# The Value of Mapping Green Infrastructure





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### Introduction

This paper discusses how approaches developed using geographical information systems and Ordnance Survey large scale data have been adapted to demonstrate the value of mapping green infrastructure to a range of planning policy and development projects in Liverpool and the wider Mersey region.

Green infrastructure planning is completely scalable: it can take place at the neighbourhood street level all the way up to regional or even national level. The key at each level is an understanding of the purpose of planning at that level so that the right type and resolution of information is gathered and the outcomes from the process can be used in a meaningful way by the levels of planning immediately above and below.

Apart from the advantages to wildlife and ecological diversity, the benefits of green infrastructure to the health and welfare of the communities which enjoy them is documented in a number of studies, as is the converse link between social deprivation and ill health when communities have very limited access to green open space, especially in urban areas<sup>1</sup>.

This paper illustrates how green infrastructure and its benefits have been recognised and enshrined within policy with particular reference to the Mersey region. It details how a methodology developed by The Mersey Forest to identify, record, store and evaluate specific green infrastructure resource of an area into a spatially enabled register has been adapted to serve both policy formulation within strategic framework documents but also how specific, localised development have provided opportunities for the implementation of green infrastructure policy.

#### Local policy context and drivers

Within the Liverpool and Mersey region there are a number of policy initiatives and drivers to identify and understand green urban infrastructure right from the regional level down to the scale of individual sites. To enable these initiatives, local and regional authorities, such as Liverpool City Council, established a need to develop a green infrastructure strategy if the area were to maximise benefits to be gained from the sustainable management of its natural environment.

As The Mersey Forest state in Liverpool City Council's Green Infrastructure Strategy (2010) "green infrastructure is a critical infrastructure for the economy and health of the city"<sup>2</sup>. To that end a database of the green infrastructure resource needed to be created. The current Planning Policy Guidance 17 (PPG17)<sup>3</sup> provides a guideline typology which could be further adapted as required, whilst OS MasterMap® Topography Layer provides the basic geographic framework on which to build the resource register. What was required to bring all these elements together into an effective tool to support the different policies was the necessary expertise in Geographical Information Systems (GIS), appropriate resources and a good understanding of green infrastructure functionality; for that the authorities turned to The Mersey Forest.

<sup>&</sup>lt;sup>1</sup>Green space access, green space use, physical activity and overweight: a research summary. (Natural England, 2008) and Natural England Technical Information Note TIN055: An estimate of the economic and health value and cost effectiveness of the expanded WHI scheme 2009 (Natural England, 2010) <sup>2</sup>Liverpool Green Infrastructure Executive Strategy (2010) (Liverpool City Council)

<sup>&</sup>lt;sup>3</sup>At time of writing a replacement PPS – Planning for a Natural and Healthy Environment had been issued for consultation but was not yet adopted. More information on PPG17 can be found at: http://www.communities.gov.uk/publications/planningandbuilding/planningpolicyguidance17

#### **The Mersey Forest**

The Mersey Forest is the biggest of the UK's 12 Community Forests, stretching from the Sefton coast in the north, down across the Cheshire Plain to the canals and woodlands of Northwich in the south, covering 465 square miles of Merseyside and North Cheshire. The aim of the this Forest Partnership is to create 8000 acres of new community woodlands and a wide range of associated environmental, economic and social benefits through sustainable landscape improvements to the Mersey Forest area over a 30-year period. Through woodland planting and the creation of associated habitats, long term, sustainable benefits for the economy, people and wildlife are to be produced. Figure 1 below shows the extent of The Mersey Forest area. Through sustained activity to transform the landscape of the area following years of neglect and degradation, forest partnerships are creating opportunities for communities, for nature and for business. In this context, green infrastructure is to be created that complements, promotes and sustains community and economic development (see also **www.merseyforest.org.uk**). The GIS experience that the Mersey Forest team have gained through managing the Community Forest has led to the development of a methodology, based on OS MasterMap® Topography Layer, for identifying both the location and function of green infrastructure, which lays the basis for further work to understand and measure the different types of value the green infrastructure provides to the community.



Figure 1: The Mersey Forest boundary

## The Mersey Forest approach

#### The Mersey Forest define green infrastructure as follows:

"Green infrastructure is all plants and surface water, wherever they occur. A few examples are a street tree, the lawn in a private domestic garden, a football pitch, a moor, a river, and the sea. The green infrastructure approach considers all of these things as a system which performs multiple functions upon which people and other species rely, such as evaporative cooling, food production and recreation."

The approach is based on the 'Five Steps to Green Infrastructure Planning' process set out in the *North West Green Infrastructure Guide* and shown in figure 2 below.



#### Figure 2: Five Steps to GI Planning

Compiling the register of green infrastructure itself consists of these main tasks in order:

- 1. an assessment of data needs and availability
- 2. data acquisition
- 3. typology mapping
- 4. functionality mapping; and
- 5. needs mapping.

Typology mapping determines where the green infrastructure resources are in the study area and what type of green infrastructure the resource is. It is carried out by first dividing the study area into polygons of land (a parcel system), which are then each assigned a green infrastructure type from a master list (or discarded if they are not green infrastructure), consistently following a set of rules. The master list has been largely derived from the land use types within PPG17 but also some additional types where planning policy guidance does not provide enough granularity.

The most important dataset required is the parcel system itself. This method uses OS MasterMap Topography Layer, for the following reasons.

- It is currently readily available to public bodies under the Public Sector Mapping Agreement, in England and Wales, and One Scotland Mapping Agreement, in Scotland, with Ordnance Survey.
- It is generally accepted as Great Britain's foremost mapping data.
- The parcels are relatively small, which gives a high level of detail and a high level of fidelity to reality. For example, the mean area of parcels in a Northwich pilot study area is just 646m<sup>2</sup>, about the same as the penalty area on a football pitch.
- It is regularly updated.
- The parcels are designed to correspond well to real parcels of homogeneous land cover on the ground.
- Ordnance Survey gives the parcels several attributes that help with assigning types to them.

The original methodology developed by The Mersey Forest was largely manual and as a result the parcels, which can be quite small, effectively define the size of study area for which the manual methodology is feasible. The kinds of study areas that a manual method is likely to be appropriate for include clusters of sites, towns and villages, and other areas between roughly 1km<sup>2</sup> and 100km<sup>2</sup>.

The Mersey Forest used this original methodology as a springboard to develop increasingly automated versions of the methodology which could be used for much larger areas, potentially even the whole country. The application of the methodology to larger project areas is discussed in the following sections. The second most important data set is aerial imagery. The Mersey Forest used 25cm resolution colour imagery sourced from local holdings, supplemented by online datasets and other datasets as appropriate. There are many other datasets that are useful, especially open space surveys, which most local authorities have carried out, and are useful for distinguishing between various kinds of public open spaces containing green infrastructure. The final set of information needed is the boundary or extent of the area for which the register is being compiled.

Once all the individual OS MasterMap parcels that are candidates for the register have been defined by their inclusion or intersection with the chosen boundary, assigning a type to them is largely a process involving:

- 1. a 'bulk' typing automated exercise based on the attribution with OS MasterMap Topography Layer and additional datasets, such as the open space surveys
- 2. some manual intervention; and
- 3. the use of automated data extraction from the aerial imagery.

This process does vary depending on which version of the methodology is used.

The process assigns types to all polygons. The first process above will correctly categorise about 80% of the polygons. The remaining 20% or so will need to be corrected and are examined manually or extracted automatically from aerial imagery.

Once the initial register has been created containing each physical feature and its type, the next stage is to assign a function or functions, bearing in mind that each piece of green infrastructure can have more than one, based on the typology list. Functions include recreation, shading from the sun, heritage, food production and so on, which indicate the benefits that each item provides. Figure 3 shows the distribution of green infrastructure that provides shading from the sun in Liverpool.

Ordnance Survey's Research team also supplied an extract of infrared data for The Mersey Forest to assess as a suitable data source for green infrastructure identification. The findings are discussed in Annexe 1 – **Using Infrared** at the end of this white paper.

## The Mersey Forest approach

Any single item can provide multiple functions and therefore multiple benefits. A set of rules have been developed by The Mersey Forest to make the assignment of function as consistent and meaningful as possible, so that any subsequent policy or decision is defensible. Once it has been determined which parcels of land provide which functions, not only can separate maps be produced showing where each function of green infrastructure is performed in the study area, but also the total number of functions for each parcel can be calculated, giving a map of multi-functionality. Such a map may be useful as an overview of the existing situation and can form the basis of a more detailed plan. It provides a level of certainty on the number of functions and can support policy formulation and post implementation monitoring. Figure 4 gives an example of a multifunctionality map for Liverpool where the lowest numbers of functions (1 or 2) are shown in yellow and the highest (20) in blue. Zero functions are shown in white.

## Figure 3: Mapping showing 'shading from the sun' function in Liverpool

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### Figure 4: Multifunctionality mapping using The Mersey Forest approach



## The Mersey Forest approach

### Mapping the benefits of green infrastructure

Once the functions have been mapped, the benefits that result from them can also be mapped. There are many ways of dividing up the benefits that green infrastructure provides, but the system of eleven proposed by Natural Economy North West is now widely politically accepted, at least in the North West of England. It was originally intended as a list of just economic benefits, but with a small adjustment of perception it can easily extend to cover all benefits of green infrastructure. The identified benefits are:

- 1. Climate change adaptation and mitigation
- 2. Flood alleviation and water management
- 3. Quality of place
- 4. Health and well-being
- 5. Land and property values
- 6. Economic growth and investment
- 7. Labour productivity
- 8. Tourism
- 9. Recreation and leisure
- 10. Land and biodiversity
- 11. Products from the land.

There are many different ways in which a function could be said to result in a particular benefit or set of benefits, so the list of benefits and explanations of how particular types perform particular functions which lead to particular benefits are perhaps most useful when persuading landowners, planners and so forth to support particular green infrastructure plans.

These plans can be regional or city wide strategy frameworks or localised to small development sites, so any approach to creating registers of green infrastructure needs to be adaptable across a range of areas.

# Adaptability of the approach developed by The Mersey Forest

The approach described above has proved very adaptable to a range of different sized areas and projects, from the regional to the city and the neighbourhood down to a specific site. The following sections discuss four projects, one from each of these sized extents, where the approach has been used to solve particular problems.

The four projects, in order of the size of area considered, are:

- Liverpool City Region Green Infrastructure Framework
- Liverpool City Green Infrastructure Strategy
- Liverpool Knowledge Quarter
- Alder Hey Children's Hospital.

Figure 5 below shows the different project areas.

#### Figure 5: The four project areas



## **Project: Liverpool City Region Green Infrastructure Framework**

A City Region is defined in the North West Regional Spatial Strategy (2008) as:

"the economic footprint of a city – the area over which key economic markets, such as labour markets, measured by travel-to-work areas, housing markets, and retail markets operate".

According to the Framework document, the Liverpool City Region<sup>4</sup> itself consists of the city of Liverpool and the surrounding local authority districts of St. Helens, Wirral, Knowsley, Warrington, Sefton and Halton. The population of the city region is approximately 1.5 million (2009<sup>5</sup>). The area is said to form the core of a larger economic zone of influence of over two million people which extends into West Lancashire, West Cheshire and parts of North Wales.

The 2007 Index of Multiple Deprivation from the Department of Communities and Local Government showed that nearly 1 in 3 of the 1% most deprived Super Output Areas within England and Wales, and 9 of the 20 most deprived, are within Liverpool City Region. There is plenty of evidence to link quality of life, health, economy and levels of deprivation with the amount and functionality of green infrastructure available to a community.

The development of a Green Infrastructure Framework for the Liverpool City Region has been mandated by the City Region Environment and Waste Board as part of their responsibilities to lead on strategic issues for the City Region Cabinet.

The work started with the Liverpool City Region Green Infrastructure Framework aims to provide a sub regional level strategic assessment of green infrastructure that provides the basis for the management, enhancement and creation interventions that will maximise economic, social and environmental benefits from the natural environment, assisting sustainable development. In particular, the Multi Area Agreement for the City Region identified the following areas as priorities to be addressed within the framework:

- Unemployment and Skills
- Increasing Jobs
- Improving Health
- Running Businesses Efficiently.

Specific objectives for the framework are to:

- Identify the key sub regional issues which green infrastructure can help to tackle
- Highlight that green infrastructure is a critical infrastructure
- Ensure that the asset is planned and managed so as to maximise benefits
- Provide a basis for joint working at the city region level.

In short, in producing the City Region framework, The Mersey Forest's purpose was to embed the green infrastructure plan within a range of sub regional and local plans and strategies so that the actions are supported, resourced, monitored and delivered. In addition the framework can also assist in the delivery of the strong policy framework for green infrastructure and inform spatial planning.

The purpose remains to provide a framework for sub regional working and a source of information for the development of local authority and site level strategies and plans. A key outcome of sub regional green infrastructure planning is to help to assist in identifying the key issues at this scale for which green infrastructure may be able to offer some of the solutions. The intention is not to replicate work that is already underway at the city region level, nor to try to carry out work that will be necessary at the local level.

<sup>4</sup> http://www.merseyside.org.uk/displaypage.asp?page=169

<sup>5</sup> Figure taken from www.merseyside.org.uk

## **Project: Liverpool City Region Green Infrastructure Framework**

#### The framework will identify in particular cross boundary issues and key needs that green infrastructure can meet and assess whether:

- The need is being met and assess whether that is likely to be sustained
- Where need is not being met, what can be done through green infrastructure planning and implementation
- Identify how the needs can be addressed using existing structures and influencing policy and strategy in the sub region

This will enable better informed decisions to be made about land use planning and management from regional schemes to individual developments, such as the Alder Hey development, based on a sound and agreed evidence base.

## Adaptability of methodology to sub regional green infrastructure planning

The Liverpool City Region Green Infrastructure Framework has been developed using the standard five step process set out in the North West Green Infrastructure Guide (figure 2).

The actions taken within each step have been adapted to meet the needs of stakeholders and the objectives of the framework, and some of the developmental work can be used to inform the next iteration of the Green Infrastructure Guide for the region.

Due to the development work enabled by the Liverpool City Green Infrastructure Plan it has become possible to carry out full typology and functionality mapping across the sub region so that it has much improved base for the Framework.

## **Project: Liverpool City Green Infrastructure Strategy**

The Liverpool Green Infrastructure Strategy<sup>6</sup> has been developed to maximise the benefits that the city can gain from the sustainable management of its natural environment. Green infrastructure is a critical infrastructure for the economy and health of the city.

Green infrastructure is simply a term that is used to cover all the vegetation and open water in and around the city, whether it is rare or common, private or public, in the city centre or the city suburbs – Croxteth Park or a single street tree. However, green infrastructure planning is a new approach, going beyond business as usual, focused on the benefits that can be delivered.

#### The key findings of the strategy are<sup>7</sup>:

- 62% of the city is green infrastructure. Liverpool is a green city and should use this fact for marketing and competitive advantage
- The largest individual type is private domestic gardens at 16% of the area of the city. These represent a real asset for the city, and which local residents and communities have a direct responsibility for and influence over
- The City Centre and Inner Areas have low levels of green infrastructure and that which is available is of low functionality
- Green infrastructure is not equally distributed across the city. 22% of the areas have 80% of the total accessible green infrastructure and some areas have no accessible green infrastructure
- The most affluent areas of the city have 18% more green infrastructure than the most deprived
- Green infrastructure is an £8bn asset for the city

- Low levels of green infrastructure occur in areas of the city with a higher incidence of:
  - Coronary heart disease
  - Poor mental health
  - Poor air quality
- Green infrastructure interventions will help tackle some of Liverpool's most pressing problems
- The most effective actions will be those that concentrate on making the best use of the existing green infrastructure resource through appropriate management.

The Mersey Forest was tasked with producing a green infrastructure strategy for Liverpool which will form part of the evidence base necessary to ensure that green infrastructure policy to be included in the Local Development Framework is both justified and effective. The strategy should assist the Liverpool Primary Care Trust and Liverpool City Council to improve health outcomes in the City, while delivering high levels of urban growth and mitigating and adapting to climate change. These objectives are reflected in the following five priorities as stated in the Action Plan.

**A sustainable city** – supporting business, regeneration and housing growth within environmental limits.

A city providing natural choices for health – supporting improved physical and mental health.

A cool city – adapted to projected climate change.

A green and biodiverse city – supporting good quality of life for all.

A city where green infrastructure is well-planned – green infrastructure as a critical infrastructure.

The purpose of the strategy can be summed up as:

"to support the aspirations for the future sustainable development of Liverpool to ensure that it is one of the best places to live, work, invest and enjoy life".

<sup>6</sup> http://www.greeninfrastructurenw.co.uk/liverpool/

<sup>8</sup> Liverpool Vision People Place and Prosperity: An economic prospectus (2009

<sup>&</sup>lt;sup>7</sup> Liverpool Green Infrastructure Strategy Executive Summary (2010)

## **Project: Liverpool City Green Infrastructure Strategy**

# Adaptability of methodology to city level green infrastructure planning

The methodology and the register that can be built from it are the essential mechanisms that will allow green infrastructure to be planned and managed.

The ability to assign multiple functions and benefit is particularly important when there is a need to support such a wide range of planning requirements. The methodology is very thorough in its definitions of type, in particular, and even goes further than the current PPG17 requirements. Figure 6 shows the typology for Liverpool derived from the methodology.

It is therefore a highly flexible tool that can collect many pieces of information and use them to serve many different policy drivers and should be adaptable to any city of the same size and nature.



## **Project: Liverpool Knowledge Quarter**

The Liverpool Knowledge Quarter comprises three institutions of learning: the University of Liverpool, Liverpool John Moores University and the Royal Liverpool University Hospital. Despite only occupying 1% of Liverpool's land area the three institutions make significant contributions to the city's economy. Around 7% of the city's full time employed citizens works for one of these three employers. The economic importance of the Knowledge Quarter is therefore not to be underestimated, and furthermore all three facilities intend to invest heavily in redeveloping the Quarter over the coming twenty years<sup>9</sup>.

The trigger for applying the Mersey Forest methodology to these redevelopment plans came from the city's economic development company, Liverpool Vision. In July 2008, Liverpool Vision published an Urban Design Framework for the Knowledge Quarter, authored by URBED, a Manchester-based urban design consultant. It included a Climax Plan showing what the arrangement of buildings, streets and open spaces might look like in twenty years' time. The Mersey Forest, together with Natural Economy North West and other partners, suggested that a more detailed look at how green infrastructure could be incorporated would be vital to the plan's success, helping to deliver a wider range of benefits for this key area of the City.

In particular, The Mersey Forest was asked to assess how the changes in the Climax Plan will affect the green infrastructure of the Knowledge Quarter site. The project had to maximise the benefits of green infrastructure planning and implementation for:

- Quality of Place the image of the area
- Quality of Life the health and wellbeing of those who live or work in the area or are patients at the hospital
- Quality of Learning creating a "knowledge landscape", a rich resource for study on the doorstep of the universities

These three objectives also have clear links in to several of the key themes within the City's Green Infrastructure Strategy and the City Region Framework. The customer needed a methodology that could make an assessment of where each of 28 specifically defined functions of green infrastructure are performed within the Knowledge Quarter area, both at present and in the Climax Plan future. The functions ranged from recreation to water interception to wildlife habitats. Then the Climax Plan could be compared with the existing arrangement in terms of green infrastructure multifunctionality and an assessment made on whether the provision would be more or less functional.

This illustrates that the methodology is not only able to identify what is available now but also as a tool for testing future plans. It can therefore be adapted to not only provide the basis on which to formulate policy and monitor the subsequent implementation, but it can also be used to actually assess and compare different models before a policy or a plan is implemented. Such 'desktop' evaluations can highlight areas that need to change or missed opportunities, which should give policy makers much more confidence in their final decisions, before committing to major investments.

# Adaptability of the methodology to a neighbourhood

In the case of the Climax Plan, the methodology illustrated that significant amounts of green infrastructure functionality would be lost. Using this evidence, the Climax Plan was improved to retain and add to the current overall amount of green infrastructure functionality. The methodology was applied again to the revised Plan and an increased functionality was clearly demonstrated. This is shown in figure 7 (before) and figure 8 (after) below.

<sup>9</sup> Liverpool Knowledge Quarter Green Infrastructure Assessment: an example of added value, http://www.urbed.coop/journals\_show.php?j\_id=142

## Liverpool Knowledge Quarter



### Figure 7: Change in multifunctionality based on the original Climax Plan.

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## **Liverpool Knowledge Quarter**

#### -19 -18 -17 -16 -15 -14 -13 -12 -11 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 17 18

### Figure 8: Change in multifunctionality based on the revised Climax Plan.

The Mersey Forest approach prompted URBED to revise the climax plan to increase the functionality. This approach has ensured that the green infrastructure element of the redevelopment of this highly important site is of equal quality as the other public spaces and amenities within the area.

Reproduction from the Ordnance Survey mapping with permission of Her Majesty's Stationery Office © Crown Copyright. Unauthorised reproduction infringes the Crown Copyright and may lead to prosecution or civil proceedings. TMF Licence No. 100031461 (2009) There has been a medical facility on the site of Alder Hey Children's Hospital since 1914. Alder Hey now has a world wide reputation for the specialist treatment of children and serves a population in excess of 7 million as well as taking in children from all over the UK and beyond. Alder Hey is being redeveloped, with the aim of opening the new facility for its centenary in 2014. A major part of the redevelopment will be formed by a Children's Health Park around the new hospital buildings, making Alder Hey the first medical facility of its kind in Europe to have its campus set within a park expressly designed to promote the health and aid in the recovery of Alder Hey's young patients, but also for the wider community<sup>10</sup>.

Alder Hey's vision, as stated on their website for the Children's Health Park is:

#### "an ambitious and radical vision to redefine what a hospital is and how it relates and interacts with its patients, visitors and environment".

This health park will naturally form a significant piece of green infrastructure for Liverpool and, again, there are close parallels between their drivers – social, health, economic, environmental – and the five key themes within the Liverpool City Green Infrastructure Strategy and the City Region Framework.

Alder Hey is administered as an NHS Trust. Before embarking on the physical redevelopment of the site the Trust wanted to ensure that the proposals would deliver tangible social, health, environmental and even economic benefits. A method was needed to compare and evaluate the various benefits. The solution was to build on the green infrastructure expertise available from both The Mersey Forest, and the Institute for Sustainable Water Integrated Management and Ecosystem Research (SWIMMER) based at the University of Liverpool, to produce a detailed series of maps and reports, using large scale Ordnance Survey OS MasterMap data and GIS modelling techniques, to measure the benefits. The challenge for The Mersey Forest was to adapt their established methodology to a site that was much smaller, and required much greater detail, than any the methodology had been applied to previously and had specific criteria for assessing the new designs and the impact on a number of key stakeholder groups such as patients, visitors, staff, the local community and the wider public, who were also consulted. The children, in particular, had been encouraged to draw maps of what they wanted the new facility to be like and a key challenge for the scheme would be to reflect and meet some of these expectations.

# Adaptability of methodology to a development site

In particular a new methodology was needed to enable the project team to not just map what was proposed, or what already existed, as previously, but to map the change in functions and benefits that are likely to occur during the redevelopment of the site and the creation of the Health Park both graphically with maps and quantitatively so that the change can be measured.

This new methodology included:

- the use of additional expert judgement on the health benefit likely to be gained
- the introduction of a different typology that included non-green infrastructure types for comparison
- the omission of several other types of green infrastructure that were deemed irrelevant
- a shorter list of functions, again to exclude some irrelevant ones; and
- a different scoring mechanism to assess type against function that allowed for greater ambiguity and a wider range of scores.

As the development of the Health Park progresses this new approach is flexible enough to be tested and adapted to respond to the changes during the redevelopment.

## **Conclusions / Annexe 1 – Using Infrared**

### Conclusions

Green infrastructure is being increasingly acknowledged at all levels of planning policy, from regional down to site specific, as providing a multitude of benefits, particularly where it is in comparatively short supply, such as large urban areas. There is a strong argument that it should be planned for and maintained in much the same way as 'grey' infrastructure to realise return on investments and maximise the benefits. As the key themes within the four projects detailed here show, green infrastructure has the capacity to meet many different types of aspirations that a city or community may have, whether that be addressing global issues like climate change and biodiversity, or very personal ones like the health and wellbeing of a child.

A pre-condition to even understanding the benefits from green infrastructure is to identify where this resource exists, understand what type of resources they are and assign the correct function or functions that they perform.

The work that The Mersey Forest has done on developing a geospatial methodology to create registers of green infrastructure with all this information, based on detailed topographical data from Ordnance Survey, has provided an adaptable, robust approach to creating the base information upon which to develop and implement policy as well as test, model and refine site specific plans to ensure that green infrastructure is optimised and that return on investments can be realised in the most amount of ways.

The four projects discussed here are in their initial stages of implementation. Over the coming months and years there is further work for the methodology to do in terms of incorporating measures for how well the green infrastructure is performing in terms of realising the benefits, and in adapting to the ever changing social, political, economic and environmental drivers that exist in dynamic and demanding areas like Liverpool and its region.

#### Annexe 1 – Using Infrared

Ordnance Survey's research team supplied The Mersey Forest with some sample infrared data for them to assess its suitability for the methodology (right). Initial findings were encouraging. Two main indicators in the infrared range were identified, that would particularly help The Mersey Forest to quantify, classify and ascribe functions to green infrastructure a lot more accurately and easily than with just visible-wavelength aerial photography, in combination with a Digital Surface Model and a compatible Digital Terrain Model. These are:

- the percentage green infrastructure cover in each land parcel, which is especially important for private domestic gardens – the paving over of which is a big problem
- the percentage tree cover in each land parcel. Trees typically provide more functionality than other green infrastructure, and a different set of functions.

#### Sample infrared imagery for Liverpool





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