NORTHAMPTONSHIRE PHYSIOGRAPHIC STUDY

CONTENTS

INTRODUCTION

Northamptonshire County Council, Built and Natural Environment Service have prepared a landscape character assessment model for Northamptonshire. The overall model comprises three parallel Landscape Character Assessment (Current LCA), Biodiversity Character Assessment (Biodiversity CA), Historic Landscape Character Assessment (Historic LCA) which, informed by this Physiographic Assessment and the Land Use Assessment, have been integrated to form one overarching Environmental Character Assessment (Environmental CA), as well as being capable of standing individually.

All three elements base their assessment on a single physiographic model providing a common background over which the natural environment, historic and modern land uses can be overlaid. This base model will therefore provide the reference for, and link between the three separate strands of the model.

Northamptonshire Archaeology undertook the preparation of the physiographic model on behalf of the Landscape Character Assessment Team of Northamptonshire County Council. The work was carried out between January and March 2003. This report was subject to peer review and has been edited to this final stage by the River Nene Regional Park Team for Northamptonshire County Council.

This report details the background, methodology and results of the work. It forms an accompaniment to the GIS data sets that make up the physiographic model.

BACKGROUND

2.1 PREVIOUS AND RELATED STUDIES

Various categorisations of the county's physiographic character have been undertaken over the years. These have included topographic descriptions found in the works of the early antiquarians, academic studies of particular geological features and phenomena, the preambles to archaeological, ecological or environmental reports and, most recently, the landscape assessments undertaken as part of comprehensive characterisation projects.

As a minimum, authors have generally stressed the differentiation between the 'heights' or 'uplands' at the west of the county and the Nene Valley in the centre and northeast. Steane has highlighted the early cartographers' depictions of this physical contrast (Steane 1974, 25), whilst Thompson has demonstrated antiquarian consideration of the upland areas as the principle watershed of the region – in Camden's words "the Heart of England" (Thompson 1919, 7).

Further to this bi-partite division, additional zoning of the county's physiographic character has often used historical or cultural terms to define boundaries. Modern county histories by the likes of Steane (*op cit*) and Greenall (2000) employ names such as 'Bromswold' and 'Rockingham Forest' for their natural regions. However, prior to modern landscape characterisation projects, more rigorous definitions have been lacking.

The most notable of the modern assessments was the pioneering work undertaken in the county by Holland and Field in 1928 and later developed by Beaver and Stamp as part of the Land Utilisation Survey of Britain (Beaver 1943). The survey defined 12 principle regions based upon land-use and animal husbandry but also included separate sections on the historical and geological background to the county (Appendix 1). The geological section identified a separate group of 12 regions based upon the underlying solid geology and soils but did not name them.

More recently, a county landscape assessment was undertaken in 1992 for Northamptonshire County Council and the Countryside Commission Midlands Region by Cobham Resource Consultants (Cobham Resource Consultants 1992). The report considered the geological and topographic background but did not provide a separate physiographic assessment. The assessment identified nine separate 'Landscape Character Zones' based on visual criteria. Of these nine areas, the descriptive terms for five were primarily based upon topographic criteria whilst the remaining four zone names reflected historical or cultural aspects (Appendix 1).

In 1996 English Nature and the Countryside Commission produced a map depicting the natural and cultural dimensions of the country's landscape (Countryside Agency 1999). The natural areas defined by English Nature comprised "biogeographic zones that reflect the geological foundation, systems and processes and the wildlife in different parts of England". The map defined Northamptonshire as lying within five of these zones. The Countryside Commission formulated 159 distinct character areas for the country, of which Northamptonshire occupied seven (Appendix 1).

The Countryside Commission's character areas were broad, regional areas defined by a combination of physical, historical, buildings and settlement and land-cover attributes. Stephen Warnock and the Living Landscape Project have extended this process by developing a methodology that breaks the landscape down into smaller 'building blocks' termed Landscape Description Units (LDU) (Warnock 2002).

The character assessments of the last two decades have therefore produced a range of character areas at different scales and based upon different criteria. However, their component parts are rarely presented as separate entities and it is not always easy to estimate the effect or influence of the physiographic (or indeed other) elements on the finalised areas. The current County Council approach is, therefore, in some ways a return to Stamps' Land Utilisation Survey model in that each of the contributing elements will be available as stand alone studies. The present physiographic model is one of these.

2.2 TOPOGRAPHICAL AND GEOLOGICAL OVERVIEW

Although its overall physical character is not dramatic, the county none the less exhibits distinct changes in landform (Fig 1). A broad band of undulating high ground runs around the west and northwest of the county. The highest point, situated at approximately 220m above OD, lies at Arbury Hill in the parish of Badby, halfway along this band. Around Daventry, the high ground narrows and is bisected by the Watford Gap before broadening out again into the northwest of the county. Here the highest ground reaches 210m above OD around Honey Hill in the parishes of Cold Ashby and Elkington. This rounded and undulating landscape forms the watershed for the Rivers Avon, Nene, Welland and Cherwell and as such has been described as the 'most important water parting in central England' (Brown 1911, 17). The lowest parts of the county (below 10m OD) are situated along the base of the Nene Valley where the river runs through the parishes of Yarwell, Nassington and Fotheringhay, close to the border with Cambridgeshire.

The Nene Valley itself forms a dominant topographic feature through the centre of the county (Fig 3). As it progresses through Northamptonshire, the valley broadens out significantly from about 3km wide at Northampton to approximately 5km wide around Warmington. Its main tributaries, the River Ise, Harpers Brook and Willow Brook, lead off to the north forming smaller steeper-sided valleys. The other major rivers of the region mainly influence the boundaries of the county. At the north, the southern side of the Welland valley forms a steep scarp overlooking Rutland and Leicestershire, whilst at the west the Avon marks the wide expanse of the Warwickshire clay lands. The River Tove cuts into the southwest of the county creating narrow dendritic pattern of tributary valleys.

BACKGROUND

The dominant geology across the county is the glacially deposited Boulder Clay. Large sheets of this generally chalky till remain from the Wolstonian glaciation and cover the earlier solid geologies. Further drift geologies include the sand and gravels laid down during periglacial activity. Although occurring in pockets across the county, these permeable formations are principally located along the upper reaches of the Nene between Northampton and the Watford Gap.

Four River terraces have been distinguished within the county and although their precise chronology is not certain, those associated with the River Nene have been shown to be post-glacial (Rice 1968, 350, Castleden 1980, 29). Only the first and second terraces cover any significant extent. More extensive are the alluvial deposits that occupy the base of most of the county's river valleys. These deposits are relatively recent, continuing to be laid down well into medieval times.

The earlier solid geologies of the county primarily comprise sedimentary deposits. The oldest of these strata are to be found at the west of the county, where Lias Group deposits are exposed in the valleys of the Avon and Cherwell. Here the Marlstone Rock Formation has formed an important building stone and has been quarried where locally available (Sutherland, 2004).

The Whitby Mudstone Formation clays (Upper Lias) form the second most extensive geology in the county and are mostly exposed on the uplands at the west of the county and also along the upper reaches of the Brampton Brook. Here they underlie the Northampton Sand Formation of the Inferior Oolite Group. Along with the river gravels, the Northampton Sand has been the target of the majority of quarrying activity in the county, for its famously iron rich ore. Further quarry material has been provided by the Great Oolitic Group Blisworth Limestone Formation that occupy the sides of the Nene and Tove Valleys and their tributaries, whilst the Lincolnshire Limestone Formation (Lower) in the north-east of the county has also formed an extensive source of building material over the years (Sutherland, 2004).

OBJECTIVES AND METHODOLOGY

The Assessment seeks to describe the physiography of the county by delineating areas that are defined by a common series of natural attributes. The analysis aims to be as objective as possible and work to a transparent methodology. The principles and rationale underlying the physiographic model were fully discussed in the original methodological statement (NCC 2002). In summary, Geology and Topography were considered to be the two main influences on the physiographic character of the county. The weighting to be given to these influences and their component parts were outlined, and the following order advanced:

GEOLOGY	TOPOGRAPHY
Solid Geology	Altitude or Elevation
Drift Geology	Angle or Slope gradient
Soils	Aspect or Attitude

Primacy was given to the underlying rock formations since it was from these that soils were derived and the topography formed. It was considered that in each case the surface geology was the most significant to understanding physiographic form and so no attempt was made to factor in the deeply stratified geological deposits. Other influences, such as that of ground water were considered but not thought necessary for the basic physiographic model. It was suggested that these additional data could be tested at a later date.

The method for forming the model comprised assembling the data sets corresponding to the geological and topographic influences and then using MapInfo GIS system to map areas based upon pre-determined combinations and weightings of these data.

In practice the process had four stages:

1) Data preparation and evaluation.
2) Formulating descriptions of the physiography based upon those data.
3) Using the query functions of MapInfo to map the areas.
4) Testing the model.

3.1 DATA PREPARATION AND EVALUATION

A full list of the data reviewed or used in the preparation of the physiographic model is presented in Appendix 2.

Geology

Geology data were largely taken from Northamptonshire County Council's digitised versions of the British Geological Survey's Solid and Drift paper maps. However, as the available maps did not fully cover the whole of the county these were supplemented in the later stages of the project by DigMapGB-50, the Geological Survey's new 1:50000 digital series. Although the NCC's geology data was separated into individual tables, under the terms of the BGS license all objects within each table were linked and therefore needed editing before they could be used within the physiographic model

Soils

Generally speaking, the soils throughout the county directly reflect the underlying geology. Where they do not, it is usually as a result of modern man-made activity and landform alterations. As such, although they formed a useful test and corroboration for the physiographic areas, it was not felt necessary to use them directly in the formulation of the descriptions. Consequently only a paper copy of the 1:250000 Soil map was referenced (Soil survey of England and Wales, 1963).

Altitude

Information was taken from the OS Contour data set (contours at 10m intervals). To make it useable, the line data were transformed into closed polygons and divided into separate tables. Once this was done, data were combined to form tables with other ranges of contour values such as 20m and 30m.

Gradient

A generalised map of gradient was formed using the OS contour data. A grid comprising 500m grid-squares was placed across the county and the number of 10m contour bands that crossed each grid-square was counted. Each band was only counted once within each grid-square. The resulting table produced a measure of steepness ranging from 1 (flat) to 7 (steep).

A measure of ground 'undulation' was also attempted whereby the number of repetitions of contour bands within a grid-square was counted. This was only undertaken using 5km grid-squares, which proved too generalised to be useful. A more detailed version using the 500m grid is being prepared and may be tested against the provisional physiographic model at a later date.

Aspect

Initial investigation suggested that Aspect could only be usefully coded at a micro level (possibly within individual land parcels) and was therefore not useable at the more generalised level required for the physiographic model. Indeed, the Aspect distinction between physiographic areas is probably self-evident without the need for coding. It is envisaged, however, that some form of these data will be produced at a later date to test for their usefulness.

3.2 FORMULATION OF DESCRIPTIONS

After the data sets had been assembled and edited so that they could be used effectively within MapInfo, it was necessary to formulate descriptions of areas based upon those data. Firstly a hierarchy of physiographic areas was compiled. These areas were then defined in terms of the existing data sets and finally 'queries' were devised that could be used within MapInfo GIS.

The process entailed breaking down the physiography of the county into component parts and then re-assembling those elements into the physiographic areas. This had the advantage that if different criteria were introduced or different weightings applied to the data the basic building blocks could be re-assembled in different ways. In this respect the modelling formed a 'repeatable' process.

As a start, it was taken that the county could be divided into three basic areas: the River Valleys, the flat Plateaux and the Upper Ground. These three main terrain types were then subdivided. The river valleys could be divided into their component parts (Valley Floor and Valley Side) whilst the upper ground and the plateaux were subdivided according to geological type. Further sub-divisions were possible based upon contour heights.

Plateaux: Plateaux were defined as continuous areas of flat ground comprising either clay or limestone.

Gradient: Steepness< = 2
Geology: Boulder Clay OR Oxford clay OR Lower Lincolnshire Limestone OR Great Oolite Limestone
Altitude: N/A

Valley Floors: Defined as flat areas of ground, containing the river itself and composed of Alluvium and river terrace gravels.

Gradient: Steepness< = 2
Geology: Alluvium OR 1st Terrace OR 2nd Terrace OR 3rd Terrace.
Altitude: (30m contour bands used to subdivide the valleys)

Valley Sides: Valley sides were initially described purely in terms of their gradient, since their geologies varied so much across the county. The different geologies were subsequently used for subdividing the category.

Gradient: Steepness> = 4
Geology: (geology used as subdivisions)
Altitude: N/A

Upper Ground The Upper Ground was perhaps the most nebulous of the areas to define. Since there was some overlap with the descriptions for valley sides, the Upper Ground areas were defined last and excluded the previously defined Valley Sides.

Gradient: N/A
Geology: Northampton Sand Ironstone OR Upper Lias OR Middle Lias and NOT Valley Sides
Altitude: > = 70mOD

3.3 RUNNING THE QUERIES

Since geology was considered the dominant influence on the physiography, it was decided that geological divisions would form the boundaries to each area. However, this raised two potential issues. Firstly, these divisions are 'sharp' whilst in reality areas tend to merge, one with another. Secondly, geologies often form large blocks of ground that extend through more than one area often with smaller outcrops of other exposed rock formations.

The sharpness of the divisions was not considered a problem. The physiographic model will form the basis upon which the other characterisation elements (natural and cultural) will be placed. These elements will form their own boundaries, which will need to be merged with the physiographic areas. Thus the 'blurring' of the lines will come at a higher level within the characterisation process.

With regard to the extent and distribution of the geology, since characterisation is a generalising process, it was necessary to exclude or merge unrepresentative areas. Therefore, the second issue was approached by developing a set of 'rules' about 'what to include' and 'what not to include'.
In order to exclude small non-continuous outcrops of rock, it was decided that criteria for size and extent would be employed. Patches of geology under 500 hectares or below 50% of the area under consideration were excluded. Thus with the Clay Plateaux,

areas were removed if they were simply 'small' patches of Boulder Clay or if more than half of their area had a steepness greater than 2. With regard to River Valleys, Valley Floors less than 2km long were also removed so as not to have a myriad of small streamlets.

It was decided, wherever possible, that the physiographic areas should be geographically continuous and no artificial divisions should be placed across the geological boundaries. For the purpose of the model, 'continuous' was defined as areas of geology less than 50m apart. This figure was chosen so as to accommodate the fact that the numerous small streams that cut through the geology would otherwise create too many unrepresentative divisions.

A single exception was made to this rule. With Valley Floors, contour heights were used to create the divisions. This was done because if based solely upon their geology all river valleys would be single, continuous entities and different sections could not be defined.

3.4 TESTING

The original model was subject to peer review, and sent to interested parties, and comments received on these and other data sets, were used to test the model.

RESULTS

THE PLATEAUX (FIG 2)

Eight areas of Clay Plateaux and two areas of Limestone Plateaux were derived from the modelling.

The clay plateaux can be divided into three principle areas based on their location and form. All are primarily composed of sheets of glacial Boulder Clay. CP1, CP 2 and CP7 lie along the southern part of the county adjacent to the county boundary. Together CP1 and CP2 form the northwest extent of the area historically known as Bromswold. All three areas overlook the Nene River Valley and are for the most part not dissected by smaller tributary streams.

The second group comprise CPs 3, 5, 6 and 7, which form the high flat ground between the tributary valleys for the Nene and Welland rivers. The third area is represented by CP8, which largely covers the historic area of Whittlewood. CP8 is more heavily bisected by streams than the other areas and its discontinuous nature makes it the least 'plateau - like' of the examples.

There are two major areas of flat limestone tableland, situated at opposite ends of the county. LP1 is located at the extreme northeast of the county and overlooks the steep Welland Valley at the west. This area comprises Lower Lincolnshire Limestone. LP2 is located at the southwest end of the county and is made up of a flat area of Great Oolitic Limestone.

THE UPPER GROUND (FIG 3)

The physiographic model highlighted three areas of Ironstone Upper Ground and five areas of Lias Upper Ground.

The two areas of Ironstone Upper Ground are situated adjacent to each other in the centre of the county. IUG1 overlooks the Nene Valley at the south, the Brampton Brook at the west and the Ise Valley at the east. It is separated from IUG2 by Clay Plateau CP5. Both areas are traversed by the upper narrow valleys of the tributary system.

Although the model generated five areas of Lias Upper Ground, in effect the areas are more or less contiguous. They occupy a broad band running down the west side of the county that includes the area that has been traditionally described as the Northamptonshire 'Uplands' or 'Heights'. LUG1 forms a continuous block south of the River Nene whilst LUG2 – LUG5 are located to the north of the valley.

THE VALLEYS (FIG 4)

Valley areas formed the most numerous divisions within the physiographic model. A total of eighteen separate valley sides were generated whilst the valley floors were subdivided into six divisions.

The majority of the valley sides are associated with the River Nene and its tributaries. However, the other river systems that impinge upon the county are also represented. VS1 defines the southern side of the Welland Valley, whilst VS16 forms the upper reaches of the River Tove. The valleys of the Avon, Leam and Cherwell, which run down the western side of the county, are shown as the broad swathe of VS18, whilst VS4 and VS17 represent the upper valleys of various tributaries of the Great Ouse.

The remaining Valley Sides belong to the River Nene. Due to the differing geologies exposed throughout the county, the physiographic model generated a variety of areas. Because of this, certain of these have been grouped together since either geographically or based upon their underlying geologies they appear to form common areas. On the final model the groupings are identified by colour.

- VS2, VS3 and VS5 – VS8 have been grouped together since they form the main valley sides of the lower part of the River Nene.
- VS9 -VS13 form the central section of the River Nene along with the River Ise and the Brampton Brook.
- VS14 forms the western arm of the River Nene. It generally comprises glacial gravels.
- VS15 forms the extreme upper reaches of the River Nene at the west of the county.

The valley floors were subdivided using 30m contour bands. This produced a sequence of six divisions, however VF5 and VF6 are not very extensive and are barely recognisable at a county scale. VF1 – VF4 appear to mark out the major stages of the rivers. For the Nene this essentially creates a tripartite division with its lower reaches running from Yarwell to Wellingborough, its middle stretch running from Wellingborough to Northampton (and including the lower parts of the Ise and Brampton valleys) and its upper stretch from Northampton to Badby and Watford. The numbering sequence (VF1 –VF6) was applied collectively to all the river systems in the county since their clearly separate geographical positions appeared to distinguish them sufficiently.

DISCUSSION

During the creation of the physiographic model a number of factors became evident. Firstly the effect of topgraphic and geological features from neighbouring counties is quite significant. Certainly, the Welland and Avon valleys show up as distinct areas in the final model (Fig 5). This emphasises the fact that the county boundary is an artificial division and that any subsequent revision of the physiographic model may benefit from including a wider spread of data sets.

Secondly, due to the nature of the original data sets, all editing of the model was done 'by hand'. The acquisition of new digital geological data for the county has made it easier to select and edit elements within the maps, and may also allow for a wider choice of parameters to be employed in the future.

Finally, although the decision to use geological divisions has led to 'sharp' boundaries, it should be considered that the working scale of the map is probably around 1:50000.

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ILLUSTRATIONS

APPENDIX 1

LANDSCAPE AREAS USED BY OTHER CHARACTERISATION PROJECTS

LAND UTILISATION SURVEY

North-Eastern Mixed Farming region
Rushden-Oundle Boulder Clay Region
Rockingham Forest
Limestone Arable Region
Central Arable Region
Nene Pastures
Central Mixed Farming Region
Leam-Avon-Welland Pasture Lands
Western Pastoral Uplands
Cherwell Ridge and Valley Region
Wold Arable Region
Cherwell Valley Pastures

COBHAM

Western Uplands
Upper Valleys
Welland Valley
Middle Nene Valley
Eastern Fringes
Urban Areas
Salcey Forest and Yardley Chase
Rockingham Forest
Whittlewood Forest

ENGLISH NATURE

Midland Clay Pastures
Rockingham Forest
West Anglian Plain
Cotswolds
Yardley-Whittlewood Ridge

COUNTRYSIDE COMMISSION

Bedfordshire and Cambridgeshire Claylands
Northamptonshire Vales
Yardley-Whittlewood Ridge
Rockingham Forest
Northamptonshire Uplands
Dunsmore and Feldon
Cotswolds

APPENDIX 2

DATA USED OR REFERENCED DURING CREATION OF THE PHYSIOGRAPHIC MODEL

NAME	ORIGINATOR	HELD BY	DETAILS
Landline	OS	NCC	County mapping, Ref NOR170, Issued 04/011/02
Spot Heights	OS	NCC	Spot heights across county, Ref NOR168, Issued 10/09/02
Contours	OS	NCC	County 10m contour map Version 1, Ref NOR124, Issued 26/04/99
Geology	Northamptonshire Heritage	B&NE	County geological data digitised from paper maps by Northamptonshire Heritage
DigMapGB-50	BGS	B&NE	Digital data sets of county geology
Sheet 3 Soils of Midland and Western England	SSEW	B&NE	1:250000 paper map of region's soils
Steepness	B&NE	B&NE	Map of steepness across county derived from OS Contours
Undulation	B&NE	B&NE	Map of undulation across county derived from OS Contours
Contours 10m [20m][30m]spacing	B&NE	B&NE	OS Contours map separated into individual polygons and tables

ABBREVIATIONS

B&NE: Built and Natural Environment, Northamptonshire County Council
BGS: British Geological Survey
NCC: Northamptonshire County Council
OS: Ordnance Survey
SSEW: Soil Survey of England and Wales

FIGURES

PLEASE REFER TO THE DOCUMENT **'NPS - FIGURES 1-5'**.