GIS & Countryside Management

Theory and Application

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on Thursday 3 July 1997

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Proceedings of a workshop organised by the
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on 3 July 1997

Edited by Edmund Blamey,
CRN Manager

Formatted by Siân Griffiths,
CRN Assistant

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Countryside Recreation Network
Dept. of City & Regional Planning
Cardiff University
PO Box 906
Cardiff
CF1 3YN
Tel.: 01222 874970
Fax: 01222 874728
e mail cplan-crn-l@cf.ac.uk

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A UK-wide Network, CRN gives easy access to information and people concerned with countryside and related recreation matters. The Network helps the work of organisations and individuals by:

Research:
to encourage co-operation between members in identifying and promoting the need for research related to countryside recreation, to encourage joint ventures in undertaking research, and to disseminate information about members' recreation programmes.

Liaison:
to promote information exchange relating to countryside recreation, and to foster general debate about relevant trends and issues.

Good Practice:
to spread information to develop best practice through training and professional development in provision for and management of countryside recreation.

The Countryside Recreation Network is committed to exchanging and spreading information to develop best policy and practice in countryside recreation

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INTRODUCTION

By the Network Manager,
Countryside Recreation Network

There have been dramatic developments in the power of computers and the ever increasing sophistication of software. This is reflected in the increasing use of GIS for a greater and more complex range of tasks. This CRN workshop aimed to provide a review of the present use of GIS for the planning and management of countryside recreation.

Specific objectives of the workshop were to:

- raise awareness of the potential of GIS within different areas of countryside management; and to

- demonstrate how GIS can be used to best effect within organisations to help meet particular needs.

The workshop was based on case studies of the application of GIS by both the National Parks Authority and Farming and Rural Conservation Agency (FRCA). It examined in detail how the Lake District National Park has adopted and utilised GIS in the last seven years and how the FRCA use it to manage Agri-environment schemes, including those that provide for access to the countryside. A series of afternoon discussion groups identified:

- some general aspects on design of GIS programmes;
- data sources for a variety of situations and;
- how GIS can be best applied to differing professional needs.

THE USE OF GIS FOR COUNTRYSIDE MANAGEMENT:

THE EXPERIENCE OF THE NATIONAL PARKS

By David Briggs and Dominic Tantram,
Nene Centre for Research, Nene College Northampton

Introduction: the need for information

Under the terms of the Environment Act 1995, National Parks have two main purposes. These are:

- to conserve and enhance the natural beauty, wildlife and cultural heritage of the Parks; and
- to promote opportunities for the understanding and enjoyment of the special qualities of National Parks by the public.

In addition, the Environment Act places a duty on National Park Authorities to seek to foster the economic and social well-being of local communities within the Parks. Within this context, National Park Authorities have a wide range of responsibilities, and need to undertake a wide variety of roles. These include:

- Park management e.g. maintenance of Rights-of-Way, habitat management, care of historical and cultural features;
- land use planning e.g. development control and preparation of local plans;
- strategic planning e.g. development and monitoring of National Park Management Plans;
- surveillance and monitoring e.g. long-term monitoring of land use or habitat change;
- research and modelling – e.g. the investigation of *'what-if'* scenarios or exploratory studies;
- providing public information e.g. public exhibitions, displays, production of state of environment reports.

In order to fulfil these tasks, National Park Authorities need to have access to, and be able to use, a wide range of information. Information is needed not only on the natural

qualities and resources of the National Park; but also on its cultural characteristics, on the way it is perceived and used by the public; and on its social and economic character and potential. Effective management also requires information on the management activities which are being applied, and the effects of these on the Park. In addition, to serve the needs of the public, and to involve the wide range of other stakeholders involved in Park management, this information needs to be made easily and widely accessible to a range of individuals and agencies.

Many of these needs are inherently *'geographic'* in concept. They relate to where things are in the countryside; to how they vary across the countryside; to how they relate to each other in space; and to how to allocate time, energy and resources between the different needs of the countryside. It is for this reason that geographic information systems (GIS) are proving to be such important tools for countryside management within the National Parks. They provide a powerful means of handling, analysing and presenting geographic data, in a form which users need. This paper summarises some of the recent experience of the National Park Authorities as a way of illustrating the wider potential of using GIS for countryside management. It is based on a more detailed study, carried out on behalf of the Countryside Commission and Association of National Park Authorities (Briggs and Tantram 1997).

The development of GIS for countryside management

Recent years have seen enormous strides in the use of GIS for countryside management. Probably the greatest advances have been made by local authorities. The potential for GIS application in local government was clearly highlighted by the Chorley Report, in 1987 (Department of the Environment 1987). By 1993, about 60% of Shire counties in the UK had acquired GIS (Campbell and Masser 1992, Masser and Campbell 1993). Today, almost all county councils and a large proportion of district councils use GIS. Amongst the major users are typically those departments concerned with countryside management, for example, planning, highways, parks and leisure services.

Interestingly, authorities which have not yet established GIS are beginning to face what has been termed a *'GIS paradox'* (Worrall 1994). They realise that financially GIS may be beyond their reach, yet strategically and operationally they are essential. The development of GIS in National Parks was initially slow. Only in 1991 did the first two Parks, the Peak District and Lake District, begin GIS development. These were followed by Pembrokeshire Coast in 1992, and Brecon Beacons and Snowdonia in

1993. Since then, however, major progress has been made and today all the National Park Authorities run at least formative GIS. The New Forest Committee also recognises the potential value of GIS for policy development and management, and is actively encouraging use of GIS through its member organisations.

The motives for GIS development in the National Parks have been varied. In some cases it was a response to specific data opportunities or needs. In the Lake District, for example, the primary motive was seen to be the opportunity to analyse the *'Monitoring Landscape Change'* data. In the North York Moors and Pembrokeshire Coast it was the need to review and capture the definitive *'Rights-of-Way maps'*. In the Broads, it was the opportunity to use Fen resource survey data and, later, OS digital mapping. In other cases, the motive was more strategic. GIS development in the Brecon Beacons, for example, derived from the decision to move from a paper-based to digital information system. In the Yorkshire Dales, GIS was seen as a tool to integrate different data sets and reduce costs. In Exmoor, GIS development was motivated by the promise of easier access to data, the establishment of a centralised mapping capability and improved resources for data analysis.

A number of factors have also contributed to this development. One has been the advances made in computer hardware and software, which has brought GIS within the reach of many more agencies. Equally important has been the efforts of the Ordnance Survey to digitise copies of the national topographic map series and other data (e.g. administrative boundaries, postcode locations, address-point files and digital elevation models) and make them available to National Parks through *'Service Level Agreements'*. The advantage of this development lies not only in the access to the maps themselves, but also the increased capability to use and analyse other data sets (e.g. census data, address or post-coded planning data, digital elevation data) linked to these maps. In addition, a major stimulus to GIS development for countryside management has come from the growing number of thematic data sets which are now becoming available. The *'Monitoring Landscape Change in the National Parks'* (MLC) data were, for example, instrumental in promoting GIS in the National Parks, most especially in the Lake District National Park. More recently, completion of the Countryside Survey 1990 and the Land Cover Map of Great Britain has provided further important data sources for countryside management though in truth, these have not yet been used by National Park Authorities to any great extent. Generally, the development of satellite remote sensing and digital aerial photography has greatly

added to the availability of information on the countryside. Their potential has not been fully exploited.

What can GIS do?

A GIS can be defined as a computer-based system for the collection, handling and display of spatially-referenced (i.e. geographic) data. As such, GIS fulfil a number of functions. They help to:

- **manage data** – by providing methods for data capture, integration, storage, updating and quality control.
- **accessing data** – by providing quick and easy methods for searching and retrieving information according to need.
- **visualising data** – both on screen and as hard copy, in a variety of different forms (e.g. as maps, graphs, 3-D diagrams and tables).
- **analysing data** – e.g. to overlay, combine and compare different data sets, or to derive new information from the existing data.

GIS for data management

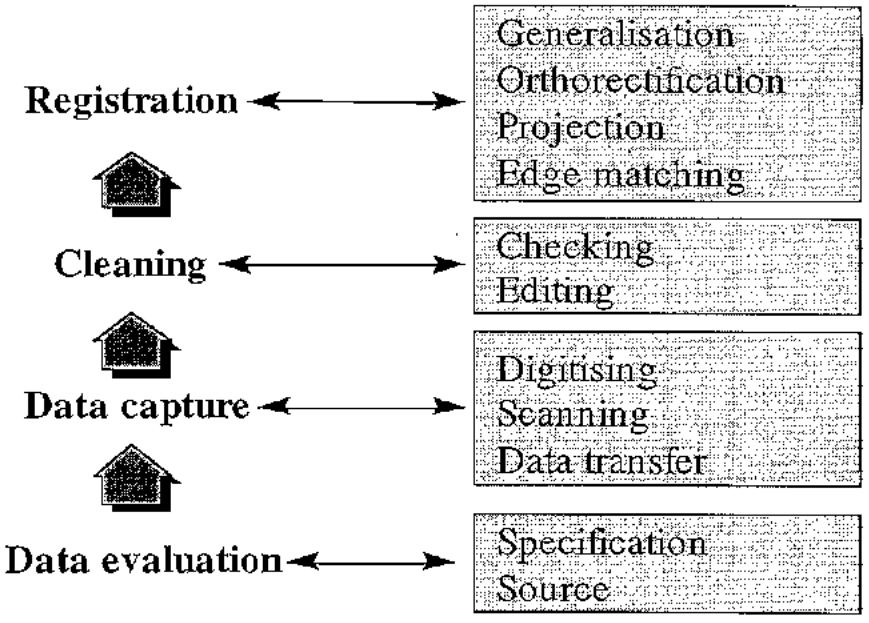
In many ways, the least exciting, but possibly the most important, of these capabilities is data management. Managing a National Park involves using a wide range of data, including:

–	information on topography	–	statutory designations
–	land cover and land use	–	land ownership
–	habitats and species	–	levels of pollution
–	transport networks and flows	–	visitor numbers and patterns of use grant availability and uptake
–	rights of way	–	management operations and public attitudes.
–	planning applications and consents		

These data are derived from many different sources in many different forms. Under traditional, paper-based systems, managing all this information was far from easy.

GIS, however, can greatly facilitate the process. They not only provide a means of capturing spatial data (e.g. from maps, plans, air photos or satellite images) in digital form, but also allow for the maintaining of data quality and integration of different data sets into a consistent geographic framework i.e. matched to a common geographic base (See figure 1). This, in turn, provides the ability to search and retrieve information more efficiently and flexibly, and adds value to the data by allowing them to be compared and combined to provide new information.

Figure 1. Data Capture and Integration



GIS also helps in the updating and maintenance of data needed by National Parks. Again, under a traditional paper-based system, this is a major undertaking. A typical National Park Authority may hold several thousand Ordnance Survey and associated maps. Simply finding storage space for these in the past presented significant problems. Safe keeping of a large and frequently used map collection is even more problematic. Apart from the inevitable risks of damage by humidity, changes in temperature and sunlight, the maps are subject to wear-and-tear during use, loss and misplacement, and annotation. Maintaining and replacing map collections is inevitably costly. Many historic maps, or maps which contain large amounts of manually annotated information, are essentially irreplaceable, making the consequences of loss or damage extremely serious. Updating paper maps is also costly and difficult. Updates have to be done by manually adding information to the paper maps, or by replacement of the previous maps. Neither is easy to organise on a corporate basis, in which many

different copies and versions of the original base maps may be in use. As a result base maps tend to become out-of-date, and different versions of maps tend to proliferate across the organisation. This makes it almost impossible to maintain proper data standards, either for data analysis or presentation.

Storage of the data within a GIS helps to mitigate all these costs and risks. In digital form, data is much more compact and a complete map cabinet can be held on a single CD-ROM. Holding base maps as single digital masters, in a central database, also ensures that users all use the same map base. The automatic updates provided for OS maps, as part of the *'Service Level Agreements'*, also ensures that these base maps are routinely updated, and are held in pristine form. The traditional planning map, with its plethora of overwritten comments, stick-on markers and areas of wear and tear is thus a thing of the past. The same information can simply be added as secure data layers within the GIS. Purpose-designed maps, such as local plans or site maps can also be readily backed up. Modifications can be stored as new map coverages, so that previous versions of the map are not lost. Base maps may be protected from modification by making them available in read-only form. Easier access to maps is guaranteed whilst reducing the costs of map replacement, and improving the quality and security of the data. At the same time, the ability to access data centrally, and to bring together data sets, which previously would have existed as separate maps, helps to foster a corporate view of data, and to establish common data standards.

Accessing data and making maps

Many of the routine management operations in the National Parks are inevitably map-based. Easy map access is thus a vital element of Park management. This is perhaps most clearly seen in relation to the National Park Authorities' (NPA's) responsibilities as local planning authorities. This requires NPA's to respond to a wide range of enquiries from the public; to check for planning constraints; to prepare for planning enquiries; to respond to land charge enquiries; to deal with development control enquiries, and to provide information for local plans. In order to fulfil these obligations they need to be able to:

- access maps;
- search for and retrieve information from maps (e.g. by name, address or grid reference);
- produce maps and plans.

Under a traditional paper-based system, access to maps is often both time-consuming and problematic. A study of map use within a local authority department by Palmer (1991) illustrated the costs involved. Of the total time spent on map-based work:

- 50% of time was spent finding and replacing maps from the map store;
- 27% was spent extracting information from the maps;
- 9% was spent adding data to the maps;
- 3% was spent modifying data on the maps;
- 11% was spent copying maps or sections of maps.

GIS greatly speeds up this process. Maintenance of a digital map directory allows users instantly to identify which maps are held within the GIS. Access to these maps is feasible from a desk, at little more than the click of a button. The time taken to download and display these maps is reduced to a matter of seconds. If additional information, from other coverages, is required, these too can be obtained almost instantly. The risk of maps being unavailable is all but eliminated. Using GIS, maps can also be accessed in a wide variety of ways, for example by:

- named location;
- address;
- National Grid Reference;
- defining a point, line or area on screen;
- proximity to a defined location or area (e.g. by buffering around a point);
- searching for areas or sites which meet specified search criteria.

Where search and retrieval of data or map production is carried out routinely, the process can be largely automated. Several Park Authorities have thus established customised menus within their GIS, which enable users to select the data sets which they need from a prepared list. These lists might include individual map layers or predefined combinations of map layers (e.g. for land charge searches or constraints checks). Details of map formats (e.g. legends, copyright statements, title) can also be predefined for each type of application.

One example of this approach is for automated constraints checking. The Brecon Beacons National Park Authority, for example, has established an automated system

for constraints checking in MapInfo (Pettitt, 1995). In the Peak District National Park, a similar approach has been set up in the Wings GIS. The first step in this case is to select the map layer(s) of interest from the dialogue box. This automatically defines the map layout. The user, however, can choose different map scales and page layouts, according to need. A rectangle is then drawn on screen defining the area of interest. The shape and size of the printed area will vary depending on the map scale and paper orientation chosen. The map can then be automatically compiled and printed. This process clearly saves considerable amounts of staff time and also ensures consistency in map formats.

Data analysis

GIS are not only systems for management and presentation of data. They also provide powerful tools for data analysis. In relation to countryside management, some of the most important analytical functions are the methods they offer for:

i. **Map measurement.** This enables users to calculate distances between, and areas of, features on maps. One of the most valuable applications is to estimate the total area or length of features of interest (e.g. hedgerow length, area of land under management agreements). This could be used as a basis for quantifying the stock of important habitats. It also provides a valuable management tool, by enabling estimates to be made of travel time between sites, or the costs of site management.

ii. **Buffering and filtering.** This enables users to construct and analyse buffer zones around features. At its simplest, it provides a powerful method of data search and retrieval (e.g. to find all sites within a specified distance of a target location). More powerfully, it enables data to be *'smoothed'* across a map (e.g. by passing a moving window across the map, and averaging values of all grid cells within each window). This technique is often used with remotely sensed data to remove noise from the data, and generate simpler, more generalised maps of land cover.

iii. **Map overlay and intersection.** These procedures enable users to overlay and compare or combine maps in various ways (e.g. by using one map to *'cookie cut'* another, or to add two map layers together). In these ways, new map layers can be constructed. They might be used, for example, to compare the distribution of land use and wildlife species, or to derive maps of recreational potential by combining data on altitude, landscape features, vegetation cover, access conditions and routes.

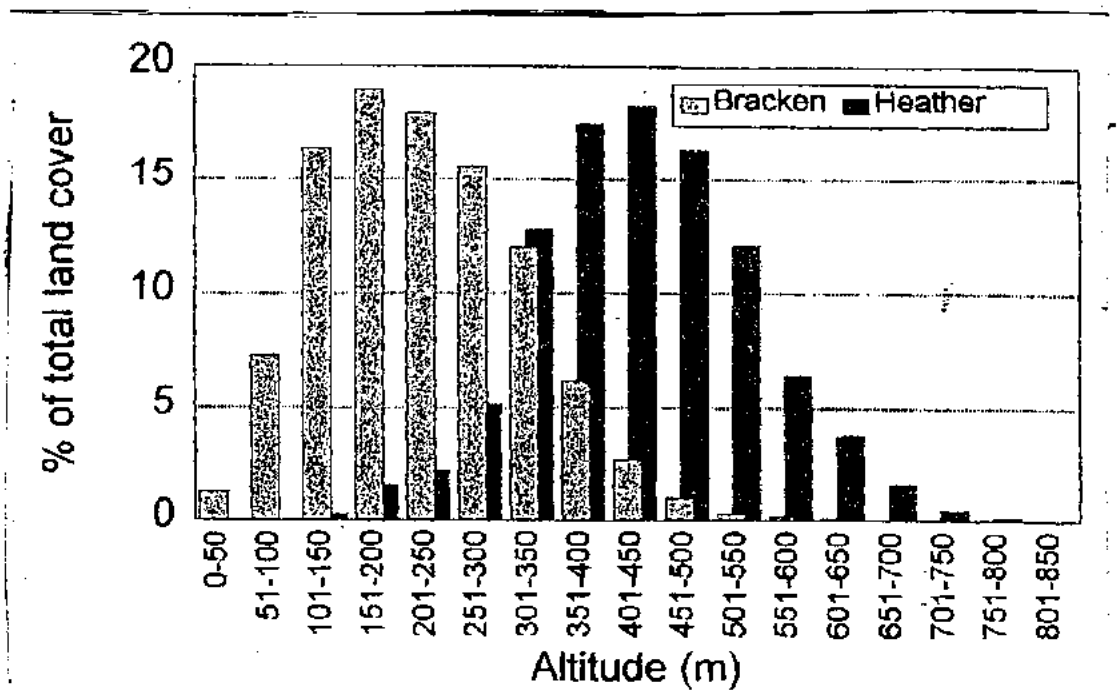
iv. Spatial interpolation and surface modelling. GIS provide a range of methods for estimating conditions at unsampled sites, and thus for modelling spatial patterns in the countryside. These might be used, for example, to model patterns of air pollution or recreational pressures on the environment; they can also be used to analyse the distribution of car parks or other facilities relative to need.

v. Network analysis. This enables users to model patterns and processes along linear features. They can be used, for example, to analyse travel time and traffic flow along a road network; to model transport of pollutants along a stream; to investigate hedgerow connectivity and undertake corridor analysis and plant dispersal; and to contribute to modelling and planning of recreational routes.

In recent years, several National Park Authorities have begun to use these methods as part of Park management. In the Exmoor National Park, for example, map measurement and overlay techniques have similarly been used to analyse changes in land cover on West Anstey Common, as a result of cultivation, grazing and recreational pressures. Probably the most advanced and varied applications, however, have been in the Lake District National Park (further discussed in the following paper by John Clayson). Here, buffering and map overlay techniques have been used, for example:

- *To model the distribution of the rare High Brown Fritillary butterfly on the basis of altitude and land cover.* The butterfly tends to favour areas of bracken, close to woodland at intermediate altitudes (Clayson 1996). The results were used both to justify and target detailed field surveys.
- *To identify areas of heath at risk of invasion from bracken.* GIS was used to analyse the altitudinal range of bracken and heather (See figure 2, p16) and to identify areas of potential overlap where the risk of bracken invasion might be considered greatest.
- *For intervisibility* analysis. GIS was used to model the visibility of both proposed wind farms and a rock characterisation facility from within the National Park. Results were used as contributions to planning enquiries.
- *To analyse the distribution of archaeological sites.* The distribution of different types of site were plotted and analysed in relation to both altitude and land cover, in order to investigate possible associations with environmental factors, and to help plan field surveys.

Figure 2. Altitudinal distribution of heather and bracken in the Lake District National Park



As these example indicate, use of the more advanced analytical functions for spatial data analysis and modelling, offered by GIS, has great potential. They provide valuable exploratory techniques, by which users can investigate their data and gain a better understanding of the spatial patterns, relationships and processes which characterise the countryside. This can encourage new ways of looking at the issues concerned, and can help to develop new management strategies. Equally, they offer more immediate practical benefits, for example, by helping to direct and prioritise survey and management effort; by providing a basis for costing and comparing different management strategies; and by providing *'high level'* information which can be fed directly into decision-making procedures, such as planning enquiries. Whilst the more mundane applications, data management and map production, will continue to provide the mainstay of GIS use in the National Parks, in time we may expect the range of applications to become considerably more diverse. This will occur as users discover the potential of GIS to help them address new problems and undertake new tasks in innovative ways.

Conclusions : The costs and benefits of GIS

The establishment of GIS is, of course, far from cost-free. Significant costs may be involved in purchasing and installing the necessary software and hardware. Even larger costs are often encountered in compiling and converting the data required for the GIS. Hard data on these costs are not available for the National Parks, but their experience is probably little different from that of local authorities, where it has been estimated that data acquisition may account for as much as 70-80% of the total costs of GIS development. Other significant costs include system support and maintenance and staff training.

Nevertheless, it is already becoming clear that GIS has offered significant benefits to the Park Authorities. It has enabled staff to do more efficiently many of the routine tasks which they have always had to do, and provided a capability for new tasks, which previously were impossible or too complex to perform. Some of these benefits are relatively concrete and easy to identify. One of the most important has been the increased productivity for many routine tasks (e.g. map access and data search and retrieval). This has also been reflected in the faster response times which can be offered (e.g. for constraints checks or land charge searches). Reduced wear-and-tear on maps, and the capability for central management of the data has also improved data security and facilitated data maintenance. These various benefits have, in turn, enabled significant cost savings to be made in many cases, not only in terms of staff time but also through sharing costs of data acquisition and by reduced costs of map replacement. In some cases, adoption of GIS has additionally provided the capability to generate income, either by selling on data sets or by providing consultancy and support services to other organisations.

Other benefits are less tangible, though in the long run no less important. In general, GIS should have contributed to improved communication both within the National Park Authorities and with other, external agencies and the public. By making data more readily available to managers, and available in a more appropriate and understandable form, they should also contribute to improved decision-making in the National Park Authorities. The extent to which such improvements happen, however, are dependent upon the organisational structure and culture of the Authorities concerned. As the recent PIMS study (Briggs *et al.* 1996) showed, not all Parks have yet developed the strategic thinking and culture necessary to make full use of the information available.

Herein, however, lies a further important implication of GIS. Because GIS have such wide-ranging potential, because they act to generate new uses and activities as well as serving established needs, and because they need and tend to foster a more open attitude to information, they have far-reaching impacts on the organisations involved. Amongst other effects, for example, they:

- create the need for systematic georeferencing of data, which may require changes in the way in which surveys are carried out and recorded;
- facilitate sharing of data, thereby encouraging staff to view data as a corporate resource;
- encourage awareness of the need for common data definitions and formats, and strengthen the need for corporate policies on data standards;
- help to stimulate inter-departmental and inter-institutional collaboration;
- give staff more analytical capability *'at their fingertips'*, thereby encouraging them to think more creatively about their data and their responsibilities;
- make data more accessible, and can help develop a more information-based approach to Park management and policy-making;
- can stimulate the demand for specialist training and staff development;
- provide an important means of empowerment for users both within and outside the Authority.

The adoption of GIS is therefore unlikely to be a simple, one-off event within the National Park Authorities. It will, over time, lead to substantial changes in NPA's ways of working and in their capability to manage the countryside. It is likely to lead to significant changes in NPA's relationships with Park users and with other agencies. By making the process of management more informed, more open to scrutiny and a more collective activity, however, GIS will surely enhance the work of the National Park Authorities, to the wider benefit of the countryside.

Editor's note: The next article will examine use of GIS by one National Park, the Lake District National Park Authority in more detail.

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MORE QUESTIONS THAN ANSWERS? GIS HELPS REDRESS THE BALANCE IN THE LAKE DISTRICT NATIONAL PARK

By John Clayson
Lake District National Park Authority

Abstract

The Lake District National Park Authority (LDNPA) has been using Geographical Information Systems (GIS) since 1991 when a 3-year development project was initiated in partnership with the Countryside Commission. Since then GIS has been used in a variety of work, from the automation of routine tasks to the analysis of data for public inquiries and policy documents. This paper provides some examples of the non-routine work undertaken with GIS in the LDNPA, illustrating how the technology has enabled the organisation to maximise the use of the information they hold and apply it in new ways.

Introduction

GIS was first introduced to the LDNPA in 1991 following the completion of the "Monitoring Landscape Change in the National Parks Project" (Countryside Commission, 1991; Taylor et al, 1991). A 3-year development project was established to investigate how GIS could be used in a National Park, with particular emphasis on using the newly acquired land cover datasets. The aim of the development project was to investigate a wide range of operational issues which could be tackled using the technology, but not to set up a fully operational GIS for use by all staff. A number of case studies were produced (Fishwick and Clayson, 1995) providing examples of how GIS could be applied to countryside management. This work complemented GIS developments that were emerging in the other National Parks (Briggs and Tantram, 1997). The development project also had a number of other aims, including: raising awareness of GIS amongst the National Parks; investigating joint ventures and joint working with other organisations; and the sharing of digital data to reduce duplication in data capture. Since the end of the development project GIS has continued to be used in two broad areas of work; the automation of routine existing tasks; and data analysis and modelling.

In the following section, a brief summary will be given as to how GIS has been used to address some key questions in the Lake District National Park:

- Where are large-scale developments in the countryside visible?
- Where can we effectively target our grants and surveys?
- How can we develop new, or justify existing, policies?

Where are Large-scale Developments in the Countryside Visible?

A number of GIS, or add-on modules produced by third party suppliers, are now able to produce visibility maps, allowing the user to predict where a location in the landscape is visible. The LDNPA has used this facility for a number of applications based on the Ordnance Survey 1:50,000 point digital terrain data known as *"Landform Panorama"*.

Nirex underground Rock Characterisation Facility public inquiry

The Rock Characterisation Facility (RCF) proposed by Nirex was to be situated close to Sellafield, just outside the National Park. At the public inquiry about the development, the LDNPA argued, amongst other issues, that the visual impact of the above ground works associated with the RCF would be too intrusive. The new site would, however, be seen in the context of the existing Sellafield industrial complex. It was important therefore, to try and establish not only where the new buildings would be potentially visible, but also where they would be visible in relation to Sellafield. Using GIS, visibility maps were produced for two sets of cooling towers at Sellafield, and for the winder houses at the proposed RCF site. The separate layers of information were then combined to give an indication of where the development would form a new visual impact . The results were used to help target site visits during the inquiry and provide a framework on which arguments concerning the new visual impact could be based during the planning process.

Wind Farms

During the last 4 years there has been a dramatic increase in the number of wind farms in the U.K. Such developments are restricted inside the Lake District National Park by virtue of the visual impact that large man made structures have in the open countryside. A number of schemes have been proposed immediately outside the National Park, especially on the Furness peninsula adjacent to the southern boundary. All the wind farm schemes were subject to a visual impact assessment, usually carried out by consultants, and were plotted on a visibility map which indicated the locations from where the site would be seen. Virtually all these assessments concentrated on a very small radius around the site and neglected the longer distance views. Planning Officers in the LDNPA were interested in where the proposed wind farms would be seen inside the National Park and what the

cumulative effect of a number of proposals in the same area would be. To this end visibility maps were produced for the tallest turbines at the highest point on each of the proposed sites to give an overview of the potential visual intrusion of the development. The individual maps were then overlaid in the GIS to produce a cumulative impact map. Both sets of maps were used to help target site visits by planners and committee members, and to identify problem areas.

Where can we Effectively Target our Grants and Surveys?

The amount of money available to spend on grants and surveys continues to be increasingly tight in most organisations. More than ever, efficient use has to be made of limited funds to reap the maximum benefit. The LDNPA has used GIS to maximise the potential use of available digital data to help target resources and surveys.

Hedgerow Grants

As part of the *Monitoring Landscape Change* survey (MLC), information was collected on the length of hedges, walls, fences and other linear features on a 1km basis. This data was used to help *'zone in'* to areas of the National Park where grants for hedgerow renewal and planting were most needed. The MLC data had been collected during the early 1970s and then again in the late 1980s. GIS was used to plot the current density of hedge lengths per km≤ and to produce a change map by comparing the hedge lengths in the 1980s with those in the 1970s. The change map was combined with the density map, to show areas where hedges were an important landscape feature and where they had suffered a significant loss. This information was utilised by the landscape architect and ecologist to plan site visits, define target areas, and justify the distribution of hedgerow grants.

High Brown Fritillary Butterfly Survey

The High Brown Fritillary is a nationally rare butterfly that has suffered a large decline in its population over the last 50 years. An initiative was established in the Lake District between the Butterfly Conservation groups, English Nature, Forest Enterprise and LDNPA to find out more about the current abundance and distribution of the butterfly in the southern area of the National Park. The possible survey area was very large and had to be narrowed down to enable a small group of surveyors to cover the most likely areas where the butterfly would be found in a short space of time. Within the constraints of the available data, experts defined the most promising survey sites to be areas of bracken close to woodland at low to intermediate altitudes. The data was extracted from the GIS as a series of layers and then overlaid to produce the final map (Clayson, 1996). After two survey seasons, High Brown colonies were identified, entered in to the GIS and are now used in automated constraints checking.

Heather area under threat from bracken

At a meeting held at the LDNPA, concern was expressed on the expansion of bracken into areas of heather. Although some local examples could be given, there was no overall picture as to the likely extent of the problem. It was a commonly held belief that bracken and heather had distinct attitudinal ranges within the Lake District that would influence the spatial distribution of the potential threat. However, there were no hard facts available to quantify this belief. In order to address this shortcoming, the digital terrain data, already used for visibility analysis, were used to analyse the altitudinal variation of the two land cover types, and the results were produced in graph form. This analysis confirmed that bracken was more abundant at lower altitudes than heather and less abundant at higher altitude. The information was used to reclassify the heather map to represent, in a simplified manner, where there was a threat of incursion from bracken, i.e. heather was more under threat at lower altitudes. The results have provided a *'first stab'* at identifying key areas, and provided a useful overview. It is hoped that the work will be taken forward by incorporating slope, aspect and land management into the model.

How can we Develop New, or Justify Existing, Policies?

GIS enables organisations to use data in new ways. If decision makers are aware of what GIS has to offer it should lead to more comprehensive use of digital data for the development of new policies, or the reinforcement of those already in existence.

Mapping tourist accommodation

An important policy that has been established for a number of years by the LDNPA, and defined in the Lake District Local Plan, is the concept of the differentiation of the *'busier central valleys'* and other *'quieter areas'*. GIS has been used to help differentiate the character of these areas with respect to tourist accommodation.

The Cumbria Tourist Board supplied a database of registered tourist accommodation. The dataset contained a list of addresses, postcodes, number of bedrooms, bedspaces, and type of accommodation. The data could not be mapped without a grid reference and the postcodes on their own were unable to provide this. The data was mapped by purchasing the Royal Mail's Postcode Address File (PAF), which lists an 8 figure grid reference for the centre of each post code area. The PAF data was combined with the tourist accommodation database in the GIS and a point distribution map created. The distribution of the different types of tourist accommodation were mapped, analysed and compared against the *'busier central valleys'* and *'quieter areas'* to help reinforce the differences in these policy zones.

Lake Windermere speed limit inquiry

A public inquiry was held in 1990 to debate the proposed change in the Windermere bylaw to allow a 10mph speed limit to be imposed on the Lake. Part of the evidence submitted by the LDNPA tried to define those areas of the Lake from which there would be a noise disturbance on the adjacent land if power boasts were within a specific distance from the shore. Using a survey already carried out on the land around the Lake, GIS was used to create 500m buffer zones around those areas of shore defined as: land open for informal recreation; residential; education centres; and caravan or camp sites. The 500m zone was used after previous studies had shown this to be a reasonable distance over which noise disturbance occurs. During the inquiry a request was made to re-run the analysis using 250m zones to compare against the original map. The new buffer zones were created within a few hours and were ready for inspection at the inquiry the following day.

Conclusions

In the examples given, seeing GIS as anything other than a tool can lead to resistance because some users will perceive it more as a threat than a help. It is important also to know when to draw the line when using GIS to analyse data for a given problem. In the examples given above, the GIS techniques used were fairly simple and uncomplicated, hence the results were obtained relatively quickly. In virtually all the examples, other datasets could have been *'thrown into the pot'* and more analysis undertaken as the GIS derived new layers of information from the existing data. However, when this happens it is the technology that has become the driving force, and the analysis is performed simply because the capability is there. The original question that needed answering begins to blur into the background and the focus of the work can be lost.

There has to be a compromise between what the GIS will allow you to do and what actually needs doing. Ideally the use of GIS should be application driven rather than technology or data driven. The type of data available does, however, become a key consideration, especially if it is likely to prove expensive in time or money to obtain the required data. GIS will take whatever data you give it, process it and provide results, but it is important to remember that the answer you get out is only as good as the data you put in. In many cases it is the efficiency gains brought about by the automation of existing tasks that helps to convince managers to introduce the technology into an organisation. However, if the sole use of GIS is to simply do what you already do, a number of additional benefits will be lost, as the examples in this paper illustrate.

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STRATEGIC SCHEME MANAGEMENT
MANAGING COUNTRYSIDE STEWARDSHIP AND ESAs: THE ROLE OF GIS

By David Askew,
Farming and Rural Conservation Agency

The Farming and Rural Conservation Agency (FRCA) is a new executive agency of the Ministry of Agriculture (MAFF) and the Welsh Office. It came into being on the 1 April 1997 with some 480 staff based in local offices throughout England and Wales. FRCA has been formed to assist government in the design, development and implementation of policies on the integration of farming and conservation, environmental protection and the rural economy.

A GIS based approach has been taken to aspects of FRCAs work for government across all these policy areas. The FRCA GIS Unit, based at Leeds, has led development in this area. The Unit uses ArcInfo and ArcView GIS software as well as other analysis packages such as ERDAS Imagine satellite image processing software. The technical support service provided by the Unit is based on the extensive collection of datasets that form the *National Environment Database* (NED). Data ranges from Agricultural Census to satellite imagery, to physical data such as climatic variables, through to information on environmental designations. The use of GIS has been particularly developed in the agri-environment policy area, for schemes such as *Environmentally Sensitive Areas* (ESAs) and the *Countryside Stewardship Scheme* (CSS). Under these schemes farmers and others are offered financial incentives to manage their land in ways that deliver particular environmental benefits.

ESAs have been operating since 1987 and the 22 designated areas in England now cover some 10% of all agricultural land. They cover a wide variety of landscapes and habitats from the upland haymeadows of the Pennine Dales to the grazing marshes of the Broads, to the heather moorland of Exmoor. In all these ESAs payments are made in return for agreements to follow set farming prescriptions. The prescriptions might include, for example, a requirement not to plough grassland, to limit fertiliser use or to maintain drystone walls. All agreements are made on a voluntary basis and last for 10 years.

The Countryside Stewardship Scheme is the other major scheme implementing MAFF's agri-environment policy. The scheme was originally launched by the Countryside Commission in 1991 before being transferred to MAFF in 1996. It is available throughout England (except in ESAs) and there are now over 6000 individual agreements. Under this scheme payments are offered to farmers and other land managers for the enhancement and conservation of English landscapes, their wildlife and history and to help people to enjoy them. The scheme is targeted at particular landscapes; such as, chalk and limestone grassland, lowland heath, and countryside around towns.

Before looking at GIS applications developed to assist in the management of these schemes it is important to consider the range of people involved in scheme management. MAFF Policy Divisions have responsibility for developing overall policy whilst at a more local level MAFF Regional Service Centres are responsible for day to day scheme administration. FRCA provides a technical input into managing these schemes through Project Officers dealing with agreement holders on the ground and often working with other specialists such as ecologists and landscape architects. There is therefore, a wide range of people involved in scheme management, all with particular interests in different aspects of the schemes. None of these people however are GIS experts. These factors have had to be very much borne in mind in developing useable GIS support systems.

Before looking at the examples of specific systems developed, the main application areas can be summarised. GIS has had a role at the initial policy design level. For example information on agricultural systems and environmental features such as soils and habitat types can be analysed within a GIS to identify potential target areas for schemes. Once schemes are in operation a wide range of day to day management questions can be addressed. For example, in assessing applications, questions arise such as ; *'Is this application within a SSSI?'*. Finally, in evaluating the performance of schemes GIS also has a role. Strategic spatial questions include; *'Where is the land that has come under agreement?'*.

Using GIS to help these various aspects of scheme management has highlighted a number of advantages. A GIS approach allows the integration of a variety of datasets utilising their common geographic framework. This means that information on scheme agreements can be related for example to physical environment information. Large data volumes can be handled and made accessible. This is particularly important given that with a long history of operation, there is a large volume of information relating to these schemes and this is continually growing. GIS allows analysis of the same data at

a variety of scales and the combination of regional or local datasets into *'seamless'* national coverages. This aspect is particularly important given the range of people interested in scheme management, from those with a purely local interest to those requiring a national overview. Finally, GIS almost by definition, allows data to be subject to spatial analyses not possible with other data handling systems.

The development of systems for ESA and CSS management has confirmed a number of general lessons relating to the implementation of GIS based information management solutions. Overall the systems have demonstrated the value of GIS for a range of people involved in scheme management who are not and do not want to become *'GIS experts'*. Systems have to be designed with this in mind which has involved, for example the building in of customised queries. The spread of systems around a dispersed national organisation also raises the problem of the physical movement of data and particularly the maintenance of dynamic data in remote systems.

FRCAs experience has confirmed the importance of defining as precisely as possible the end uses of applications and, consequently, the importance of involving users in system development. A realistic approach has to be taken to defining the limitations of what the GIS will and will not do. Conversely, whilst not advocating a technology led approach, encouragement may have to be given to users to develop a spatial approach to management issues. Making data available in a GIS makes possible an approach to aspects of management that may not have been considered simply because they have not previously been possible.

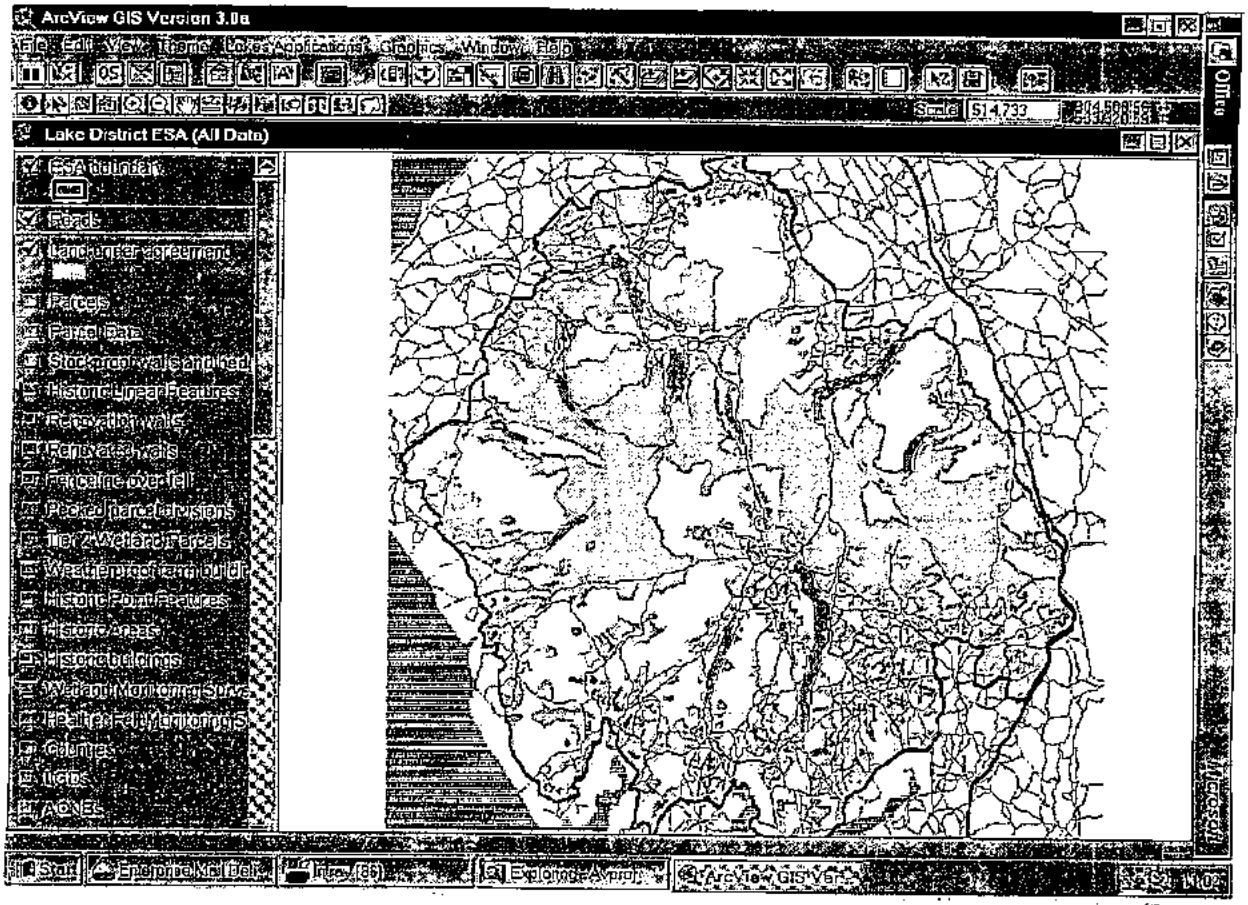
System Demonstrations

Management systems primarily designed for use by scheme Project Officers have been developed for ESAs and CSS. Information has been subdivided to cover the area of interest to particular project officers, either for a region, or a particular ESA. The same information has also been amalgamated, in similar systems, for addressing strategic management issues at a national level. All systems have been set up using ArcView and *'Project Officer Systems'* have been put on stand alone PCs in regional offices.

ESA System

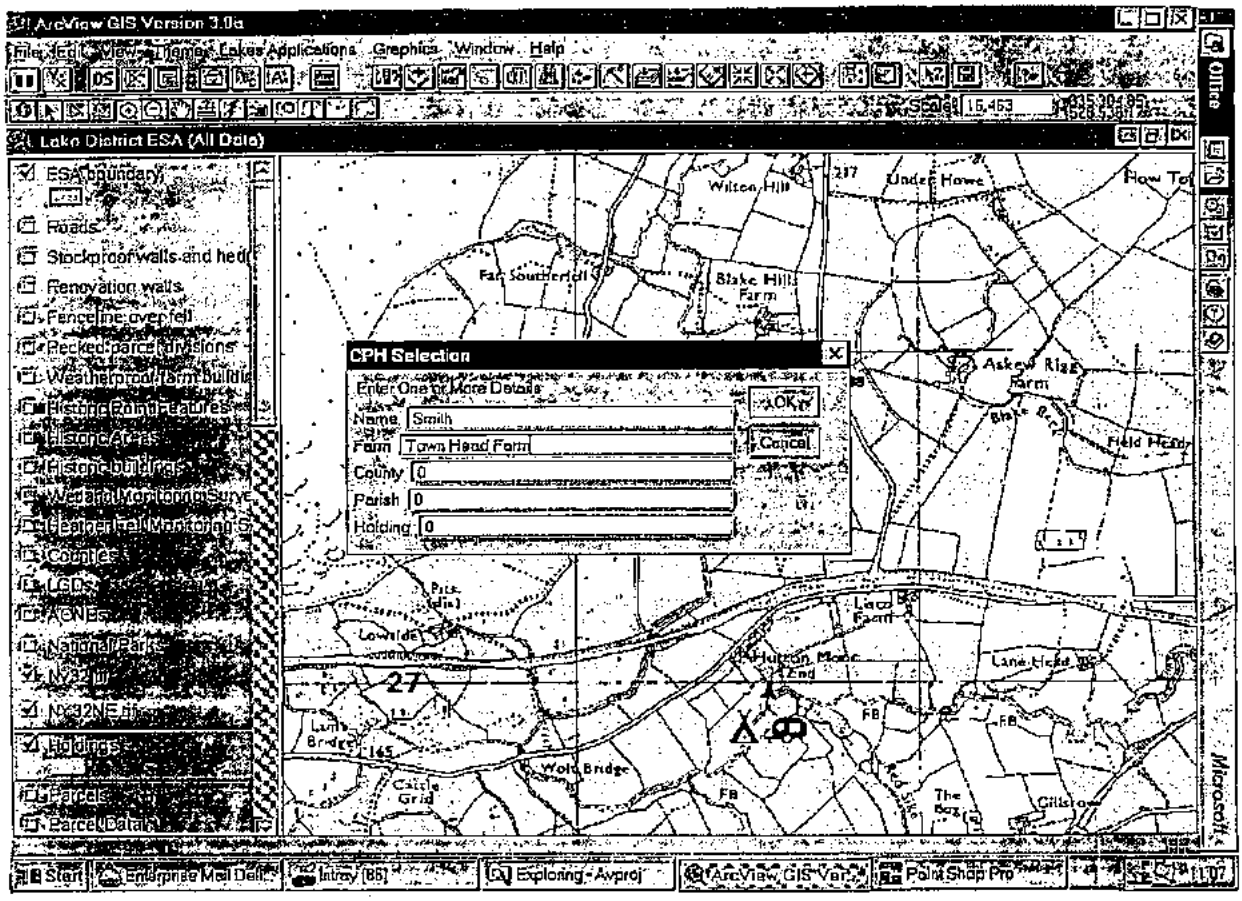
Under a pilot project systems have been developed for both the *Pennine Dales* and the *Lake District ESA;* the latter illustrated here. The *Lakes system* holds information on all scheme agreements. This includes names, addresses, farm holding boundaries and other details of land under agreement. This information is transferred from the digital contract maps that are drawn up for each agreement on entering the scheme. At a simple level this data can be viewed to illustrate the overall pattern of uptake (see figure 1).

Figure 1.



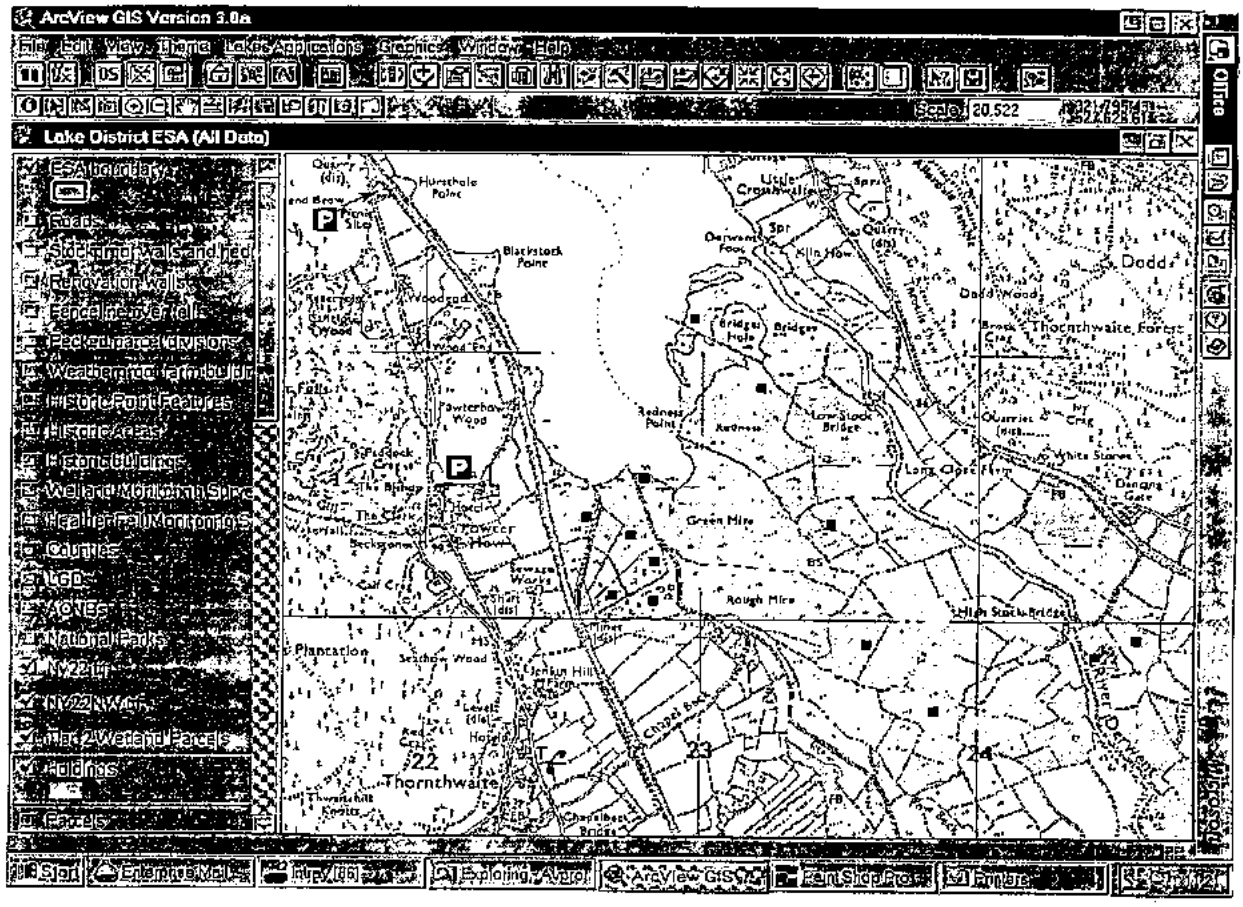
From this, gaps in uptake can be identified and Project Officer work targeted accordingly. In dealing with individual agreements the system can search for named agreement holders and details down to the field level can be displayed. This data is accessed via a customised search routine that prompts the user for agreement details (see figure 2).

Figure 2.



The system holds a range of environmental data. This allows, for example, the distribution of target species to be related to land under agreement. For example in the Lakes potential Marsh fritillary butterfly breeding areas can be matched with wetland fields under agreement. These sites will contain the most suitable breeding habitat for this species. Wetland sites with potentially suitable habitat can be identified and management agreements tailored accordingly to optimise habitat conditions (see figure 3).

Figure 3.

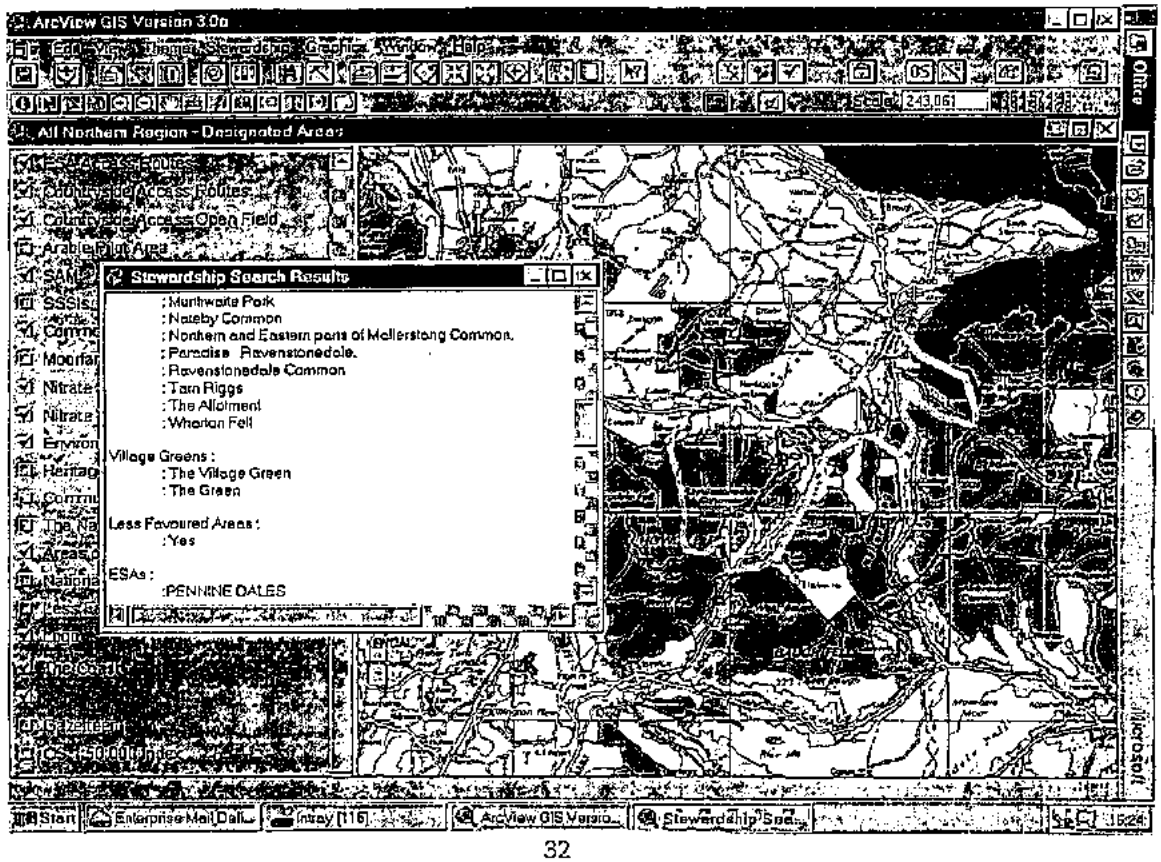


CSS System

Regional systems have now been set up in all FRCA offices from where Stewardship Officers operate. In principle, the systems are similar to those developed for ESAs. A wide range of environmental information is held. This includes information on for example, topography, geology and administrative boundaries. In addtion habitat information such as ancient woodland and lowland heathland sites are held. A wide range of designations are also recorded; these include National Parks, SSSIs and Scheduled Ancient Monuments. Much of this data has been transferred from other agencies and departments such as English Nature and English Heritage. The development of these systems has encouraged the exchange of digital environmental data.

A particular feature of the CSS system that has been built in as a customised routine is the facility to carry out a *'constraints check'*. This involves the system searching all relevant datasets for environmental information for a specified location. A printable report is produced summarising all relevant designations affecting a site (figure 4). A map is produced. This has been developed to assist in the processing of scheme applications to determine their context and what further consultations need to to take place.

Figure 4.



Conclusions

By way of conclusion in relation to agri-environment schemes and other MAFF policy areas GIS will have an increasing role to play in both FRCA and MAFF. This will in part be driven by the increased need to take a strategic view of schemes and their impact, the integration of schemes, and increased targeting within schemes. The focus of attention will continue to move away from purely technical aspects towards data issues, although the question of data transfer and networks will increasingly come to the fore.

COUNTRYSIDE MANAGEMENT APPLICATIONS FOR GIS: ENVIRONMENTAL DESIGN

By Alan Fishwick,
Lake District National Park

It was agreed the scope of the topic is potentially enormous. The workshop considered the subject of Environmental Design for GIS under three main headings:

- Tasks and Applications;
- data issues;
- practical advice on implementation of GIS.

The approach reflected the views from the morning's sessions that use of GIS needs to be *'applications led'*. Each application will have specific requirements, pose particular problems and is likely to generate new opportunities that extend beyond the initial application. The workshop explored a few of the applications identified by participants (1) from which a number of general observations were distilled (2 and 3).

1. Tasks and Applications

- Defining limitation and constraints on actions e.g. applications as diverse as routine checking of the location of planning applications against designated sites, defining areas with least development (*'wildland'*), and mapping of windthrow hazard.

- Searching for appropriate opportunities to do things e.g. defining potential areas in which to expand woodlands (see Woodland Creation: Needs and Opportunities in the English Countryside, Forestry Commission and Countryside Commission CCP 507).

- Predicting where *'special'* features or events might occur e.g. using known preferences of species, or characteristics of sites, to search for other locations where these parameters occur e.g. rare butterflies, landslips.

- Assessments of particular scenario's; *'what if'* type questions.

- Visualising the consequences of a set of proposals.

- Monitoring the spatial consequences of particular policies or incentives.
  In reality these points are not mutually exclusive. Key themes noted in relation to the applications were: the need to combine GIS technical skills with expert knowledge of the subject of the application; the potential gain from integrating information from different disciplines; the ability to make assessments in three dimensions via digital terrain models/elevation data.

2. Data Requirements and Issues

- An understanding of data quality is fundamental to any GIS application: how it was collected, at what scale and accuracy factors determine its suitability or otherwise for a particular application. This in turn influences the degree of confidence that can be placed on results.

- Different applications may be tolerant of quite different levels of accuracy. e.g. a point location referenced to the national grid might serve to analyse distribution patterns of particular features over extensive areas, while precise site boundaries of the feature represented by the point might be needed for a study of that locality.

- Management of Data to maintain quality is vitally important to the success of GIS applications applied over time. Responsibilities for datasets have to be allocated, and protocols for editing and updating are needed. Centralisation should not be an automatic response to the recognition of *'corporate data'*. Data needs to be held at the *'right level'*.

- Digital Data acquired for a specific purpose is likely to open up new possibilities for further work in other areas. However the problems of transferring data reference from features on one map scale to another need to be taken into account: Mention was made of problems associated with definitive footpaths and the differences between national and local datasets e.g. the FA's national datasets are being digitised at 1:25,000 reflecting the very significant costs of acquiring the necessary OS base. Local Authorities often worked at

1:10,000 reflecting digital maps supplied under the Service Level of Agreement with the OS.

3. Key considerations relating to GIS systems/organisational issues

- Routine Applications – Ease of use by non specialists is a key consideration. Software must allow applications to be customised by specialists to meet users needs (issues such as approaches to defining users needs, training, support etc. flow from this).

- Applications requiring specific programming – some applications requiring fairly complex functions, or which are used infrequently are likely to be most appropriately undertaken by either an in-house GIS expert, or be contracted out to consultants. As use of GIS expands in an organisation, changing staff capabilities is likely to change the scope of work tackled internally.

- Gaining Organisational Support – consider which *'Start up'* applications can provide quick results that make a difference to how things are done and to the quality of presentations (a high profile may well be needed to generate attention and necessary funding).

- Ensure direct access to relevant systems for those who need the capability – the case work from the FRCA presented in the morning provides one model of the way that different GIS have been developed for different purposes. It also illustrates relevant applications have been designed both to provide policy advice nationally and access to information by individual project officers in the field.

COUNTRYSIDE MANAGEMENT APPLICATIONS FOR GIS: THE NATURAL ENVIRONMENT

By Mary Anne Robinson,
Scottish Natural Heritage

Structure

The workshop began by outlining its aim:

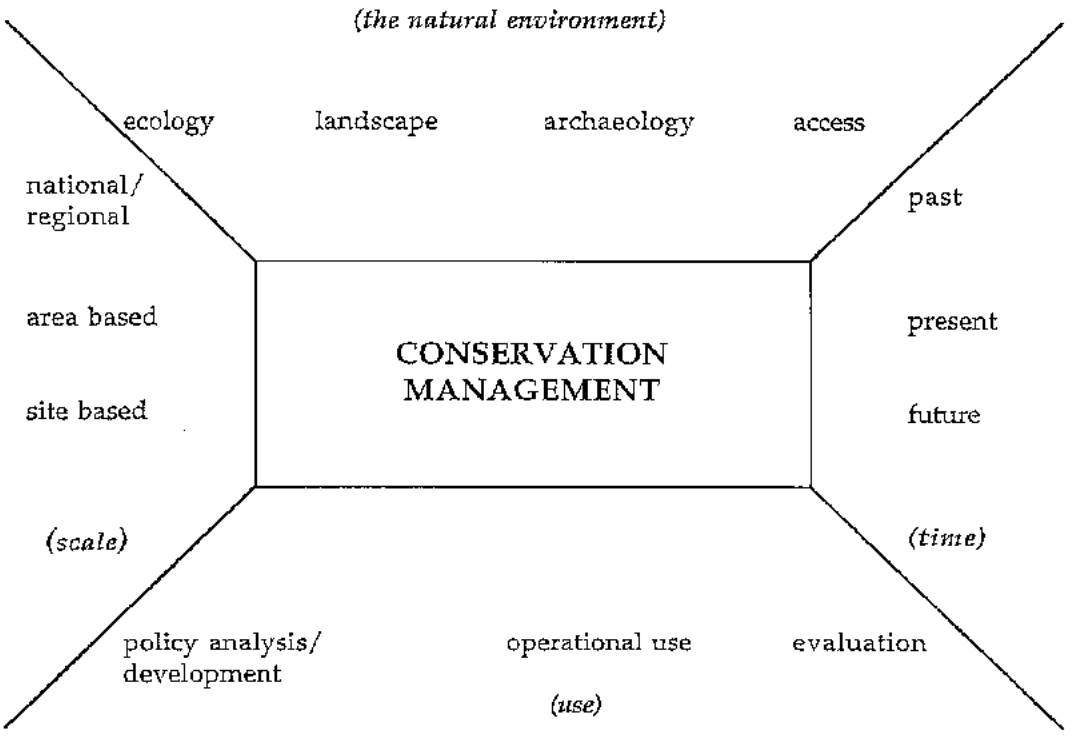
- to inform the production of informative briefs to help countryside managers consider the benefits of GIS;
- offering practical advice in setting up GIS for the first time as well as expanding its use.

The workshop followed the structure requested: establishing the main tasks undertaken by the Natural Environment group;

1. identifying the type of information required;
2. considering the extent to which GIS can help; and
3. developing a checklist of some of the key issues to explore when considering GIS.

1. Tasks

The Natural Environment group was large and the tasks it undertakes diverse, but they could be set within the context of a *'square'* of conservation management, its 4 axes being the natural environment, scale, time and use.



Within this context, the main tasks undertaken by the Natural Environment group were summarised as:

- management planning at both a policy and site level;
- survey and inventory;
- monitoring change; development control; and
- the public interface.

2. Type of information

Understandably, the type of information that was required to undertake these tasks was equally diverse.

- Most fundamentally, there were the wide range of data sets related to the elements which make up the natural environment such as: geology; soils; climate; topography; hydrology; land cover; built infrastructure; land use; habitats; and species distribution.

- There were also key aspects affecting management such as: ownership and tenure; designations; planning zones and guidance; various legal aspects; rights of way; management activity; landscape assessments; public attitudes and cost.

- Each data set had three basic requirements: location, quantity and quality.

3. A checklist of key issues to consider

The main message was not to be intimidated! GIS was a potential powerful tool, and the key was to suit it to your own needs, not the reverse. Life can exist without an all singing, all dancing system. Indeed, within the group there were large organisations who were only just setting up GIS (RSPB) and small (one-man) organisations who used it with ease. A good beginning point was to see how others used GIS. The process of assessing GIS should then start by considering what your organisation does; what data was already available; and your ability to generate (or acquire) digitised data which you actually need. GIS would have an effect on your organisation: were you prepared to manage the necessary change to ensure GIS was used effectively, including training people? It was important to be flexible, considering your organisations size and resources, and considering partnerships with others.

As well as considering how GIS can help you with current tasks, it was also important to consider your future needs. The ability of GIS to help in the future was influenced by the degree it was taken into account now. This was a bit of a chicken and egg situation, however, as future use and needs may be unknown. Indeed, the advice to be prudent and to take a step by step approach to the use of GIS, allowing its opportunities to develop as your confidence in the system grew, seemed to act against this need for forethought and understanding. Conversely, GIS itself was developing all the time, and new opportunities may arise through technical advancement, along with potential problems, such as issues of confidentiality and the legal consequences of data exchange.

COUNTRYSIDE MANAGEMENT APPLICATIONS FOR GIS: RURAL DEVELOPMENT AND TOURISM

By Susan Hayes,
Farming and Rural Conservation Agency

A key message from this session is that GIS can be used to model and evaluate rural development initiatives and tourism strategies in terms of economic viability and environmental impact. Example themes would include:

- Targeting and prioritising areas for development initiatives and strategies (e.g. the evaluation of zones of relative economic decline, high unemployment or poor infrastructure).
- Planning strategies in relation to the environmental and economic resources and opportunities (e.g. defining catchments for likely trade, competition and labour skills).
- Visualising proposed strategies in relation to designated areas (e.g. planning policy zones and areas attracting development funding).
- Monitoring the effectiveness of existing initiatives in relation to subsequent economic data and trends.

1. What is the main usage of GIS by this Rural Development and Tourism group:

- Map Production;
- Tranquil area maps – cycle routes;
- Constraint checking – environmental designations/grant money;
- Rights of Way;
- Tourism Accommodation;
- Planning strategies;
- Rural Decline;
- Pleasure users of water;
- *'Honeypot'* sites.

2. Types of work that GIS may be useful for:

- Gazetteer;
- Presentation, searches, constraints;
- Tourism – development, accommodation, traffic access, rights of way;
- Recreation – downstream spend/Regional Tourist Board – *"Cambridge Model"*;
- Monitoring change – update both at national and local level.

3. Examples of work where FRCA used GIS :

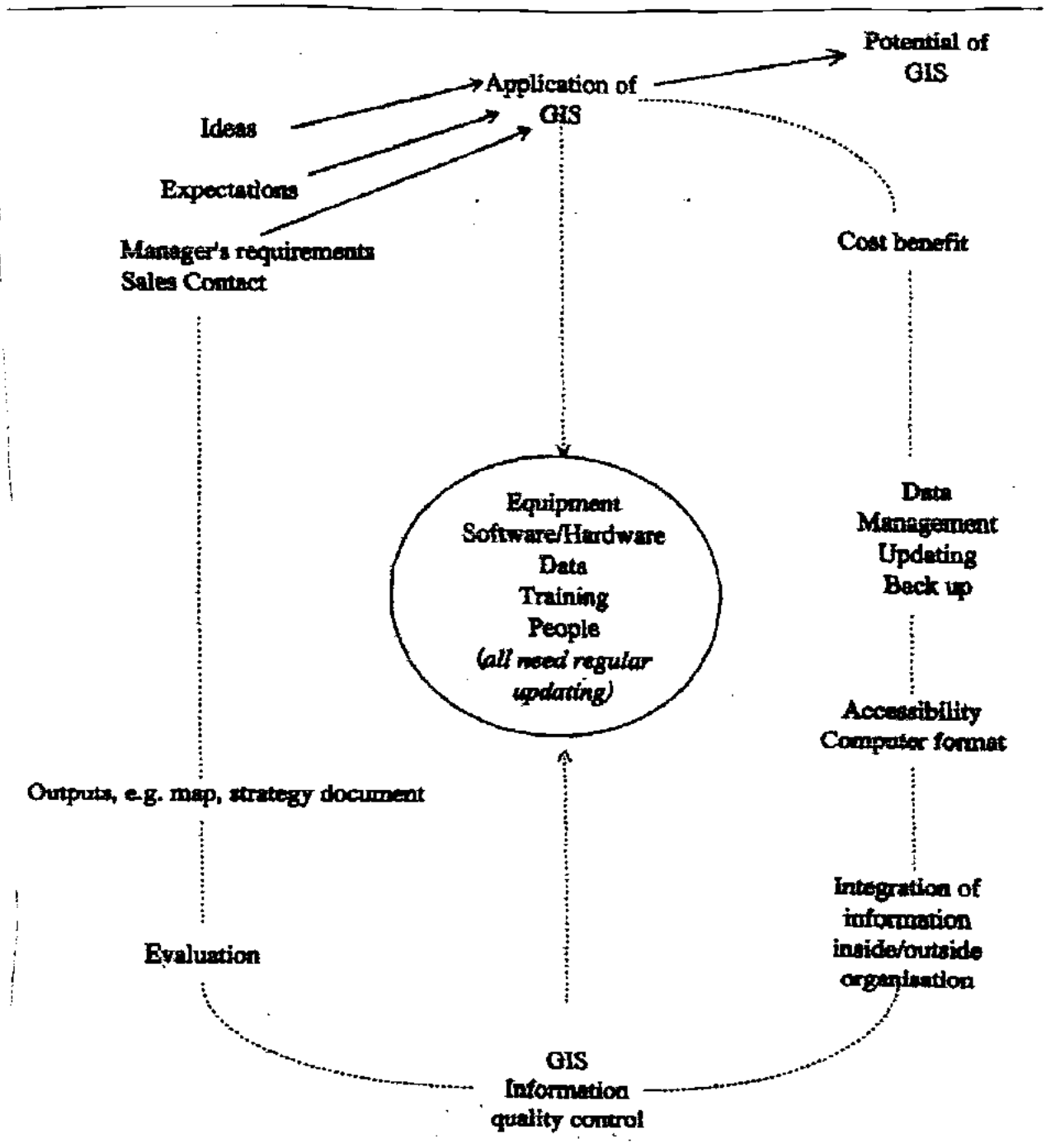
- Agricultural Land Classification (ALC) maps;
- ALC and underlying geology;
- Employment in agriculture, and/ or tourism, and /or food processing:
- Farm shops – Urban fringe, catchment area 5-10 miles
  - population data
  - socio-economic class;
- Tourist attractions;
- Soil types – *"poachability"* of land;
- EU Objective 5b
  - to define areas of greatest need
  - ALC, land quality
  - altitude, LFA areas
  - type of farm by MAFF Census data
  - size of holding by hectares and/ or labour requirement from MAFF;
- Machinery rings – labour register skills, farm type.

4. What information is needed:

End Use of Work	
Date	a date a period
Base map	detail, scale
Boundary data	altitude environmental data political/administrative area grant money/lottery
Human	post code population census data employment traffic information
Specific to our project of work	Agricultural Census – times series photographs/habitat land cover uses of area visitor numbers recreation

Flow diagram produced by group.

5. Organisational structure of GIS use



COUNTRYSIDE MANAGEMENT APPLICATIONS FOR GIS: ROUTEWAYS AND ACCESS

By Gareth Roberts,
Countryside Council for Wales

The key messages from this session were that:

1) GIS can be used to rationalise existing manual systems for recording access designations and routeways;

2) GIS can assist in the scheduling of maintenance programmes and renovation strategies; and

3) GIS can be used to model access demand from, and to, proposed developments as well as evaluate the effect of new access proposals.

Some suggested themes therefore included:

- Recording and scheduling maintenance activities, work programmes and renovation strategies.

- Modelling the likely demand of new access initiatives, in terms of population catchments and attractions within the landscape.

- Assessment of access proposals in terms of connectivity with existing routes.

- Visualisation of designs for the management of visitor pressures.

- Planning visitor access in relation to other environmental objectives (e.g. the management of fragile habitats, landscapes and historic features).

CONSTRAINTS AND CONSIDERATIONS

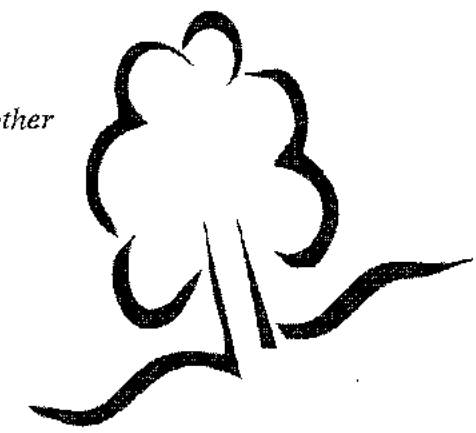
Data access, data protection, copyright, and other practical & legal considerations.

By Peat Allan
Ordnance Survey

Paper not submitted.

Programme

0900	Registration and coffee
0945	Welcome and introduction
1000	**Organising & Handling Environmental Data** *An overview of GIS applications in Countryside Management: The Experience of National Parks*
1045	Coffee
1100	**Strategic Scheme Management** *Managing Countryside Stewardship and ESAs using GIS*
1145	**Modelling and Analysis** *More Questions than Answers? GIS helps redress the balance in the Lake District National Park*
1230	Lunch and a chance to view exhibitions
1400	**(Workshops) Countryside Management Applications for GIS:** • ***Routeways & Access*** • ***Environmental Design*** • ***The Natural Environment*** • ***Rural Development & Tourism***
1505	Afternoon tea
1525	**Constraints and Considerations** *Data access, data protection, copyright,and other practical & legal considerations.*
1605	Final discussion
1630	Close



GIS & Countryside Management

Delegate List

Peat Allan
Senior Systems Developer
Ordnance Survey

David Askew
Principal Resource Planning Adviser
FRCA

Nicholas Barnes
Countryside Officer
Rotherham Metropolitan Borough Council

Olwen Beazley
Archaeological Conservation Assistant
Yorkshire Dales National Park Authority

Simon Benten
Student
University of Sheffield

David Beskine
Assistant Director
The Ramblers' Association

Steve Betts
Assistant Conservation & Recreation Officer
Environment Agency

Andy Black
Lecturer Conservation Management
Otley College of Agriculture & Horticulture

Leigh Bogardis
Internal Sales Rep.
MapInfo

Tony Bradford
Countryside Manager
Countryside Management Service

David Briggs
Director of Research
The Nene Centre for Research

Claire Brodie
Research Assistant
British Waterways

Rob Burnett
Senior Adviser
FRCA

Joan Butt
Cartographer
Sheffield Hallam University

Geoff Carr
Parks and Countryside Officer
Barnsley Metropolitan Borough Council

Jon Clark
Project Development Manager
Great North Forest

John Clayson
GIS Officer
Lake District National Park Authority

Gillian Craig
Landscape Technical Officer
Milton Keynes Council

Lynn Crowe
Course Leader
Sheffield Hallam University

Andrew Davies
IT & GIS Manager
Brecon Beacons National Park

Howard Davies
Cartographic Section Manager
Forestry Authority Scotland

Elaine Dick
Graphics & Technology Officer
Forestry Commission

Tony Dinneen
GIS Consultant
exeGesIS SDM

Mark Eccles
Area Ranger
Lake District National Park Authority

Mike Eden
GIS Consultant Dataview Solutions
Dataview Solutions Ltd

Martin Elliott-White
Lecturer in Tourism
University of Lincolnshire and Humberside

Rod Ellis
Consultant - GIS Unit (Wales)
FRCA

Chris Fairbrother
Senior Ranger
Barnsley Metropolitan Borough Council

Ian Fisher
Research Data Manager
The RSPB

Alan Fishwick
Assistant Chief Planning Officer
Lake District National Park Authority

Marina Flamank
Assistant Conservation Officer
Environment Agency

Phill Fox
Countryside Officer
Milton Keynes Council

Elaine Gallagher
Environmental Scientist
Joint Countryside Advisory Service

Phil Glennie
Senior Ranger/ Naturalist
The National Trust for Scotland

Julian Gray
Information & Interpretation Officer
Sussex Downs Conservation Board

Siân Griffiths
Network Assistant
Countryside Recreation Network

David Hancock
Malvern Hills AONB Officer
Malvern Hills AONB

Susan Hart
Conservation Secretary
The RSPB

Susan Hayes
Senior Rural Enterprise Adviser
FRCA

Guy Hopwood
Consulting - ESA Monitoring (Wales)
FRCA

Peter Howe
Principal Definitive Map Officer
Northumberland County Council

David Hunt
Mapping & Charting Officer
Farming & Rural Conservation Agency

Theresa Hustler
Assistant GIS Officer
Nottinghamshire County Council

Danny Jackson
Team Leader Countryside Service
Bradford Metropolitan District Council

Stephen Jenkinson
Senior Rights of Way Officer
City of Bradford Metropolitan Council

Lynnette Jones
Project Officer
N. Worcestershire C'side Action Project

Matthew Jones
Project Officer (European Grants)
National Trust

Nigel Labdon
Senior Ranger
Barnsley Metropolitan Borough Council

Caryn Le Roux
Research Officer
Brecon Beacons National Park

Andrew Lee
C.I.S. Co-ordinator
Ministry of Agriculture Fisheries & Food

Paul Leonard
Countryside Officer
Rotherham Met. Borough Council

James Lockyer
Student (Work Placement)
National Parks Archaeology Department

Ruathy MacMaster
Management Strategy Co-ordinator
Cairngorms Partnership

Sarah Manchester
Ranger
Milton Keynes Parks Trust

Graham Marchbank
Senior Planner
Scottish Office Development Department

Debbie McCaffrey
IT Assistant
Yorkshire Dales National Park Authority

David McGlade
Hadrian's Wall Trail Development Officer
Planning & Environment Department

Victoria Mohan
GIS Assistant
The Scottish Sports Council

Andrew Moulton
Ranger, Tarka Trail
Devon County Council

Harjit Panesar
Consultant
Farming and Rural Conservation Agency

Helen Parr
Woodland Officer
The Woodland Trust

Geoff Payne
Section Leader - Countryside & Fisheries
Brooksby Agricultural College

Jerry Pearlman
Solicitor to The Ramblers' Association
Brooke North Solicitors

Tony Pettitt
GIS Consultant
exeGesIS SDM

Tony Philpin
Coordinator
Pennine Way Co-ordination Project

Martyn Potton
Cartographic & GIS Services
Forestry Authority

Georgina Reynolds
Lecturer
Oxford Brookes University

Emma Rigglesworth
Assistant New Forest Officer
New Forest Committee

Dewi Roberts
Planning Technician
Snowdonia National Park Authority

Gareth Roberts
Head of Rec., Access & European Affairs
Countryside Council for Wales

Mary Anne Robinson
National Strategy Officer
Scottish Natural Heritage

Andrea Ryder
Mapping and Charting Officer
Farming and Rural Conservation Agency

Paul Smith
Map Development Manager
Ordnance Survey

Steve Smith
Computer Officer
Welsh Institute of Rural Studies

John Staniforth
Programmer
The Woodland Trust

Phillipa Swanton
Resource Planning Adviser (GIS)
Farming and Rural Conservation Agency

Dominic Tantram
Research Fellow
The Nene Centre for Research

Joe Taylor
Head Ranger
Coombe Country Park (Leisure Services)

Rhoderic Taylor
Lecturer
Reaseheath College

Jem Tuck
Lecturer Conservation Management
Otley College of Agriculture & Horticulture

Kate Van Den Ende
Technical Assistant
Snowdonia National Park Authority

Tim Warr
GIS Officer
Warwickshire Habitat Biodiversity Audit

Manon Williams
Administrative Assistant - Agriculture
Snowdonia National Park Authority

Elizabeth Woodhead
Planning Assistant
Snowdonia National Park Authority