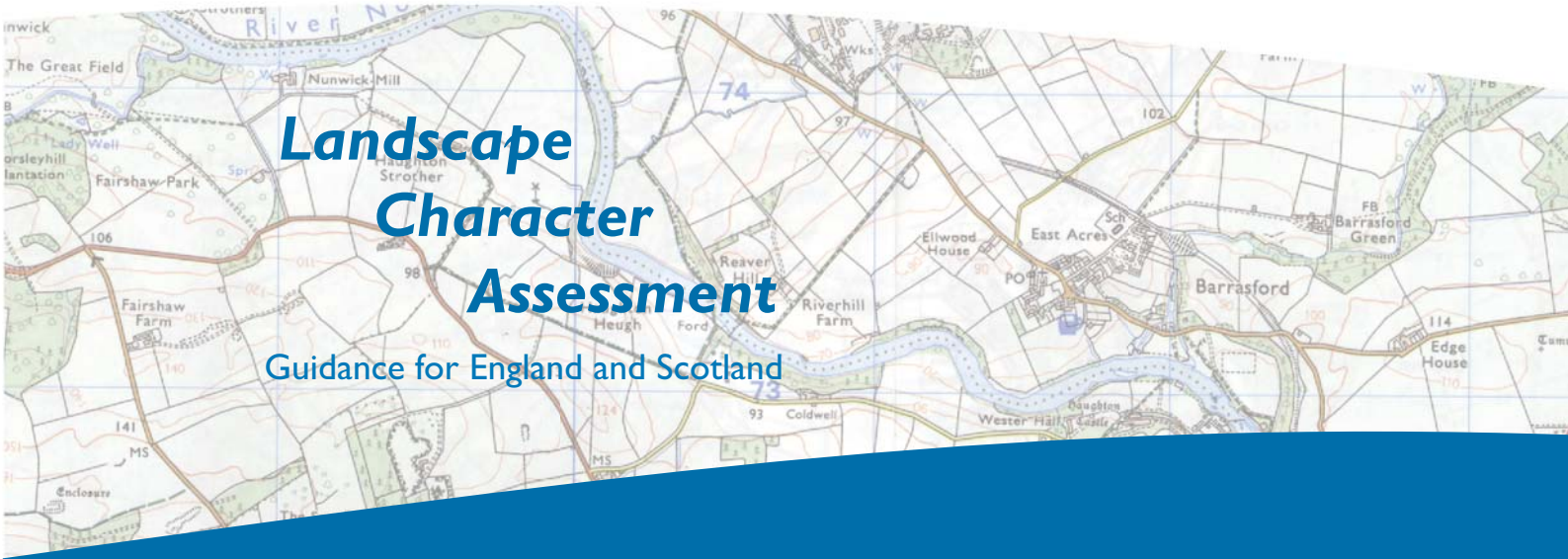
SCOTTISH NATURAL HERITAGE

The Countryside Agency




# Landscape Character Assessment

Guidance for England and Scotland

## TOPIC PAPER 4: Use of Geographical Information Systems and other computer methods

*An introduction to the use of GIS and other computer methods in Landscape Character Assessment including examples of good practice and case studies.*

## INTRODUCTION

1. Central to Landscape Character Assessment (LCA) is the analysis of relationships between different landscape elements, such as geology or settlement pattern, in order to classify and describe the landscape. Many landscape elements are represented by spatial data, whether in digital form or on a paper map. A Geographical Information System (GIS) is a computer system that facilitates the process of storage, analysis and presentation of spatial data [1] and is therefore particularly suited to LCA.

2. Geographical Information Systems and other computer methods can facilitate all stages of a Landscape Character Assessment. Investment in technology for LCA will result in a better end product that can be made available to a wide range of users. The use of GIS will ensure that whatever the current purpose of the LCA, the data will be in a readily accessible form for a range of potential new uses in the future. Digital information stored in a GIS can be the principal output of a project, taking the place of a paper report. Unlike a paper report, a GIS database is a flexible, usable and updatable resource.

3. Data gathered during LCA field survey can be compiled in a systematic manner, so that it can be stored in a GIS. Digital images of the landscape can be combined with the categorical and descriptive information to give a rich database of landscape information. This information can then be used as a resource to aid understanding landscape patterns and to support landscape planning decisions.

4. A GIS provides powerful tools for visualising, presenting and disseminating the results of Landscape Character Assessment. The outputs of a GIS can include spatial datasets, online interactive maps, 3D visualisations and paper maps. These different outputs can be made available to a wide range of users to realise the full potential of the LCA.

5. The data stored in a GIS can be accessed and manipulated interactively. Hence this data can serve as a test bed for studying landscape processes, or for analysing the results of trends, or for anticipating the possible results of planning decisions [2].

6. This paper begins with an overview of important GIS concepts, before describing the role that GIS and other computer methods can play during the completion of a Landscape Character Assessment.

## GIS - BASIC CONCEPTS

### Definition of GIS

7. A GIS is used for handling map-based information. The information is typically represented as several different layers where each layer holds data about a particular kind of feature. A more formal definition of a GIS is a computer system for capturing, storing, checking, integrating, manipulating, analysing and displaying data related to positions on the earth's surface [3]. A GIS can also be thought of as a decision support tool for tackling spatial problems.

### GIS Software

8. GIS software is a set of programs that carry out geographic processing functions. A wide range of software packages are available, ranging from simple data viewers to desktop GIS and enterprise-wide systems. To ensure that any chosen GIS software will be suitable for the purposes of the Landscape Character Assessment, the advice of other GIS users should be sought. It is particularly important to obtain GIS software that permits easy import and export of data, to facilitate interaction with other GIS users.

### GIS People

9. One of the most important aspects of a GIS is the skill and understanding of the staff using the system [1]. Investment in staff training will result in a higher quality LCA and GIS, increasing the decision making capabilities of the organisation. GIS training courses are available from private training providers, colleges and universities and via distance learning over the internet.

## Geographic Data

10. Geographic data represents landscape elements on the surface of the earth. The format, level of detail and accuracy of the data will affect this representation. Data can be stored in different formats, with each format being suited to particular applications and methods of data capture.

11. Raster data is a geographic representation of the world as an array of equally sized pixels, usually square pixels. The pixels are arranged in rows and columns and each pixel is referenced by its geographic location. Examples of raster data include aerial photography, scanned images or Ordnance Survey 1:50,000 Scale Colour Raster. Raster data is commonly used as a base to other data. Using GIS the pixels can be analysed as they represent a value at a geographic location.

12. Vector data represents each individual feature by a point, a line or a polygon. The geographic representation of a feature is linked to a record in a table containing attribute information. Archaeological finds or species records are examples of point data. Line data includes field boundaries, roads or watercourses. Polygons are used to represent character areas, parishes or woodlands.

13. Attribute information can be recorded for map features and stored in a data table. Each unique feature has its own row in this table with numerous columns (or attributes). Each attribute is assigned a data type which defines the data that can be stored. Data types include text strings, numbers, true/false or date.

## Co-ordinate systems

14. A projection is a mathematical transformation that allows positions on the earth's curved surface to be represented on a flat plane [4]. A co-ordinate system is a reference system that identifies the location of a point in space. It is important to ensure that all of the datasets in the GIS store locations in the same projected co-ordinate system. For UK-based projects the Ordnance Survey National Grid is commonly used and most datasets will be supplied in this projected co-ordinate system.

## Metadata

15. Metadata is the technical word for 'data about data'. It is the term used to describe the summary information or characteristics of a dataset. Metadata can be used to identify suitable datasets to be used for a Landscape Character Assessment. Metadata should include the title and description of the dataset, an abstract detailing reasons for the data collection, when the dataset was created and updated, originator and data supplier and the geographical extent. All metadata should conform to the latest metadata standards. The current standard is the National Geospatial Data Framework (NGDF) standard [5]. A new international metadata standard (ISO 19115) is due to be published in 2003.

# DEFINING THE SCOPE

16. The scope of a GIS will reflect the scope of the LCA and must be defined at the outset. In common with a paper-based LCA, it is essential to define data requirements and to follow a focussed approach to data gathering to meet the specific requirements of the assessment. The scoping stage will also guide the design of the GIS database. It is advisable to gain input from an expert with experience in database design to ensure that data is stored correctly and efficiently.

17. The design of the GIS will depend on the purpose of the assessment and how it is to be used. This will be the key factor in deciding the type of data to collect. Having decided what data is required it is also critical to scope:

- the extent of digital data available for the project;
- existence of other (hard copy) data that can be digitised and form part of the GIS, for example paper maps of archaeological sites or habitat survey information;
- the need for additional work to create new datasets typically, for example, information on cultural landscape factors including field patterns or settlement typology may require original research and new mapping.

18. **Table 1** provides a summary of the range of typical sources of digital data for a Landscape Character

Assessment. This table provides some examples of each data type and is an expansion of **Box 4.1** 'sources of information for desk top study' from Landscape Character Assessment Guidance for England and Scotland. It is important to consider any copyright restrictions when selecting datasets at the outset of a project. This is particularly important if the LCA GIS will eventually be published online.

19. Many local authorities hold GIS data, although there will be issues with data accuracy, data formats and consistency when working across local authority boundaries. Certain datasets are available to be downloaded from websites, for example English Nature SSSI boundaries.

20. Where digital data is not readily available - such as cultural features or settlement pattern - it may be possible to create additional datasets through further research/map analysis. However, the resource requirements to undertake this additional work are often considerable and costs will need to be built into the project at the outset. Where appropriate any new datasets should be referenced to the national mapping base OS MasterMap.

21. There are a number of government sponsored web-based initiatives that can provide information about sources of GIS data. GIgateway (Geographical Information Gateway) is a web service aimed at increasing awareness and access to geographical information in the UK (www.GIgateway.org.uk). MAGIC (Multi-Agency Geographic Information for the Countryside) is an online resource offering rural and countryside information from a range of public-sector partner organisations, bringing together definitive rural designation boundaries and information about rural land-based schemes (www.magic.gov.uk).

**Table 1: Data sources**

| Data | Source | Notes |
|---|---|---|
| Topographic map base | Ordnance Survey (OS) and other data suppliers | Vector data at 1:1,250 or 1:2,500 (Landline, MasterMap) and raster data at 1:10,000, 1:25,000, 1:50,000 |
| Aerial photography | Various | Complete coverage available for England and Wales. Full Scotland coverage available by 2005. |
| Geology | British Geological Survey | Vector data at various scales |
| Historic Landscape Characterisation | Local Authorities, English Heritage, Historic Scotland, The Royal Commission on the Ancient and Historic Monuments of Scotland (RCAHMS) | |
| Landform / Topography | OS and other data suppliers | Vector data Landform Panorama (10m) and Landform Profile (5m) |
| Hydrology | Environment Agency, Scottish Natural Heritage, SEPA | River catchment boundaries, rivers etc |
| Soils | National Soil Resources Institute, Macauly Land Use Research Institute (MLURI) | |
| Vegetation/Landcover 2000 | Landcover Map 2000 MLURI SEERAD (June census) DEFRA June Census Data | Centre for Ecology and Hydrology |

| | | |
|---|---|---|
| Trees / Woodland | Forestry Commission | Woodland inventory data from Forestry Commission |
| | English Nature and Scottish Natural Heritage | Ancient Woodlands data from English Nature and Scottish Natural Heritage |
| Agricultural Land Classification | DEFRA MLURI | |
| Habitat surveys | Local Authorities, Biological Record Centres, English Nature, Scottish Natural Heritage | Phase 1 Habitat Survey |
| Historic Monuments | English Heritage, RCAHMS | Includes Scheduled Ancient Monuments, Historic Parks and Gardens, Historic Battlefields |
| Nature Conservation Designations | English Nature Scottish Natural Heritage Local Authorities | Designation data available from English Nature website and Scottish Natural Heritage |
| Landscape Characterisation Initiatives: Countryside Character Areas National Landscape Typology (Countryside Character Database) | Countryside Agency and Scottish Natural Heritage | Local designations from Local Authorities<br><br>Contact for further details.<br><br>Typology data for England requires the signing of a license agreement. Some restrictions on supply of data, depending on nature of use. |

## Scale

22. The scale at which GIS data is captured is a critical factor in the use of GIS for decision-making. The scale of data collection must be appropriate to the project purpose and its ultimate use. As described in the main LCA guidance, the scale must be agreed at the outset and used consistently throughout the project. For example, a strategic county scale assessment may be completed at 1:50,000, or a more detailed townscape assessment or appraisal of development options at 1:10,000.

23. Although GIS provides the ability to zoom in/out and view data at any scale, it is essential to keep in mind the scale at which it was captured. Datasets captured at 1:250,000 for example are not accurate when displayed at 1:50,000. Due to limited data availability, it is often necessary to interpret small-scale data at larger scales during LCA. If the scale and method of data capture is not clearly understood then consequent decisions made using the data may be severely misguided. This is particularly important to note when dealing with boundaries.

## Recording Unit

24. When building a GIS to store information about the landscape, it is important to define a consistent recording unit. Each unit should have a unique reference code for identification. Information describing each recording unit can then be stored in the database, indexed by the unique code. Landscape information is often stored linked to polygon recording units. The size of the polygons will depend upon the scale of the assessment and of the landscape being studied. **Box 1** describes The Living Landscapes Project approach to using polygon recording units.

**Box 1: Landscape Description Units**

The Living Landscapes Project has developed a structured, GIS-based framework for describing and analysing the countryside [6]. This framework operates at different levels of spatial resolution, ranging from the regional (Level 1 - 1:250,000), through the county/district (Level 2 - 1:50,000), down to the individual site (1:10,000). The Countryside Agency in conjunction with The Living Landscapes Project has produced a GIS based regional (1:250,000) landscape character framework and associated database for England. This regional framework has been used to define a Draft National Landscape Typology [7]. The draft typology has been devised by the Countryside Agency in collaboration with English Nature and English Heritage. The Living Landscapes Project is working with local authorities across England to develop a more detailed (Level 2) landscape character framework.

The fundamental building block of the hierarchy is the Landscape Description Unit (LDU). LDUs are distinct and relatively homogenous units of land. The boundaries of each LDU are defined by analysis of definitive attributes. The definitive attributes are derived from published map-based data. The four definitive attributes at Level 1 (regional) are physiography, ground type, land cover and cultural pattern.

At Level 2 (county/district), each of the attributes is split into two parts, giving a total of eight definitive attributes. This allows for a finer grain of mapping, whilst retaining the hierarchical structure of the spatial framework. Thus an LDU defined as 'soft rock low hills' at the regional scale might be sub-divided into three LDUs at the county/district scale defined as 'scarp edge', 'plateau summit' and 'dip slope valleys'. The relationship between the Level 1 and Level 2 definitive attributes is summarised in **Table 2**.

| | Regional | County/District |
|---|---|---|
| | Level 1 (1:250,000) | Level 2 (1:50,000) |
| Natural | Physiography | Landform<br>Geology (structure) |
| Natural | Ground type | Geology (rock type)<br>Soils |
| Cultural | Settlement | Settlement<br>Farm type (structure) |
| Cultural | Landcover | Farm type (cover)<br>Tree cover |

**Table 2: Summary of LDU definitive attributes**

The process of LDU mapping involves a step-by-step procedure of data acquisition, processing and synthesis to produce a series of character based GIS layers incorporating the key factors that contribute to landscape character. The natural dimension of the landscape is mapped first (**Figure 1**). The attributes of landform, geology and soils have boundaries which are derived from existing published maps. Cultural datasets are used to describe the cultural aspect of the landscape and to subdivide LDUs where appropriate.

The definition of discrete LDUs provides a meaningful and structured spatial framework for gathering additional descriptive information about the landscape. LDUs represent areas of common character to be verified and described during Landscape Character Assessment. At the field survey stage, the boundaries of the LDUs can be checked and information can be gathered to describe aspects, such as scale, form and enclosure. LDUs can then be classified according to shared characteristics to define Landscape Character Types. If necessary, large LDUs can be subdivided to define Landscape Character Areas.

The LDU framework has been used for a wide range of applications including habitat creation targeting, woodland strategy, housing allocation and assessment of the impact of highway development.

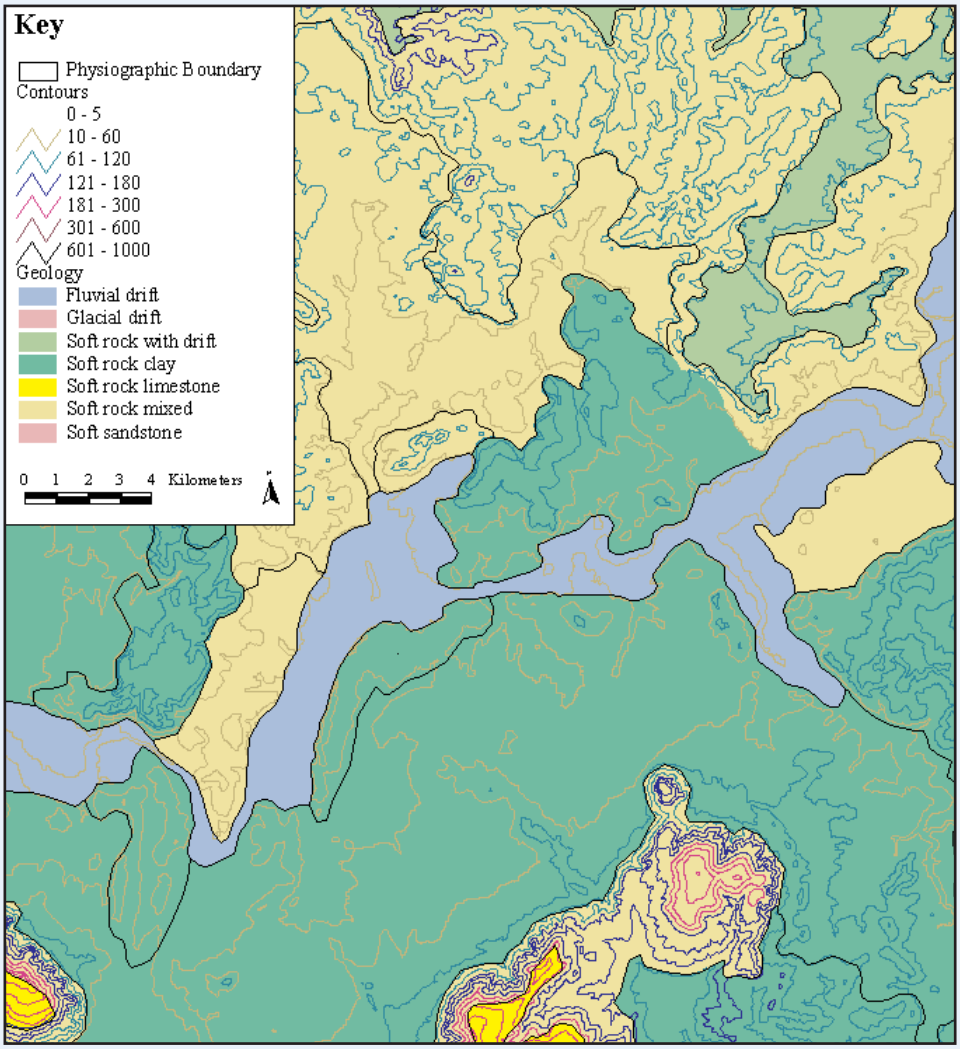



**Figure 1:** Simplified geology base with contour overlay - physiographic units shown as bold lines.

## DESK STUDY

25. The aim of this stage of the assessment is to divide the landscape into areas of common character. A valuable use of GIS is for the collation and analysis of information gathered as part of the desk study stage of a Landscape Character Assessment. GIS can be used to build up an information base by collating existing layers of digital data or digitising new layers.

26. The value of using GIS at this stage is that it allows complex layers of data to be overlaid and viewed on an OS base. The spatial relationships between datasets can then be analysed. It is important to remember that there will be assumptions, errors and inconsistency in many of the base datasets used for Landscape Character Assessment. Limitations in datasets should be acknowledged and accounted for and any assumptions made during the desk study should be recorded.

27. GIS can be used at a range of different levels to aid the draft characterisation:

- GIS can be used to view datasets and visually assess spatial distribution and correlations, which form the basis for defining areas of common character. This process has traditionally been achieved by overlaying a number of acetate sheets. Undertaking the same process on GIS not only overcomes the problems associated with enlarging/reducing source maps at different scales, but it also allows for greater scope in the analysis of the data. The

full potential of GIS continues to be constrained, however, by difficulties associated with availability of digital data and access to it. Several of the key baseline datasets are often too costly to purchase or simply not available in a digital format
(e. g. settlement).

- A particularly useful application at this stage is the viewing of information using a 3D contour model, such as one showing the relationships between landform and geology (**Figure 2**) or landform and land cover. This can aid the understanding of interrelationships between landscape elements.

- GIS can be used to interpret and analyse datasets in relation to each other, for example by setting parameters such as "show all areas over 200m elevation with >50 % woodland cover". Clearly, professional judgement is needed to define sensible thresholds and critical values for such analysis.

- At a more sophisticated level a GIS can be used as a tool to carry out spatial analysis. Such analysis can be used to combine datasets and define areas with similar characteristics. This technique has great potential to aid determination of areas of common character, but will require considerable technical expertise.

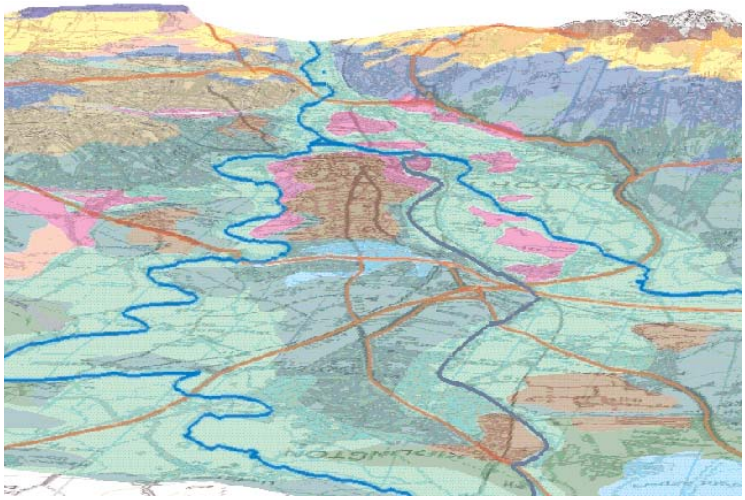


**Figure 2**: Visualising data in 3D can assist in the understanding of a landscape. In this example looking south down the Thames Valley over Oxford, the 1:50,000 OS map base, geology, rivers and major roads are all draped over a 3D model constructed from contour data. The relationship of the settlement pattern of Oxford to the landform is evident with Oxford city centre situated on raised river terrace deposits at the confluence of the Thames and Cherwell.

28. The output of this work will be a draft map of areas of common character for field testing. The use of GIS to develop the draft map in digital format has the advantage that boundaries can be easily refined and amended as the study progresses.

## FIELD SURVEY

### Hand Held Computers and Field Record Sheets

29. GIS can be invaluable as part of the field survey, notably through the use of hand held computers. This approach makes baseline information more portable for easier use in the field, allowing the interrogation of underlying datasets such as geology. The use of portable computers allows field survey information to be recorded directly into the GIS database, including any modifications to draft landscape boundaries. It is important to verify the information and check for errors.

30. It is advisable to use a weatherproof computer that is designed for use in the field. A standard laptop computer may cause practical difficulties during field survey, especially in wet weather or in bright sunshine. It is essential that field survey data is backed up frequently, either via external disks or through a mobile internet connection.

31. If it is not possible to use handheld computers then a tailored field record sheet should be used to record observations on the landscape in a systematic format. The field survey sheet should be designed to maximise the consistency of recorded information. Field sheets must be clearly linked to a recording unit or location with a unique identifier. Pick lists of pre-defined terms will help to ensure that a consistent dataset of categorical data is captured.

There should be sufficient room on the survey sheet to accommodate written comments and field observations, which can also be stored in a GIS. **Box 2** describes how this approach to gathering landscape information was used in Derbyshire.

### Photography

32. Photographic images can form an important part of a LCA GIS, recording visual characteristics of the landscape. Digital images for the GIS database can be either taken using a digital camera or scanned from photographs. Images can then be stored in the GIS and linked to point features that can be displayed as arrows on a GIS map interface.

33. Photographs collected during a LCA can be used to construct visualisations of the present landscape and scenarios for future landscapes. Even if landscape visualisations are not an immediate intended output of an LCA, the collection of suitable information and images will make this possible in the future and will add value to the data gathered in the field without significant increases in cost. Photographs that record individual landscape features will be useful for constructing more realistic landscape visualisations. Features recorded could include tree species or building materials and images should be composed to allow features to be 'cut out' using graphics software.

34. All photographs should be assigned a unique identifying code together with a grid reference, bearing, date and notes describing the image. In addition, the following information should be gathered about each photograph to aid the construction of landscape visualisations: notes to allow a future visitor to locate themselves at the same spot, the time of the photograph and weather conditions. It is also important to record the focal length and field of view of the camera lens. For a fixed lens this information would only need to be recorded once.

### Global Positioning System

35. Global Positioning System (GPS) is a satellite-based positioning and navigation system owned and operated by the US Department of Defence. GPS can give an instantaneous, real-time position to within approximately 20m using a handheld receiver. GPS should be used in conjunction with a paper map or field GIS for positioning and plotting of data. GPS is particularly useful for recording viewpoints, photographs or modifying draft boundaries, particularly in open landscapes with few landscape features that can be used to locate a position on a map. The use of GPS requires an initial investment in the technology and training and it should always be complemented by good map reading skills. It will be necessary to convert GPS data in latitude and longitude format to Ordnance Survey National Grid eastings and northings. The National GPS Network website (www.gps.gov.uk) contains further information about GPS and data conversion.

#### Box 2: Derbyshire Landscape Character Assessment

Derbyshire Landscape Character Assessment [8] has described and classified the landscapes of Derbyshire through detailed desk study and field survey. During the desk study stage of the LCA, some 500 Landscape Description Units (LDUs) were defined, which were divided into nearly 2000 Land Cover Parcels (LCPs). LDUs and LCPs have been digitized over Ordnance Survey 1:25,000 Raster data. Field survey was used to verify the boundaries of the units and to record attribute information for each LDU and LCP, using a structured survey sheet. Almost 100 attributes have been recorded for each LCP and nearly 30 for each LDU, together with descriptive textual information. All of the information gathered has been stored using MapInfo GIS and Microsoft Access.

Data includes:

| | | |
|---|---|---|
| Geology | Land use | Building style |
| Landform | Settlement pattern | Boundary type/species |
| Soils | Tree cover | Impact of mineral extraction |

39 Landscape Character Types were defined through a combination of GIS analysis and interpretation of the landscape information gathered in the field. GIS was used as an aid to the preparation of descriptions of each Landscape Character Type. GIS was used to produce working maps and presentation quality maps included in the draft LCA.

The GIS has been extended to include the results of Derbyshire Historic Landscape Characterisation and digital aerial photography. The inclusion of the field survey photographic record in the GIS has also been explored (**Figure 3**). The data provides a resource for Landscape Character information to inform strategic and development control planning. The database is also being used to develop a woodland strategy and to focus county Biodiversity Action Plan targets.

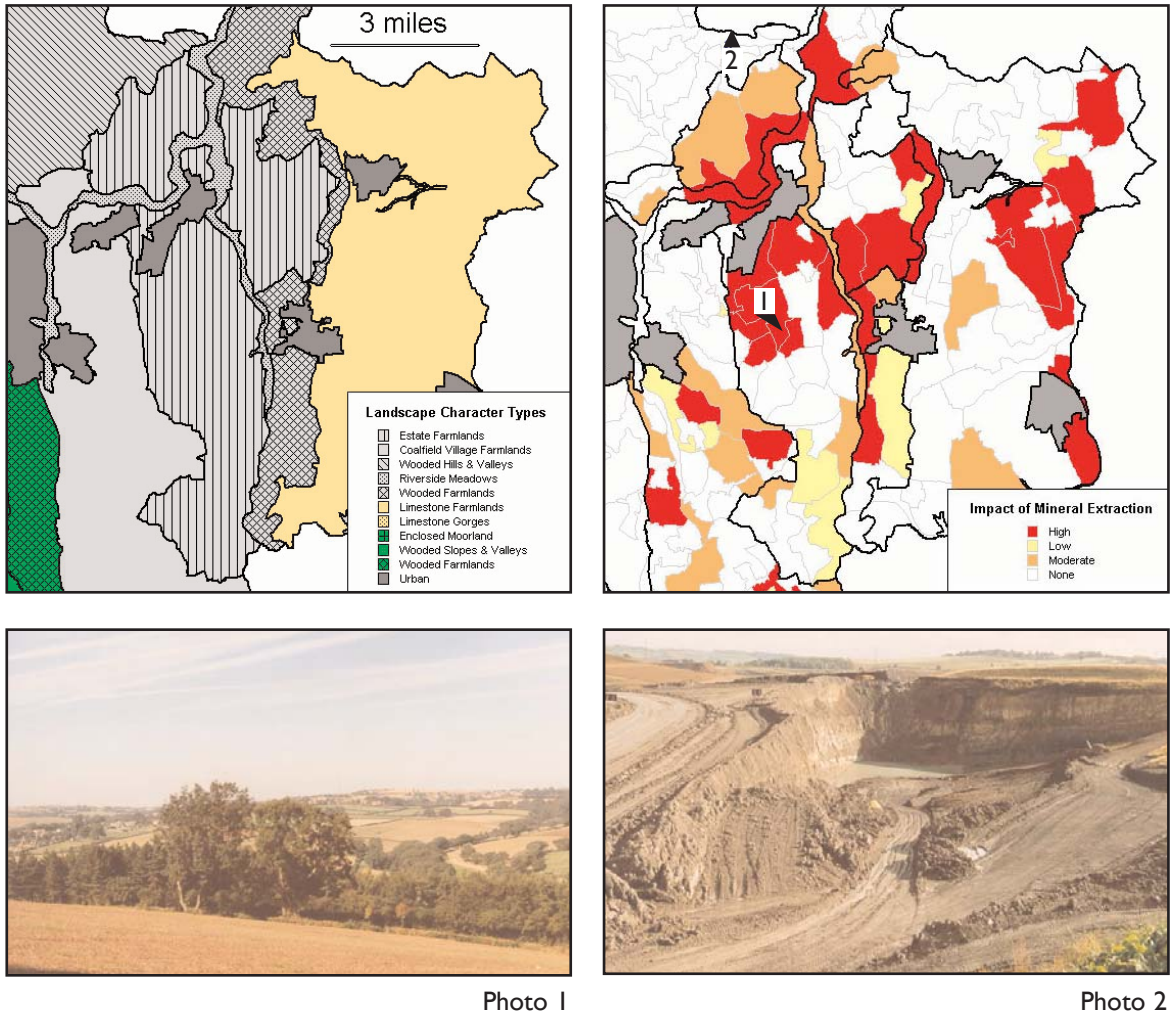



Photo 1 Photo 2

**Figure 3**. Maps showing Landscape Character Types and the impact of mineral extraction in North-East Derbyshire. Photographs 1 and 2 show the contrasting impacts of mineral extraction in the Derbyshire Coalfield and are linked to the GIS database as shown in the map on the right above.

## CLASSIFICATION AND DESCRIPTION

### Classification

36. Characterisation is concerned with the process of dividing the landscape into areas of distinct, recognisable and consistent character. Classification involves grouping areas of similar character together. Classification can be carried out manually or informed by statistical analysis of landscape data. GIS can be used to assist manual classification, or to store and process landscape data for statistical analysis.

37. Manual classification involves the combined analysis of the many layers of data gathered during the study. GIS can be used to map different layers of information to permit rapid visual comparison between layers. GIS can also be used to produce maps combining information from different layers, for example a map of tree cover character that shows the extent of woodland and the density of boundary trees. Exploring the relationship between layers of data will help users to identify patterns in the landscape and to define Landscape Character Types and Areas.

38. Computer classification involves the use of statistical techniques to identify relationships between layers of data. The success of a computer classification is dependent on the type and quality of input data and on the appropriateness of the classification technique that is used. While statistical classification can be a very useful tool for examining patterns in complicated data, considerable care must be taken during data processing and in the interpretation of the results.

39. Any data that has been gathered during the desk study and field survey can be used for classification, provided that it has been gathered and stored in a consistent and logical format. For example, if a category for dominant building material has been allocated to each recording unit then the GIS can be used to produce a map of dominant building material across the landscape. This map can be used to inform manual classification. Alternatively, the dominant building material could act as an input variable for statistical analysis.

40. Landscape Character Types and Landscape Character Areas are a key output of a LCA. They can be defined by manual techniques or through the use of computer classification methods. Importantly, they should incorporate the views of stakeholders, to ensure that they are widely accepted and understood. GIS can be useful for engaging stakeholders by facilitating the production of high quality paper maps of draft Landscape Character Types and Areas for discussion. Stakeholders can use GIS to display, understand and comment upon draft Landscape Character Types and Areas, at workshops or over the Internet using online interactive maps. Stakeholders already using a GIS can be supplied with draft data for comparison with other data sets.

### Description

41. GIS can be used to explore patterns in data collected during the LCA, as an aid to producing written descriptions. It is often useful to use queries to select manageable subsets of the database. Sorting the data using different columns can aid the identification of patterns and relationships in the data.

42. While GIS can help to identify patterns in the data, it is important that written descriptions of Landscape Character Types and Areas consider the relationship between different landscape elements. Descriptions should also include information gathered during field survey and the views of stakeholders, as described in the main LCA Guidance.

43. GIS can also be used to analyse landscape data together with additional datasets to add detail to the descriptions. For example, a digital Phase 1 Habitat Survey could be used to provide information about characteristic wildlife habitats in a type or area. A Sites and Monuments Record database could be used to identify landscapes associated with particular cultural heritage features.

## DISSEMINATION

### Distributing data

44. GIS datasets produced during a Landscape Character Assessment can be made available to a wide range of stakeholders. The datasets can be made available for download from the Internet, on a geographical feature server or included on a CD with a project report. **Box 3** describes the GIS dataset that is available from Scottish Natural Heritage. It is important to consider copyright issues when making data available to third parties.

**Box 3: GIS Dataset of Landscape Character Assessment Information in Scotland**

Following the completion of the national programme of Landscape Character Assessment in Scotland, Scottish Natural Heritage developed a national dataset compiled from the 29 Landscape Character Assessments (LCAs). This exercise provided several key attributes for each landscape unit:

- key words describing the key characteristics and features of the 366 landscape character types (LCTs) identified;
- a "pen portrait" text description; and
- a standard list of "Pressures for Change" in the landscape.

These attributes have been linked to a national GIS containing the 366 LCTs derived from the c. 3900 landscape units identified in the LCA reports, summarising information about the landscape of Scotland in a readily accessible format. As part of the exercise, the initial 366 Level 1 types were grouped on the basis of similarities in their key characteristics, into 106 Level 2 types and subsequently into 52 Level 3 types [9].

In 2002 the data was updated to correct for spatial and attribute errors in order to create a more robust dataset. This involved registration of all coastal boundaries to the OS 1:25,000 coastal dataset and the realignment of internal (land) polygon boundaries to account for this. SNH Landscape advisors were involved in this updating process, assisting with the verification and re-drawing of some LCT boundaries. It is envisaged that some spatial (and to some degree attribute) errors within the data may remain due to the original data capture methodology, and SNH will continue to review and update this valuable dataset.

This dataset will be used in a range of large scale land use planning and management work, for example, in mapping landscape sensitivity to wind energy development. It will also help to provide a better understanding of the landscape resource in Scotland.

45. To allow users to interpret and use the data correctly, care must be taken to ensure that sufficient metadata is supplied with any LCA datasets. Metadata should follow the NGDF Metadata standards (www.GIgateway.org.uk). It is particularly important that categories and technical terms used in the database are clearly defined in the metadata. It is also vital that the purpose and scale of the study are described and that contact details for the owner of the dataset are clearly identified. Data such as version number, date and author will assist with version control.

### Online interactive maps

46. Recent advances in GIS and Internet technology allow the dissemination of the results of a Landscape Character Assessment via online interactive maps. Landscape Character Types and Areas can be linked to text and images, allowing users to explore the Landscape Character Assessment interactively. Interactive maps should be well designed and easy to use. Users must be provided with sufficient metadata, background information and help resources to enable them to interpret the data.

47. Many government bodies are now making their spatial data available through corporate interactive maps. Datasets produced as part of a Landscape Character Assessment can be an engaging addition to such interactive maps. Landscape character information can provide a useful landscape context for other information. A Landscape Character Assessment database can also provide information about particular landscape elements such as landform, tree cover or building materials.

### Visualisation

48. Advances in technology have opened up the possibility of using 3D models to visualise the landscape. Visualisation techniques can be used to illustrate possible developments and landscape scenarios, for example in the production of Local Development Frameworks. A LCA GIS database can provide valuable information to be used for visualization, including digital images and data describing building materials or hedgerow species.

49. Landscape visualisation depends upon computer graphics, 3D modelling and GIS software. It requires attention to the specific challenges of modelling landscape elements. Landscape models can span a broad range of styles, presentation media, and ranges of realism from "photographic" to impressionistic and highly abstract. Choosing and using the right level of abstraction, and the appropriate medium for presentation and communication, requires both technical knowledge of the media and professional design judgement [10].

### Paper map production

50. Modern GIS and digital print technology permit the production of high quality paper maps. Sufficient care should be taken in the choice of colours, shading and layout to ensure that the resulting maps are clear and convey the correct information. It is important to remember that colours assigned to map features can appear very differently on various screens and printers. It is advisable to obtain input from a professional cartographer or graphic designer to ensure a high standard of map production.

51. When producing maps for a Landscape Character Assessment, it is important to include topographic maps of a suitable level of detail, to allow users of the map to interpret the data. Background mapping should include roads, watercourses, railways and settlements to allow users to orient themselves on the map. The production of large scale maps that clearly show buildings and field boundaries will help to engage local people.

## MAKING JUDGEMENTS

52. A dataset of Landscape Character Types and Areas captures spatial variation in natural, cultural and visual elements in the landscape. The integrative nature of a LCA database makes it well suited to be used as a framework for analysing other datasets and for holistic landscape planning.

### Easy querying

53. A key benefit of using GIS is the ease with which it is possible to query the LCA data for a particular purpose, such as targeting resources or carrying out more detailed survey work. Data gathered during the desk study or field survey can be queried using GIS and the results displayed as maps or in a table. For example, a project to conserve and enhance field boundaries could be tailored to the characteristic boundary types of each particular landscape. Similarly, a project to reduce the landscape impact of mineral extraction could be targeted to areas where a high impact has been recorded in the field. A project to survey the distribution and extent of a particular wildlife habitat could be limited to landscapes that are known to be associated with that habitat.

### Combination with other datasets

54. Analysis of the LCA data and the addition of other datasets can be used to study patterns in the landscape, produce spatial landscape strategies and to target resources. GIS can be used to reclassify landscapes using other datasets for further study of the landscape or for targeting resources. For example, landscapes could be classified according to the presence of rare or important species, using biological records. This classification could then be used to target landscape-level conservation resources.

**Box 4: The County Durham Landscape Assessment**

The County Durham Landscape Assessment [12] is based on an integrated GIS database which subdivides the landscape of the county into around 5,800 mapping units. For each of these units information is recorded on a range of attributes that influence the character of the landscape. The database evolved as new data became available during the study.

Existing GIS datasets - including Geology (solid & drift), Soils, Land use (satellite data), Woodlands, Ancient Woodlands, Historic Parklands, Settlements, Enclosure Awards, Mineral Workings & Reclaimed land - were used to create broad mapping units. These units were subdivided and refined manually on the basis of a morphological analysis of field systems and topography. These units were further refined and subdivided using aerial photography providing greater detail on land use and tree cover. As new data became available, or as new topics were explored, the data was revisited and revised.

Attribute fields in the ArcView GIS database include:

Geology: Solid
Geology: Drift
Soils
Landform
Land Use
Field Pattern
Field Scale
Boundary Type
Tree Cover
Woodland Pattern
Settlement Type
Settlement Pattern
Origins
Relics: Bronze Age Settlement & Ritual Landscapes
Relics: Medieval Agriculture & Settlement
Relics: Mining & Industry

The database was analysed for patterns of attributes. This process, together with observations in the field, was used to identify:

- Broad landscape types and sub-types
- Local landscape types and sub-types

In the early stages of development the GIS exercise was seen primarily as a tool for landscape classification. As it has evolved it has increasingly been seen as a useful tool in its own right as baseline data on a wide range of landscape features and attributes, similar in some respects to a Phase 1 Habitat Survey. While the raw data has been processed to produce landscape types, it remains available as baseline data for other uses. In many applications it is more useful than the landscape typology. For any given attribute being considered (e. g tree cover, enclosure period, settlement pattern) the baseline data involves less generalisation and therefore has greater accuracy than the typology.

Current applications of the data-set include:

- Developing Landscape Strategies at a range of levels (County, Regional Character Areas, Broad Landscape Types, Local Landscape Types). The fine grain mapping units are analysed against the landscape types they belong to in respect of their condition, their contribution to local distinctiveness, biodiversity, cultural heritage etc in order to arrive at broad strategies for conservation, restoration, enhancement etc.
- Landscape sensitivity mapping for a regional Wind Energy Capacity Study.
- Landscape sensitivity mapping for the county Waste Local Plan.
- Landscape sensitivity/opportunity mapping for a County Woodland Strategy.
- Intranet access through ArcIMS for general use in DCC and District Councils (under development).
- Extranet access for schools through ArcIMS as an educational resource primarily in Geography (under development).
- Internet access for the public at large combining ArcIMS mapping (under development) and the text based information of the Landscape Assessment and Landscape Strategy on the web.

**Future Trends**

A Historic Landscape Character Assessment is proposed for the county in 2003-2004. This will be undertaken using OS MasterMap, which has only recently become available. It is likely that the CDLA data will be reviewed at the same time to put it into that format and to be integrated with the HLCA data.

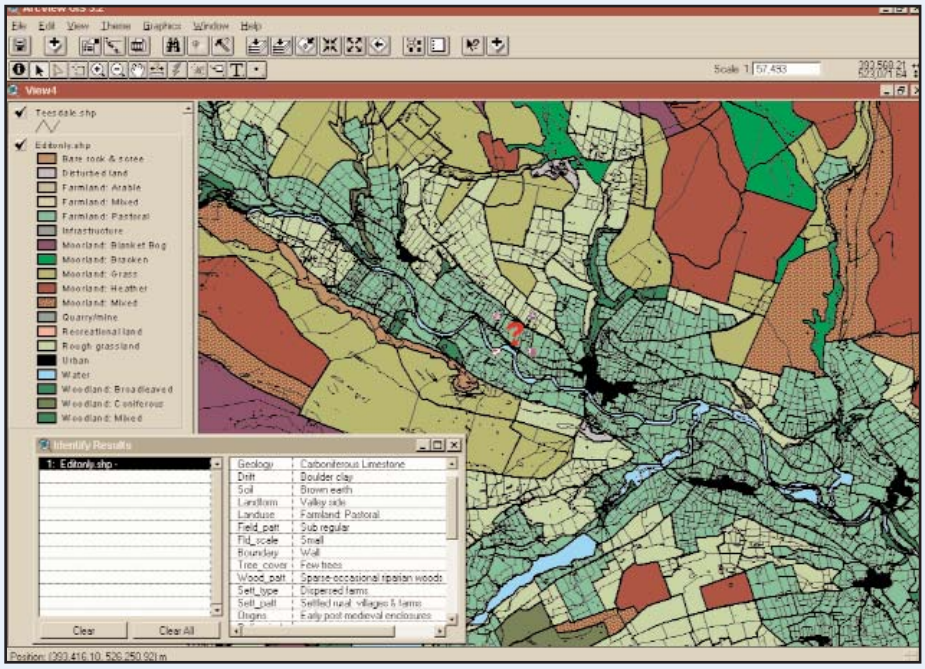



**Figure 4: Screen shot of the County Durham Landscape Character Assessment GIS database, showing the baseline data**

## Sensitivity and capacity

56. The GIS database can be extended by the evaluation stage of a Landscape Character Assessment [11]. A structured and transparent method of analysis should be developed to evaluate the sensitivity of landscapes to change. The LCA database can be combined with other datasets to evaluate the capacity of the landscape to accommodate change and development (**Box 4**). Studies have used GIS to model landscape capacity for wind energy, housing development and woodland creation.

## FUTURE TRENDS

57. GIS will become an increasingly common tool for LCA. It will be no more remarkable than the use of word processing and desktop publishing software for the production of a project report. While GIS will be increasingly easy to use and affordable, it is important that its use is backed up by sufficient understanding and training.

58. Increased public access to the internet will make online GIS more effective as a means to engage communities with LCA. Online GIS can be a live database that is updated as new information and understanding develops. Greater computer power and software development will make landscape visualisation a much more widely used technique for engaging stakeholders in landscape planning.

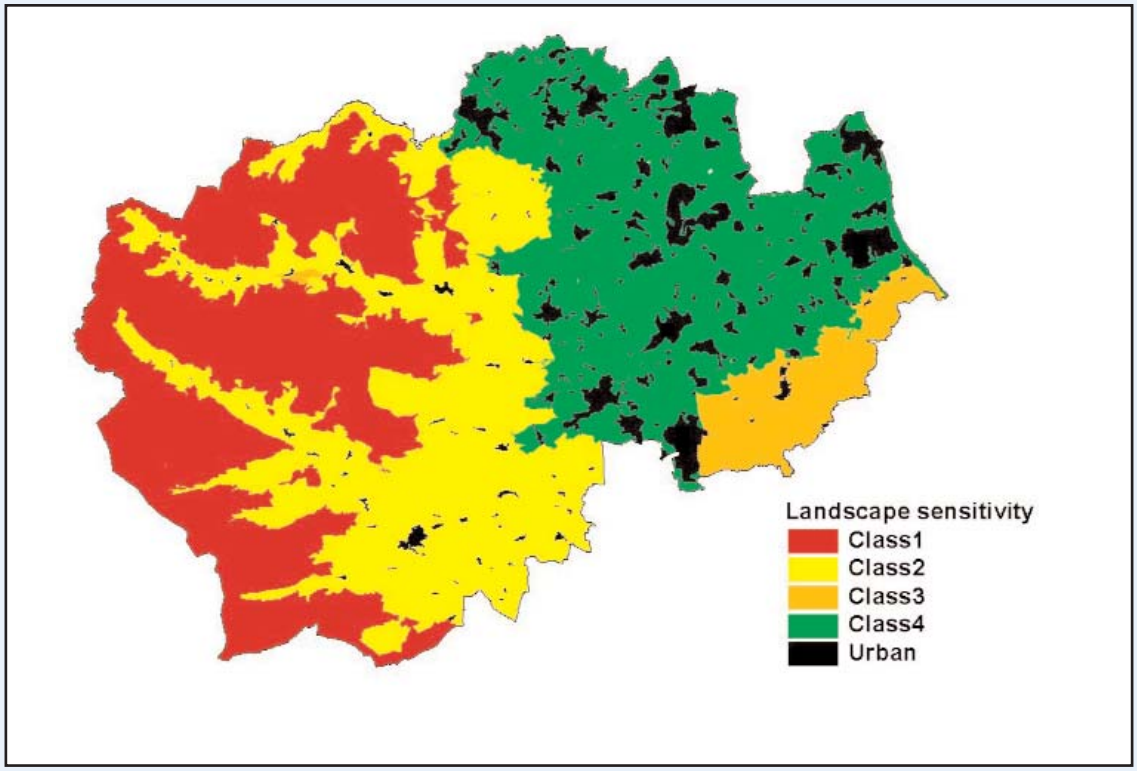



**Figure 5: Wind energy development sensitivity analysis for County Durham, carried out using the Landscape Character Assessment GIS database**

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## Further Information

Share your ideas, experience, knowledge and use of Landscape Character Assessment with others by joining the Countryside Character Network at **www.ccnetwork.org.uk**. Feedback and continued discussion on this topic paper and others can be made via the on-line discussion forum.

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The full *Landscape Character Assessment: Guidance for England and Scotland* and related topic papers can be viewed and downloaded from **www.countryside.gov.uk/cci/guidance** and **www.snh.org.uk/strategy/LCA**

Free copies of the guidance are also available from:

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