16 Bridging the urban – rural gap: GIS and the York Environs Project

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16.1 THE YORK ENVIRONS PROJECT

16.1.1 Introduction

The York Environs Project was established in May 1991 to investigate the origins of the City of York and the relationship between the Roman, Anglo–Saxon, Viking and Medieval towns and their hinterlands. Its primary goal is to establish the landscape and social context of human activity evidenced in the archaeology of the urban centre of York and its rural environs (Figure 16.1).

The development of a Geographic Information System is considered to be central to achieving the project goals. This paper will outline the aims and strategy of the Project and describe the design and pilot implementation of the York Environs GIS. We will discuss the choice of software, availability of digital map bases for regional survey projects, and the particular problems and potentials associated with the design of a GIS which seeks to incorporate both rural and urban archaeological data.

16.1.2 Project aims

The archaeology of the Roman, Anglo–Saxon, Viking and Medieval centre of York is well known. Rescue excavations have been carried out in York by York Archaeological Trust since 1972, funded initially by the Department of the Environment (now English Heritage), but more recently by a greater diversity of funding bodies, including private developers, and now amounting to some several million pounds worth of archaeological investment. Far less is known about the surrounding region and it is widely recognised that further progress in our understanding of the development of York will depend upon examination of York's hinterland.

The York Environs Project will examine the long–term evidence for human activity in a variety of environments in the region in order to identify:

1) cultural landscapes, including chronological and regional variations in use of the landscape;
2) social interaction, including the movement of people as well as materials and artefacts between York and its hinterland.

The project seeks to correlate the range of artefacts and ecofacts and the full range of recovery techniques, enabling:

1) the definition of the range of archaeological sites;
2) the prediction of the location and survival of archaeological sites within the survey area, and the subsequent testing of these predictions;
3) the preparation of management strategies for areas and sites within the survey area;
4) the application of these approaches to areas in the region beyond the survey areas.

It will contribute directly, or indirectly, to the interpretation of the archaeological resource through:

1) producing parish–based management and research strategy documents;
2) synthetic survey, concentrating on the main research themes of the project;
3) investigating the potential for museum and other forms of interpretation.

The project will also allow for the assessment of:

1) techniques of data recovery;
2) techniques of data management;
3) relative survival of evidence;
4) relative visibility of evidence.

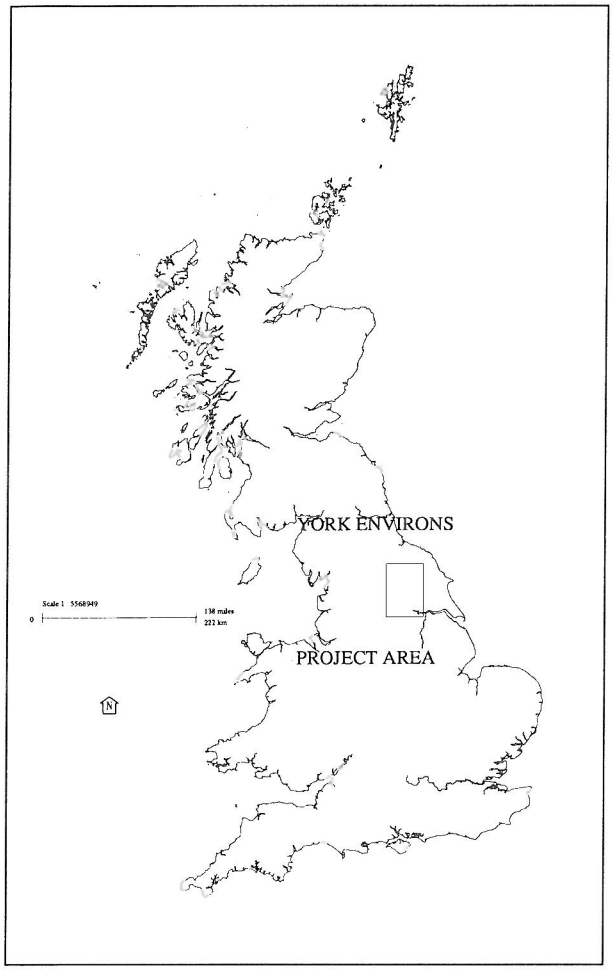

Figure 16.1: Map of UK with YEP project area indicated

16.1.3 Project strategy

The York Environs Project is intended to integrate the archaeology of urban projects within the City of York with the archaeological evidence from the region, to identify gaps in our knowledge, and to compare the past use of resources in the various landscapes in the region.

The total "Study Area" encompasses an area of over 4100 sq km with York at its centre (Figure 16.2). This runs from the Humber in the South to the North Yorks Moors in the North; from the Pennines in the West to the Wolds in the East. It includes the archaeology of three counties: North and West Yorkshire and Humberside. The area was chosen as representing those regions which naturally looked towards York for most of the period under study. Clearly, at some times the hinterland of York can be regarded as being far wider; wide–ranging international trading contacts are well–attested in the Viking Age, for instance. However, for the purposes of this project an arbitrary decision had to be taken to limit the scope of investigation, whilst providing large enough samples to permit examination of the research and management goals of the project.

Within this area, the rich farmland and former forests of the Vale of York provide just one of a number of distinctive landscapes which provided York with raw materials and which had economic and social links with the urban centre. The chalk Wolds, the sandstone and gritstone uplands to the east and west, areas of limestone and marshland, each represent resources which were utilised with varying intensity through time. Each of these areas formed a "Resource Patch" for York and the archaeology of these "Resource Patches" is one of the keys to understanding the relationship between York and its hinterland.

In each "Resource Patch" the York Environs Project will assess the nature and survival of the archaeological evidence in a sample group of ten or more parishes. Each parish assessment will comprise a brief review of the known archaeology together with visits to assess the condition of known monuments and note unrecorded archaeological finds. The opportunity will be taken to assess land use and the potential for the application of remote sensing techniques.

16.2 THE GEOGRAPHIC INFORMATION SYSTEM

We shall now outline the role and pilot implementation of the York Environs Project GIS.

16.2.1 Role

The primary goal of the York Environs Project is to examine the archaeological landscape in order to investigate the relationships between an urban core, specifically York, and its hinterland. To achieve this type of investigation we required a digital storage and display system which would:

1) Allow us to collect data for a number of geomorphologic and cultural landscapes, including both the archaeological and present–day landscape, in a variety of forms;
2) Develop a system for management of the collected data; and
3) Allow the manipulation of the collected information for the generation of graphical and statistical results of selected spatial, temporal and thematic models.

The YEP required a system whereby researchers could work at a variety of scales, primarily the "Study Area", the "Resource Patch" and the

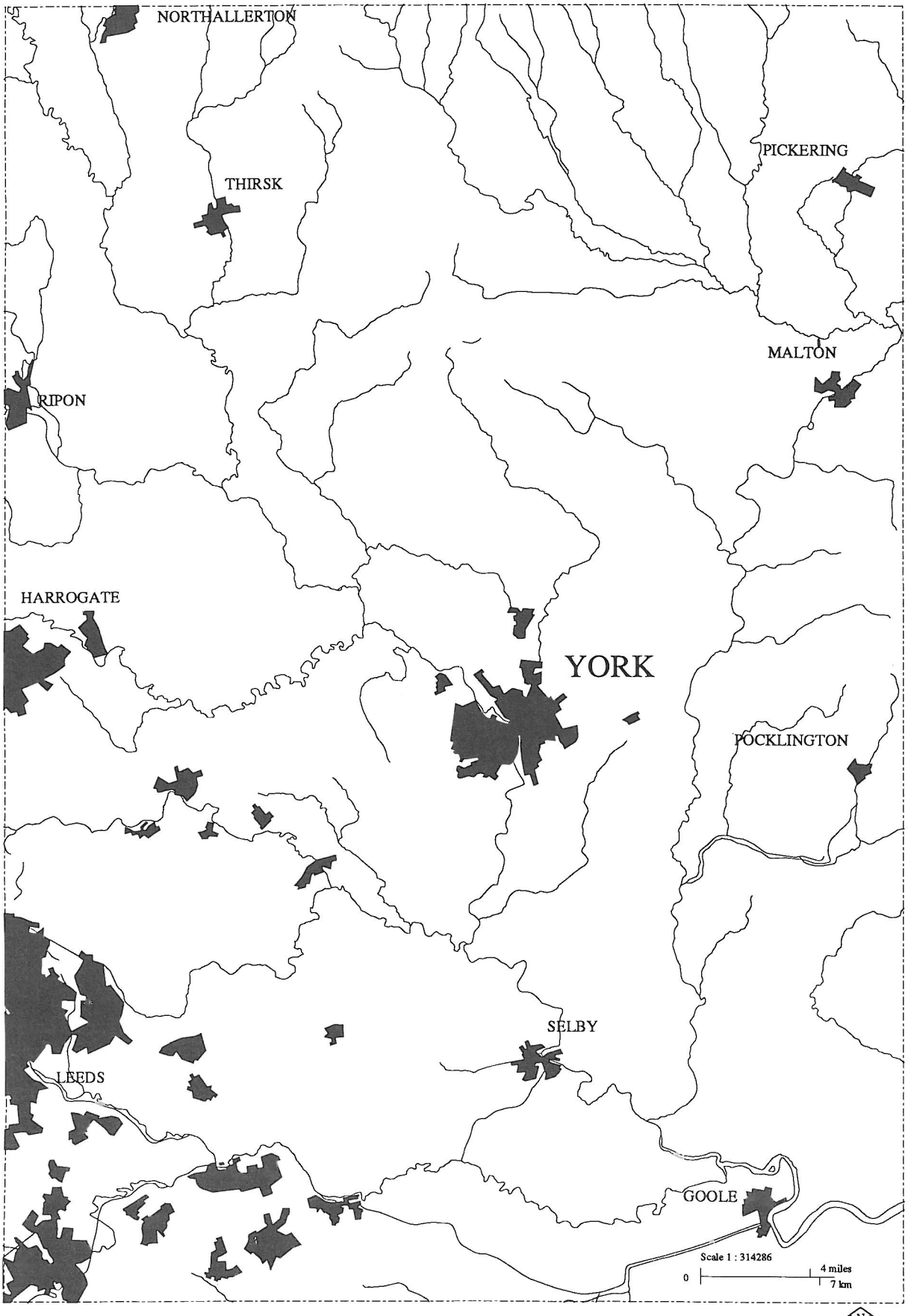

Figure 16.2: Map of YEP Study Area with Metropolitan Areas and River System

"Civil Parish", incorporating selected subsets of the urban and rural database.

16.2.2 Choice of software

Having identified the level of analysis and types of output required for the York Environs Project we set about the selection of a GIS which could satisfy the following objectives:

1) Given the three primary types of GIS (Vector, Raster and Quad Tree) and the nature of our data (point, linear and polygon) it was felt that a vector based GIS with its resolution and compact storage of digital data would best handle the types of data collected by the YEP. Vector GIS systems also utilise a traditional style of graphical output for the generation of project maps.
2) Once the type of GIS had been selected an examination of the hardware availability and platform variety was undertaken. The University of York currently has as available hardware a VAX/VMS CI–cluster including an 8550 and an 8650 processor and has recently added a UNIX based Silicon Graphics Power Server with an IRIS file server and 16 Indigo Work Stations.
3) The third criteria for the selection of the project GIS was the ability to interface with a wide variety of digital formats for both base maps and existing digital data sources. A system which would accept digital data in standard forms was essential.

After consideration of the GIS type and hardware availability, the Project chose to base its system on ARC/INFO from ESRI because of its ability to run on a variety of platforms, the existence of software interfaces to accept a wide variety of digital data formats (GBF/DIME, DLG, DXF, ETAK, IGES, MOSS, NTF, TIGER and IGDS) and its availability through the academic community CHEST purchase programme.

16.2.3 Digital map base

In order to make use of ARC/INFO it was essential that a suitable digital map base was available. It was hoped that digital coverage of the project area would be available in one of the smaller scales (1:10000 – 1:100000 range). Unfortunately at this time small scale digital coverage is not commercially available. Both the Ordnance Survey and Bartholomew's have produced commercial digital data for the entire UK at the 1:250000 scale. After consideration it was decided that this scale would be appropriate where we were working at the level of the project "Study area" as a whole.

The University of York, after consideration of cost (ca. £10000 for the OS map data verses ca. £350 for the Bartholomew's map data), selected the Bartholomew's digital UK map base at 1:250000 with coastline, urban areas, drainage systems, transportation systems, administrative boundaries (County and District), and specialised items such as national parks/National Trust, scenic areas (including SSI's) and danger zones (controlled access areas). The Bartholomew's data does not include a true Digital Terrain Model (DTM) dataset but has a partial line contour coverage available. Noticeably absent from the list of commercially available coverage's is geology (both drift and solid), current land use, and soils. Both the digital and paper map coverage for these topics is incomplete at most scales, particularly ones which would be an asset to most archaeological projects.

The York Environs Project will supplement the extant digital vector maps with both project produced vector digital coverage and raster data from LANDSAT and/or SPOT digital data (primarily as background covers). The preliminary use of the Bartholomew's data has indicated that the 1:250000 scale has definite limits in terms of reliability at the larger scales. This is particularly noticeable on complex sinuous lines such as coastlines where the long segments of the Bartholomew's digital data does not reflect the real geography. This problem is a function of the scale at which the digital data was originally entered, and until smaller scale digital maps are available it must be accepted as a limitation of commercial digital map data. A second consideration in digital map accuracy is that the Bartholomew's data was digitised from the 1928 OS maps in Cassini projection and transformed mathematically to approximate to the OS national grid UTM. This transformation introduces some register inconsistencies with the Bartholomew's digital coverage.

At the "Resource Patch", the mapping resolution chosen for the project is the Ordnance Survey 1:25000 Pathfinder series. This scale was chosen as it includes the maximum amount of information considered significant to the project aims. This OS map series is the smallest scale which includes administrative boundaries, field boundaries, and contour intervals. The OS 1:2500 scale maps will provide additional detail for selected parish–based field research. Additional digital vector data coverage's will be generated from the non–digital sources as required.

16.2.4 The databases

The issue of the dataset structure is one of the most complex issues in the consideration of designing an effective GIS for the YEP. The extant sites and monuments data for the project area is held by three separate counties. The bulk of the data is stored in an ICL system operated by North Yorkshire County Council (ca.15,000 archaeology records and ca.10,000 air photo records for the Study Area). In addition both Humberside County Council and West Yorkshire County Council have digital data on MS DOS based systems, using dBase and Superfile. To facilitate the creation of a single database we are utilising a MS DOS dBase environment to restructure the data into its optimum common denominators. This includes field splitting, field joining, field creation, field deletion and definition standardisation. The data is then transferred to the VAX/VMS system for inclusion into the ARC/INFO environment. As part of the project, fieldwork will be carried out to check the quality of the data, and the current condition of monuments recorded in the County sites and monuments records. Landscape features, such as ancient roads and earthworks, will also have to be converted into line and polygon data for work on the Resource Patches.

The project is also working with various local archaeological groups. For example, we have designed and implemented a relational database for the Yorkshire Querns Survey representing several hundred thematic records. An ongoing departmental project is recording gravestone data from cemeteries within the Study Area. Both of these projects will also be incorporated into the YEP database.

For the York urban core there is currently no SMR type database. The York Archaeology Assessment Project (English Heritage et al. 1991) compiled a database of archaeological interventions, in effect a database of deposit contacts. This comprises 1087 records held in dBase III+, and includes information about the quality and thickness of deposits, the nature of the contact, and the period of the remains. Within the York Archaeological Trust individual sites are now being recorded on computer and there is a complete index of all excavation "small finds" since 1972, which now runs to some several hundred thousand records.

We must recognise that almost all of the database information utilised in the YEP will have been at best second generation data and in some cases tertiary data. The primary issue is the problem of finding a systematic system for joining SMR type data (primarily rural based) with both Archaeological deposit models (York Archaeological Assessment) and Finds type data (York Archaeological Trust CIFR primarily urban based) which currently exist for the York urban core. The first stage of this process is to reduce the information from the three primary county systems into a unified relational database. This problem is compounded by the different data field structure and data formats as well as by definition issues such as glossary identification. To complicate the issue the data itself varies in quality from validated entries to speculative guesses with no regard to quality of data in the various databases which form the extant digital information resource.

The second stage of the process is determining a system of equating urban based finds and excavation data with rural based SMR style data. The primary issue is how to reduce to a common denominator an urban based dataset of ca. 200,000 records representing a few hundred "sites" within a small geographic spatial environment with a rural based dataset of ca. 10,000 records each representing a "site" within a archaeological landscape. This is currently an ongoing process for this project.

16.2.5 Results so far

Currently, the York Environs Project is focusing on developing the GIS for the rural area, leading to a "polo–mint" syndrome. From October 1992 a project funded by SERC in collaboration with York Archaeological Trust will be researching the use of ARC/INFO to fill the hole in the middle.

The primary focus of the rural component of the YEP has been to reconstruct the North Yorkshire data base into a form which could be incorporated into an ARC/INFO environment. This has been successfully completed and the project can now develop standard distribution plots of the data against a variety of the Bartholomew's geographical features coverage's (Figure 16.3). Problems still exist for the interrogation of variable length complex fields which use spaces for separations but progress has been made in converting these into split fields in the dBase environment. Preliminary sample distributions have been produced from attributes from single fields, multiple attributes from single fields, as well as from combinations of independent fields within the ARC/INFO environment.

The project emphasis has now shifted to the development of the structure of the unified rural/urban data base. Once this has been completed, the project can then attempt to focus upon the YEP project aims outlined at the start of this paper.

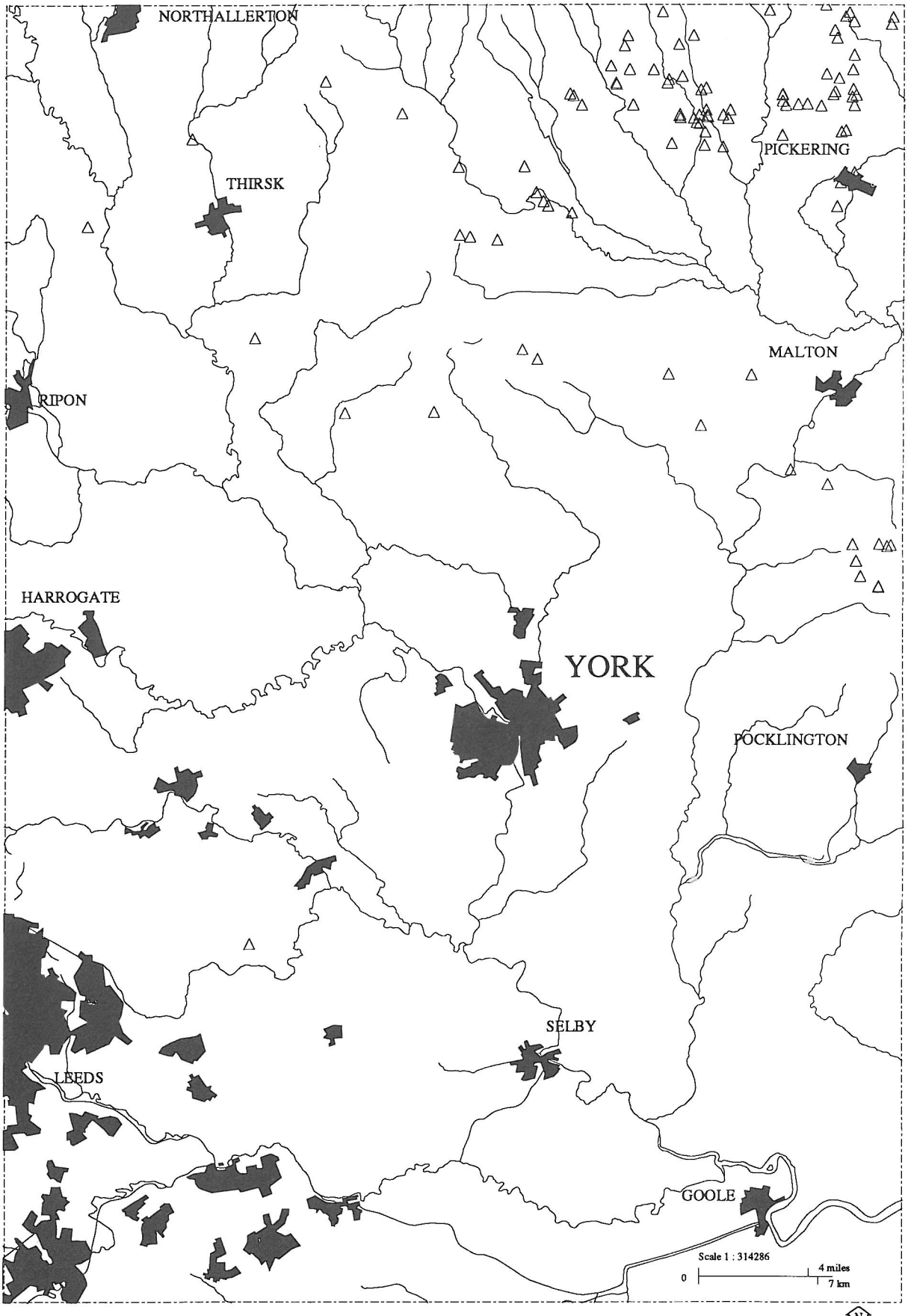

Figure 16.3: Map of YEP Study Area with distribution of Flint Arrowheads

Work on the urban core has so far concentrated on using the deposit data to generate a series of terrain deposit models for the area of the walled city, using the UNIRAS graphics system (Richards 1991). There was some experimentation on using the facility within UNIRAS to overlay a fourth variable on a terrain model to plot archaeological features, such as the Roman roads and walls, but this was of limited success.

Independently, a pilot project was carried out for us by Jillian Clark at the Department of Geography, University of Edinburgh, to investigate the potential of ARC/INFO for mapping the deposit data.

16.3 LINKING URBAN AND RURAL

We would like to conclude by raising some general issues about both the potential and problems of linking urban and rural datasets.

16.3.1 Potential

The ability to link urban and rural data in a computer–based environment has tremendous potential, which as far as we are aware has not yet been exploited by other projects. The relationship between a town and its hinterland is susceptible to examination via a map–based approach, and the power of a GIS allows us to examine a number of research questions and management issues:

1) Artefact dispersal. For example, the fall–off of material with an increase of distance from York may reflect York's role as a redistribution centre. For some periods it may also be possible to observe the movement of deposits away from the town, such as the medieval practice of manuring outlying fields with urban rubbish. York as a consumer of raw materials and finished goods should also be observable.
2) Community interaction. The distribution of artefacts will itself reflect the relationship between urban and rural populations. For historical periods, information about resource control and land ownership allows us to define precise relationships between town and country.
3) Environmental change. It should be possible to identify the effect of York on the environs, in terms of such factors as mineral extraction, woodland management, and agricultural exploitation. The environmental constraints which affected the location and growth of York can also be examined.
4) Development of Heritage Management Strategies. Parish management strategies will be designed based primarily upon the preceding research areas. From a management perspective, it is necessary to assess the management strategies for individual parishes in terms of their relationship with each other and with the urban centre.
5) Interpretation Potential Assessment. Utilisation of both research issues and management strategies will assist in the assessment of potential for museum and other forms of interpretation of the archaeological landscape focusing upon the town and country relationship.

16.3.2 Problems

The main problem addressed by our project is the urban versus rural archaeological data mismatch, in terms of both data structure and data quantity.

1) A database for urban archaeological deposits must have a special structure which reflects the unusual character of urban deposits. Landscape archaeologists have spent some time discussing how the "site" should be defined, and have resolved that it simply represents an area of the landscape where there is a relative increase in the density of activity. In the case of a town, then the complete urban core can be regarded as an arbitrarily defined singlesite, which has a number of components (Lang 1989:46). Given the density of urban activity, and the vertical build up of considerable thicknesses of deposits, it is also more likely for the same horizontal spatial co–ordinates to be the location of a number of activities separated in time (Lang 1989:45). In fact this is just a special case of the problem which faces those who try to provide a relational structure for a Sites and Monuments Record: sites often have remains representing several periods. The city of York can be considered as an example of a multi–period site. Lang and Stead (1992:73) have suggested how the relational model can help in structuring archaeological entities in a database.
2) A related problem is the difference in sample size between town and country and the sheer quantity of material that may be recorded for the town. Excavated sites may produce thousands of artefacts versus isolated stray finds in country. Nevertheless it is important to be able to link such data. As already noted, it may, for example, provide significant evidence for exchange and trade.

However, the key point to remember is that both the town and country are part of the same land-

scape. The division in the way that archaeological data is collected and stored generates a false distinction. In fact, it is rarely possible to draw a neat box around a town to define the point at which urban influences stop. In practice, there may be a number of boundaries, according to the aspect of urban life that is under consideration: craft activity, settlement, religious control, political control, land ownership, artefact fall–off etc.. Some of these will be archaeologically more visible than others, but the GIS approach adopted by YEP should allow us to identify the continuum that exists between town and country and to properly integrate this data for the first time.

Acknowledgements
The York Environs project is currently funded by the Department of Archaeology, University of York, English Heritage, York Archaeological Trust, and North Yorkshire County Council.

The authors are also grateful to a number of individuals who have so far provided assistance in developing the York Environs GIS: Jillian Clark (University of Edinburgh) for work on a pilot project; Richard Chandler for software development; Dominic Powlesland (Heslerton Project) for providing a comma–delimited file of data from the North Yorkshire CC SMR; and Peter Halls (York University Computing Service) for assistance with ARC/INFO.

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