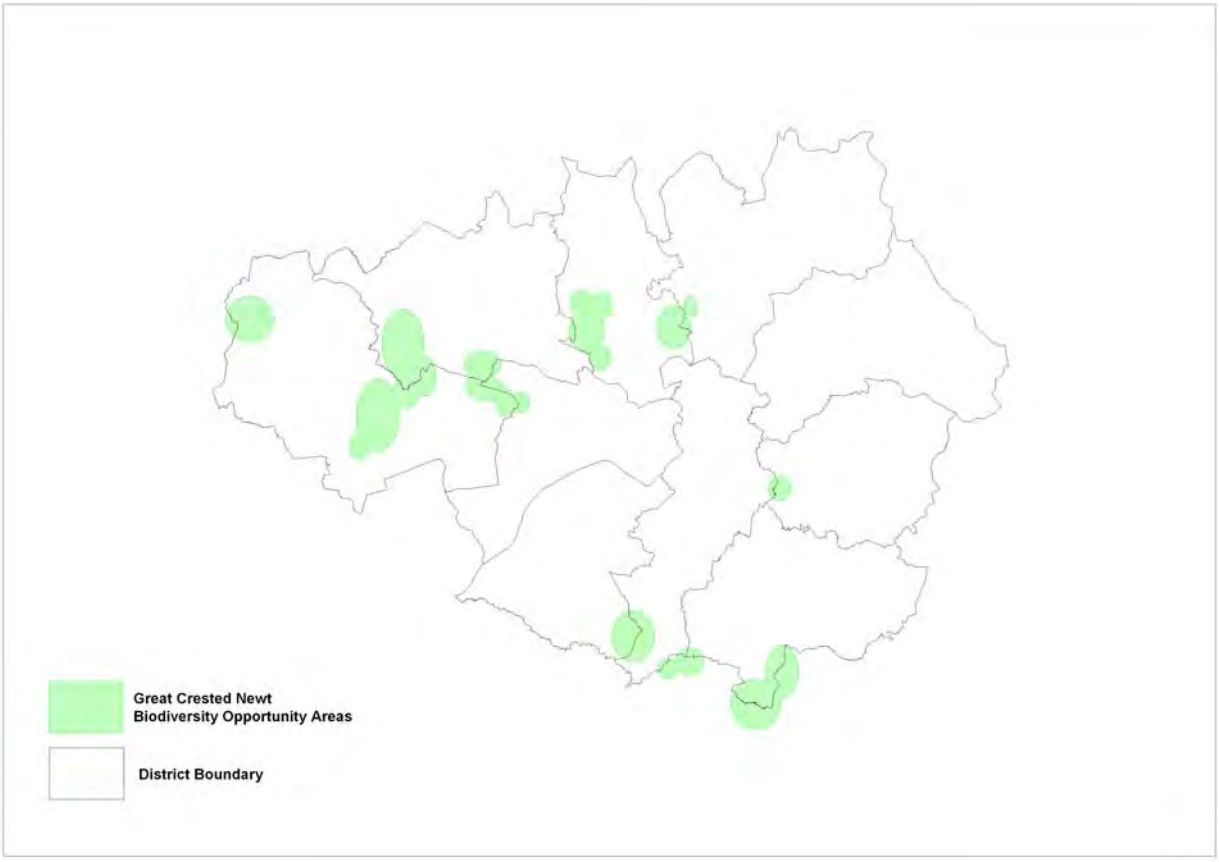

Fig. 7 Biodiversity Opportunity Areas for Great Crested Newts

9.6 Priority Sites for Habitat Creation and Repair

The Technical Guidance concerning Ecological Frameworks prepared as part of the North West Regional Spatial Strategy recommends that Ecological Frameworks could incorporate sites for 'large and visionary' habitat creation schemes. The ten districts of Greater Manchester were asked to provide details of any such sites for their districts.

Criteria used to select such sites included:

- Sites were regarded as being capable of ecological restoration in the short to medium term using identified resources and existing knowledge.
- Sites supported local concentrations of Priority habitats and/or species.
- Sites supported physical environmental factors suitable for recreation of Priority habitats.
- Sites were in part protected from inappropriate development by existing Policies in Plans.

The sites identified are shown of Fig 8 and listed in Table 1

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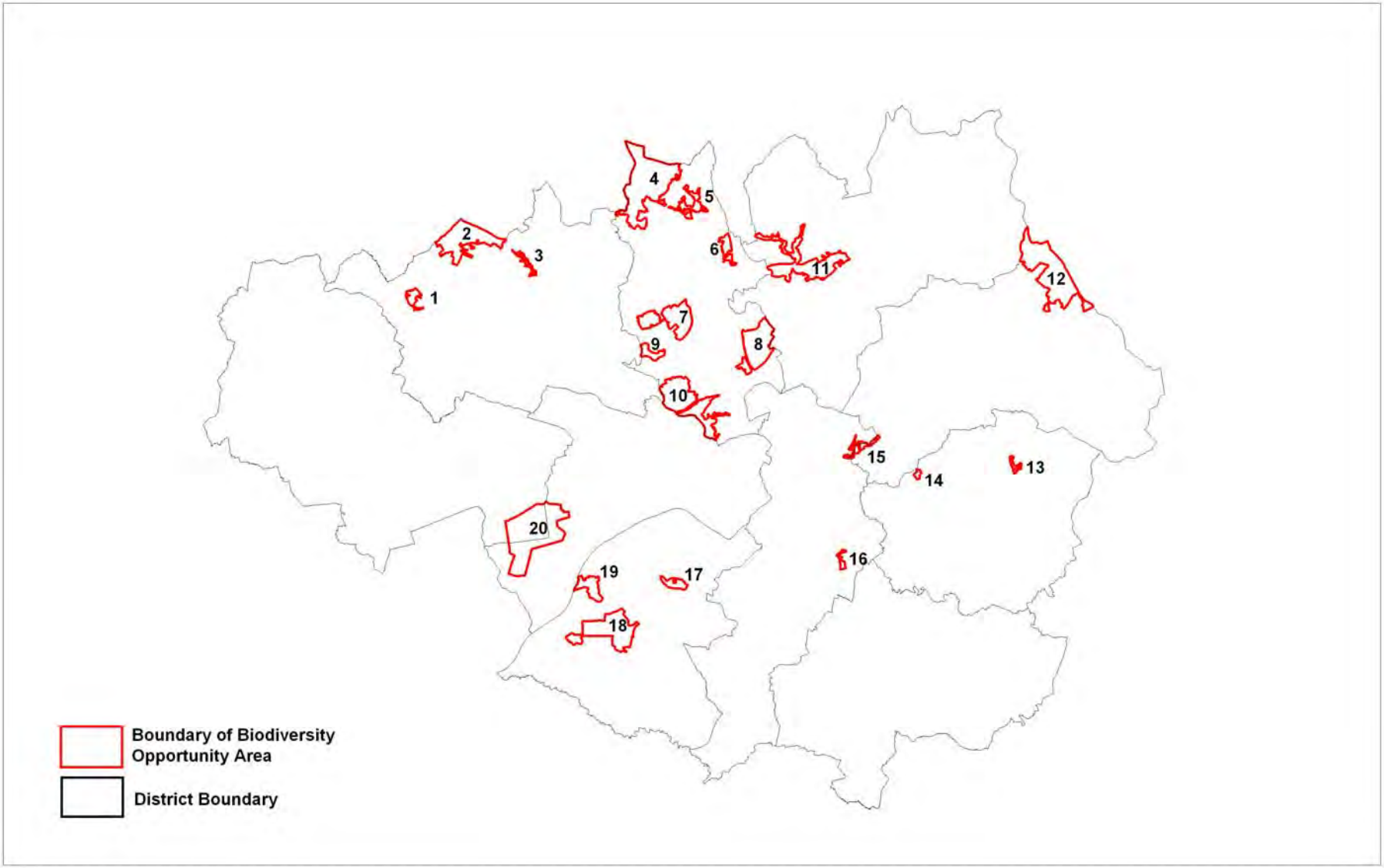


Fig 8 Priority Sites for large-scale habitat creation and repair

Table 1 Priority Biodiversity Opportunity Sites identified across Greater Manchester for habitat creation and repair.

Ref No	District	Site Name	Size (ha)	Details
1	Bolton	Red Moss	52	Opportunities for the enhancement of lowland raised bog
2	Bolton	Winter Hill & Smithills Moor	400	Opportunities for the repair of upland habitats
3	Bolton	Smithills Estate	26	Opportunities for the enhancement of lowland broadleaved woodland and neutral grassland
4	Bury	Holcombe and Hawkshaw	753	Opportunities for restoration of upland habitats
5	Bury	Upper Irwell Valley	101	Opportunities for restoration and enhancement of lowland broadleaved woodland
6	Bury	Gorses and Chetham Woods	69	Opportunities for enhancement of lowland dry heathland, acid grassland and, to a lesser extent, lowland broadleaved woodland
7	Bury	Elton and Coggra Fold	321	Opportunities for the creation / improvement of open water and pond habitats
8	Bury	Unsworth Moss	367	Opportunities for the enhancement of a pond network with neutral grassland
9	Bury	Harper Fold	62	Opportunities for the enhancement of an important pond network
10	Bury	Lower Irwell valley	478	Excellent habitat mosaic area with extensive opportunities for enhancement and creation of lowland broadleaved woodland, ponds, wetlands and neutral grassland.
11	Rochdale	Roch Valley, Heywood	453	Opportunities for the enhancement of lowland broadleaved woodland, neutral grassland, hedgerows and creation of new wetland areas.

Ref No	District	Site Name	Size (ha)	Details
12	Oldham	South Pennine Moors	650	Extensive opportunities for upland habitat restoration within and adjacent to the Special Area for Conservation. This area has been identified in other plans and strategies as of international importance and form part of a habitat network to the north west
13	Tameside	Hartshead	21	Opportunities for enhancement of lowland broadleaved woodland and neutral grassland
14	Tameside	Little Moss	14	Opportunities for wetland creation enhancement
15	Manchester / Oldham	Moston Brook Corridor	57	A strategically important area of greenspace straddling the boundary between Oldham and Manchester districts A range of habitat types occur across four distinct sites connected by the Moston Brook watercourse, including lowland broadleaved woodland, wet grassland and unimproved neutral grassland.
16	Manchester	Nutsford Vale	22	Opportunities for the enhancement of neutral grassland and lowland broadleaved woodland
17	Trafford	Stretford Meadows	61	A former landfill site suitable for grassland enhancement and the creation of wet grassland
18	Trafford	Carrington Mosslands	424	Significant potential for creating and enhancing new wetland habitats. This area is also identified in the Ecological framework as a Species Hotspot for bird populations.
19	Trafford	Wellacre (Flixton Wetlands)	116	A suitable site for the creation of lowland heathland and the restoration of wetland habitats
20	Salford / Wigan	Chat Moss	815	Extensive opportunities for the large-scale restoration of lowland raised bog habitat of national importance

APPENDIX ONE

DETAILED METHODOLOGIES

Firstly, data sources were identified; secondly, Geographic Information System analysis tools were selected; finally, a method for validating the results was chosen. The following sub-sections outline these steps.

Data sources

The most natural green space

The datasets used to identify the most natural green spaces in Greater Manchester, following Natural England's guidance (English Nature, 2002) were as follows:

1. Spatial distribution of designated nature conservation areas in Greater Manchester (Natural England, 2007): Sites of Special Scientific Interest (SSSIs); Local Nature Reserves (LNRs); Ancient Woodland (AW);
2. Inventory of Sites of Biological Importance (SBIs), which are the most important non-statutory sites for nature conservation in Greater Manchester identified by the Greater Manchester Ecology Unit.;
3. The Urban Morphology Types (UMTs), which are homogenous urban land use types identified by the Centre for Urban and Regional Ecology at the University of Manchester within the Adaptation Strategies for Climate Change in the Urban Environment project (2003-2006). Based on aerial photographs, Ordnance Survey maps, ground truthing and other sources of data, 28 UMTs were distinguished (Gill *et al*., 2007)

Table 1 Categories of Urban Morphology Types based on Gill *et al*. (2007).

Categories relating to green space	***Remaining categories***
Improved farmland	*Town centre*
Unimproved farmland	*High density residential*
Remnant countryside	*Medium density residential*
Woodland	*Low density residential*
Formal recreation	*Hospitals*
Formal open space	*Schools*
Informal open space	*Offices*
Rivers, canals and reservoirs	*Retail*
Allotments	*Manufacturing*
Church yards	*Storage and distribution*
Disused and derelict land	*Energy production*
	Mineral workings and quarries
	Water treatment and storage
	Refuse disposal
	Major roads
	Rail
	Airports

UMTs offer a comprehensive data source of land use in Greater Manchester. They are compatible with the categories used in the National Land Use Database (Gill *et al*., 2007); therefore similar process of UMTs identification could be carried out outside Greater Manchester. Moreover, the analysis of UMTs land cover composition allows for their use of UMTs in ecological studies (see section 4.4.2). The main disadvantage of UMTs is that they were digitised manually from aerial photographs; therefore, man-made errors cannot be excluded. Some inaccuracies can also be caused by the data age as UMTs were last updated with the use of aerial images taken in 2004.

Gardens

Ordnance Survey MasterMap data (version: September 2006) was used to identify the spatial distribution of domestic gardens in Greater Manchester. The advantages of the MasterMap data set are its spatial accuracy (down to 1m in urban areas), geographically comprehensive coverage and regular updates (Ordnance Survey, 2007). However, MasterMap provides very

little information about the actual land cover, what is a certain limitation in this part of the research, as the features in garden land use category can be vegetated, paved over, or a mixture of both. Yet there are no other easily accessible data sets that would allow for the analysis of garden distribution in Greater Manchester. The gardens data was extracted from the MasterMap by selecting in ArcView 9.1 the areas with “multisurface” value in MAKE attribute.

Diversity of habitats

The data set used in order to assess the diversity of habitats was the Land Cover Map (LCM) 2000, Level 2 dataset (CEH, 2001). LCM 2000 presents the spatial distribution of 19 Broad Habitats (categories used to report on biodiversity in the UK Biodiversity Action Plan). The advantage of this data set is its geographical comprehensiveness and high level of ecological details. The disadvantages are low level of spatial accuracy as the data from satellite images was recorded based on 25x25 metre squares. Another shortcoming of this dataset is that only two types of habitats are used in relation to cities: urban and suburban habitat. Therefore, this data set is appropriate for analysis of habitat variety at the Greater Manchester level; its applicability at a finer scale is limited.

Green space types

Gill *et al*. (2007) used aerial photograph interpretation of random points (Akbari *et al*., 2003) to estimate the average percentage of land cover types in the UMT areas (Figure 4.3). Following Natural England’s guidance, trees, shrub, rough grassland and water can be considered ‘natural’ (English Nature, 2002, see also chapter 2.4.4). Therefore, their percentages in UMT area were added together to estimate the total proportion of natural land cover. The range of percentages of natural cover were then split into three categories, representing degrees of naturalness in the green space, using the Jenks optimisation of natural breaks method (Murray and Shyy, 2000).

The most natural category of green space is then used in identification of the areas of high biodiversity potential.

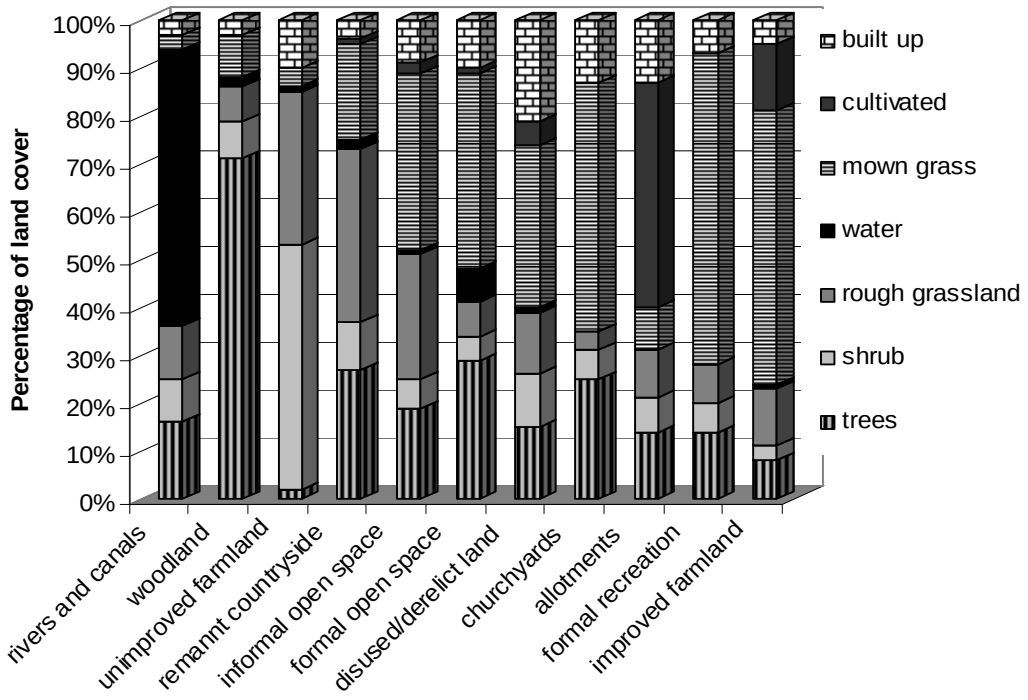
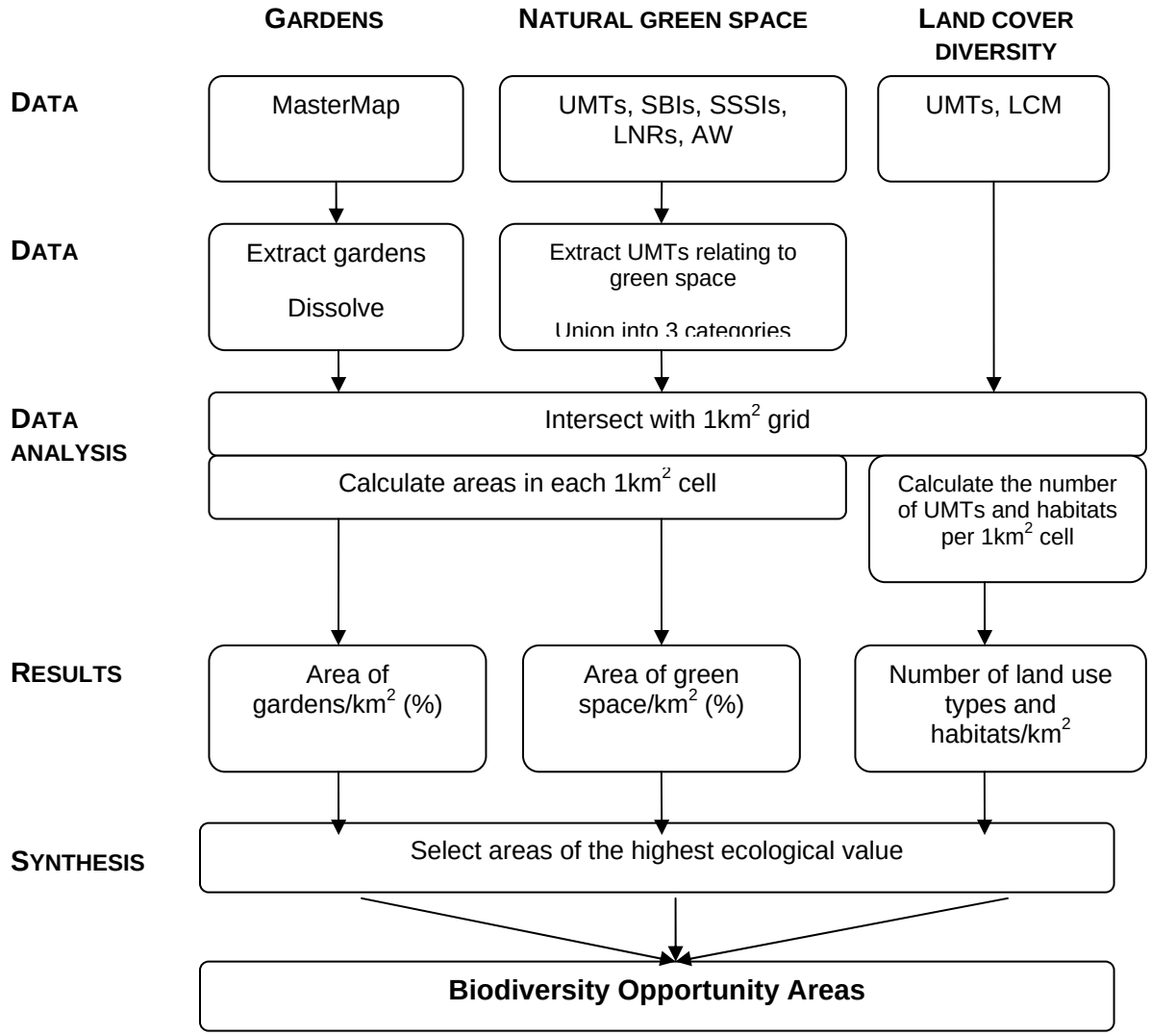


Figure **Error! No text of specified style in document.**.1 Percentage of land cover types in different green spaces (Kazmierczak and James, 2008a).

Spatial analysis of green space

Analysis with the use of Geographic Information Systems (GIS) was carried out in order to investigate the spatial distribution of green spaces, gardens and habitat mosaics in Greater Manchester. ArcView version 9.1 software was used to perform all analyses.

Two types of GIS analysis have been used, utilising the same datasets. The first approach was based on the calculation of percentage of natural habitat, garden area and variety of habitats per cell in the 1km^2 grid imposed on the Greater Manchester area. The cells of the grid in which a certain value was exceeded (30 per cent of coverage for the most natural green space and gardens; 10 or more types of habitats) were assumed to have the greatest potential to support high biodiversity (Figure 4.4; see Appendix 1 for the full description of methodology and results). However, this approach has been criticised as an oversimplification by the Interim Assessment examiners. Consequently, focal statistics were used in order to maintain the richness of data.

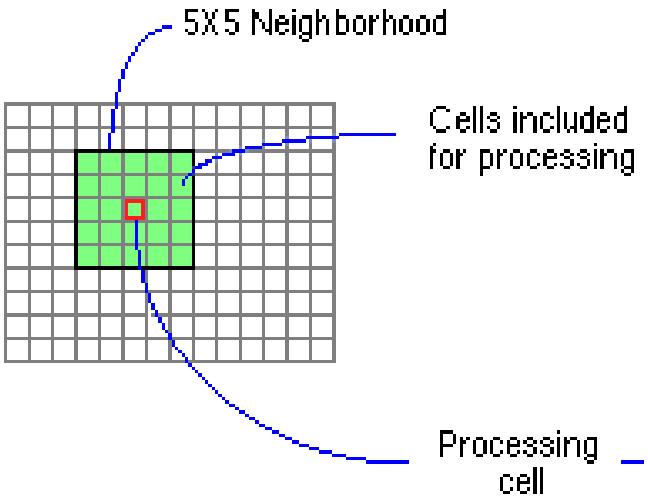


GIS analysis using 1km^2 grid. Based on Kazmierczak and James (2008a).

Focal statistics tool

Focal statistics tools calculate statistics in a "neighbourhood" (a group of cells included for processing, which shape and size are chosen by user) surrounding the "processing cell" for which the statistics are calculated (Figure 4.5). Therefore, the results for processing cell reflect the characteristics of its surroundings. The neighbourhood moves around the image so that every cell in the raster data becomes a processing cell. Therefore, analysis with focal statistics

can indicate areas with different concentrations of habitats or their variety; thus indicating area's potential for supporting high biodiversity.



Focal statistics tool (ESRI, nd). The value for the red processing cell is calculated based on the 25 green cells in the neighbourhood.

Three vector datasets: the most natural green space, gardens and LCM 2000 were converted to raster (cell size 25 by 25 metres). In the case of the most natural green space and gardens a binary approach was used, where each cell either contained the most natural habitat or gardens for respective dataset (cell value = 1) or did not (cell value = 0). The square neighbourhood size was 40 by 40 cells (1000 by 1000 meters). The SUM tool was used, which calculates the total of all values of the cells in the neighbourhood (ESRI, nd); for each cell, sum of pixels with the most natural green space (or gardens) was calculated. The values calculated for all cells were converted to percentages (0=0%, 1600=100%) in order to allow for comparison between datasets.

The diversity of habitats was calculated with the use of VARIETY tool, which calculates the number of unique values of the cells in the neighbourhood (ESRI, nd). Each of the habitat types in Land Cover Map 2000 was assigned a different value. The number of different values for each cell in its square neighbourhood (40 by 40 cells) was recorded.

The focal statistics exercise resulted in three digital maps presenting the concentrations of the most natural habitats, concentrations of domestic gardens and areas of different habitat diversity. The areas with highest density of the most natural areas and gardens and the most intricate habitat mosaics are see as the “biodiversity opportunity areas”, i.e. areas where the highest biodiversity in the conurbation can be expected. The results were validated by investigating spatial association between biodiversity opportunity areas’ distribution and the location of major bird sites (Smith, 2007) and great crested newt (*Triturus cristatus*) sites obtained from the Greater Manchester Ecology Unit.