ASSESSING THE STATUS OF DRAINAGE IN THE UK:

A Case Study of the Avon, Eden and Wensum DTCs and their representativeness with regional and national patterns.

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NATURAL ENVIRONMENT RESEARCH COUNCIL

Agricultural drainage in England and Wales

Field drainage in Britain dates back to Roman times but it was only following the Second World War with mechanisation and extensive government grants that it became widespread. The provision of grant-aid by the Ministry of Agriculture, Fisheries and Food (MAFF) for drainage schemes and the need for farm visits by ADAS Drainage and Water Supply Officers (DWSO) for prior-approval created a system of centralised technical information on drainage schemes that could be used to generate reliable statistics, since the majority of schemes would have received government grants. Prior to 1971 records were only collated at the MAFF Division level. During the 1970s detailed records were collected at the parish level and held on computer. Subsets of these data have been published (Green, 1973; Armstrong, 1981). This was a time of great agricultural prosperity, with an estimated drainage rate in England and Wales of over 100,000 ha per year for much of the 1970s. Subsequently the rate of drainage declined in the 1980s to almost negligible levels by 1989 as the most suitable areas requiring drainage for effective farming had been drained and concerns were growing about excess agricultural production and reforms of the EU Common Agricultural Policy led to the reductions in support to farmers. The requirement for prior approval was abolished from May 1980 and detailed records became increasingly less complete.

As a part of an investigation into the potential link between agricultural drainage and downstream flooding, the River and Coastal Engineering Group of MAFF's Land and Water Service commissioned an independent study by the Institute of Hydrology (IH), which is now part of the Centre for Ecology and Hydrology (CEH). In order to conduct this study, a copy of these parish data was supplied to IH to match drained areas to catchment flood records. These spatial data were combined with the results from field experiments and studies of arterial drainage (Robinson, 1990; Robinson and Rycroft, 1999).

Data provenance

Parish drainage statistics were supplied by the MAFF statistical records section at Guildford in 1983. These covered the 10 year period from 4/1971 – 3/1981, henceforth called 1971-80, and relate to about 120,000 individual schemes with an average size of 6.85 ha.

These data comprised grant-aided drainage scheme information for over 11,200 parishes in England and Wales. Also provided were the total parish sizes and 4-digit grid references of the parish centroids, providing location information in 100 km^2 squares. The average parish size was approximately 9.5 km^2.

Two sets of checks and amendments then had to be made before these data could be used by CEH.

Firstly, although the parish grid references were adequate for national or county statistics they are too coarse for hydrological studies of small catchments, and some

parishes had no corresponding grid reference. All parishes were given 8-digit grid references obtained from the Ordnance Survey, and locating parish centroids to within a 1 km^2 square. It should be borne in mind that at that time agricultural data referred to the parish containing the registered farm office and not the individual field, so setting a lower limit to the accuracy of the spatial that can reasonably be applied.

Secondly, the period spanned local government reorganisation in 1974 with substantial changes to county boundaries and the resulting changing of county parish identification numbers, in addition to the abolition/creation of some parishes. Although MAFF in 1974 re-assigned the pre-reorganisation drainage data to the new parish numbers, some DWSOs continued to use the old parish numbers to record new schemes after reorganisation, and these were not identified as invalid parishes on the MAFF storage system. The Ordnance Survey's Boundaries Section provided information on the parish changes, enabling these 'orphan' drainage schemes to be assigned to the correct parish.

Although MAFF agreed these corrections were appropriate, they could not be incorporated back into the MAFF records since they had already been published in outline form and could not subsequently be changed. Consequently there will be some differences between these data and those held and supplied by MAFF, and consequently to avoid confusion they are referred to in this Report as the 'ADAS/CEH' parish records.

Maps of these data and further background information were published by MAFF (Robinson and Armstrong, 1985) and in peer-reviewed scientific journals (Robinson, 1986; Robinson and Armstrong, 1988).

National and regional pattern of drainage

It is well known that the pattern of drainage in England and Wales is heavily weighted towards the arable farmland of lowland eastern England dominated by cereal production (Coppock, 1976). It is in these areas that the economic advantage of extending the growing season is so great that drainage became an essential part of continuous arable cultivation. In contrast the higher rainfall western and northern areas are predominantly grassland where farm incomes are lower and drainage provides relatively less of an economic advantage.

The ADAS/CEH parish data confirm this broad pattern and provide a great deal of extra spatial detail (Figure 1). This includes the concentration of drainage works in the Boulder Clay plateau of East Anglia and the London Clay land of Essex as well as in the silt and peat lands of the Fens where intensive production is totally dependent upon drainage systems.

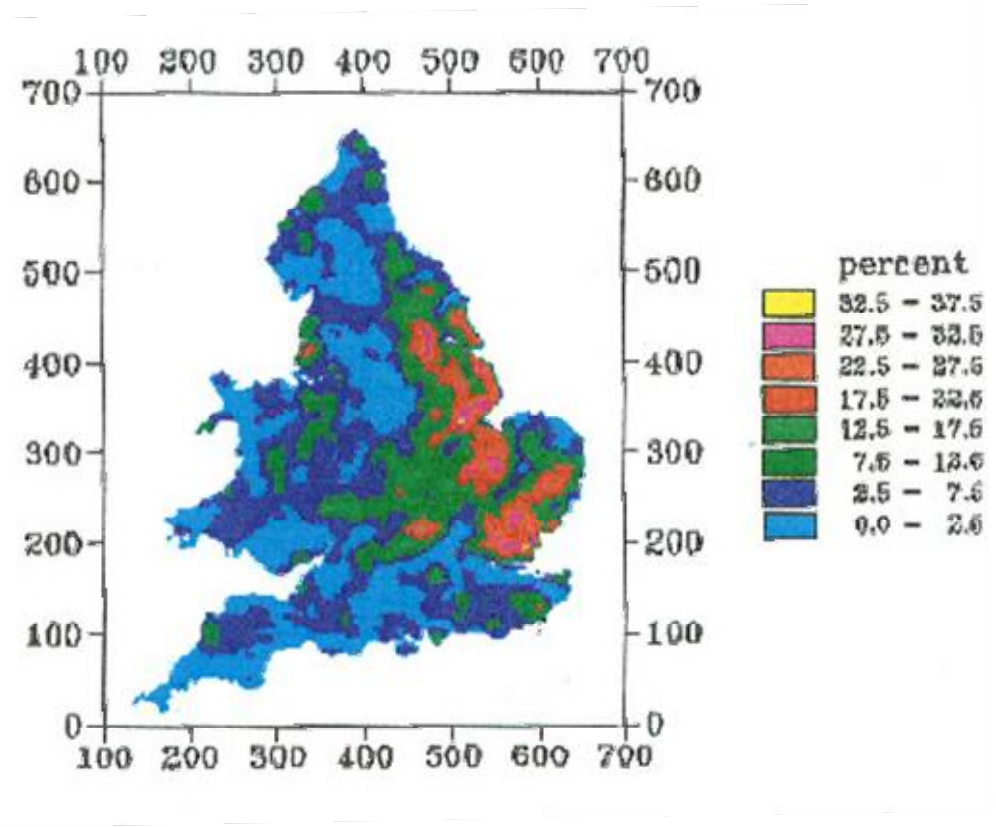

Figure 1: Percentage of agricultural land drained 1971- 80.

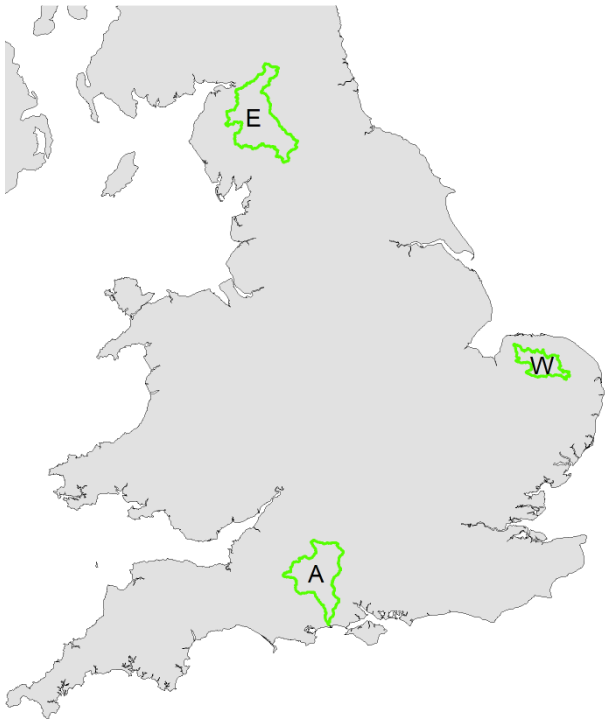

Figure 2: Location of the Demonstration Test Catchments. A= Avon, E=Eden, W=Wensum

Drainage in the Demonstration Test Catchments

None of the Demonstration Test Catchments (DTCs) lie in the areas of highest drainage (Figure 2). The Avon lies wholly in an area of low drainage, the Wensum is on the northern edge of moderately high drainage, and the Eden is intermediate in drainage activity.

The extent of drainage, 1971-80, in the three DTCs is summarised in Table 1 in comparison to the overall pattern for England and Wales.

Table 1: Cumulative percentage of parishes within each catchment with less than 4% of the parish area drained, and percentages of parishes with over 5% drained.

Area Drained	Cumulative percent			
	Avon	***Eden***	***Wensum***	***E & W***
0%	59.7%	9.6%	22.5%	**17.3%**
<1%	77.3%	24.5%	31.0%	**29.1%**
<2%	87.4%	38.3%	36.6%	**38.6%**
<3%	90.8%	59.6%	42.3%	**46.5%**
<4%	95.0%	71.3%	47.9%	**52.9%**
>=5%	2.5%	20.2%	45.1%	**42.3%**
>=10%	0.0%	6.4%	22.5%	**26.4%**
>=20%		0.0%	7.0%	**11.9%**
>=30%			4.2%	**5.1%**
>=40%			0.0%	**2.1%**

Given the known limitations of the parish data it would not be wise to read too much into individual parish drainage figures. However, with that caveat, some broad patterns may be observed in the catchment data.

The Avon catchment is in an area of low drainage activity, despite the importance of arable crops, with almost 60% of parishes in the catchment having no drainage recorded in the period. The parish drainage values (Figure 3a) are uniformly low values in this area of very high permeability geology (Figure 3b).

The Eden catchment has a higher, but still modest drainage activity, in this area of predominantly grassland. The higher values (Figure 4a) tend to be associated with the areas of low permeability bedrock in the west (Figure 4b) and areas covered by Boulder Clay and by peat in the north.

The Wensum is an area of arable cultivation and has the highest drainage activity of the 3 DTCs, with a similar profile to the national average (Table 1). Drainage in the catchment (Figure 5a) shows little relation to geology (Figure 5b) and is instead likely to be related to superficial glacial deposits.

Figure 3a: Avon parish drainage

Figure 3b: Avon geology ***(British Geological Survey datasets. © NERC. Based upon © Crown Copyright 100017897 2005).***

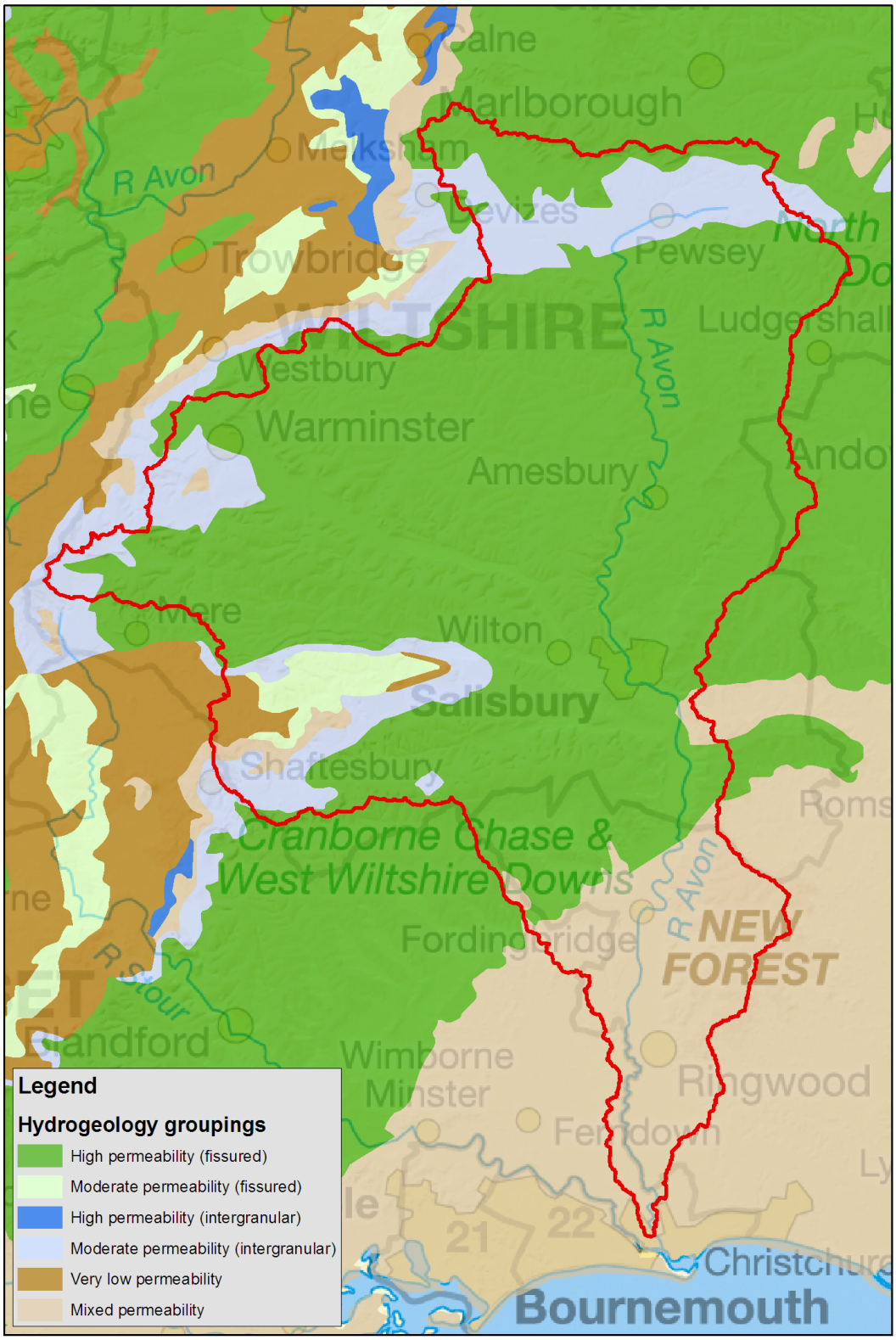

Figure 4a: Eden parish drainage

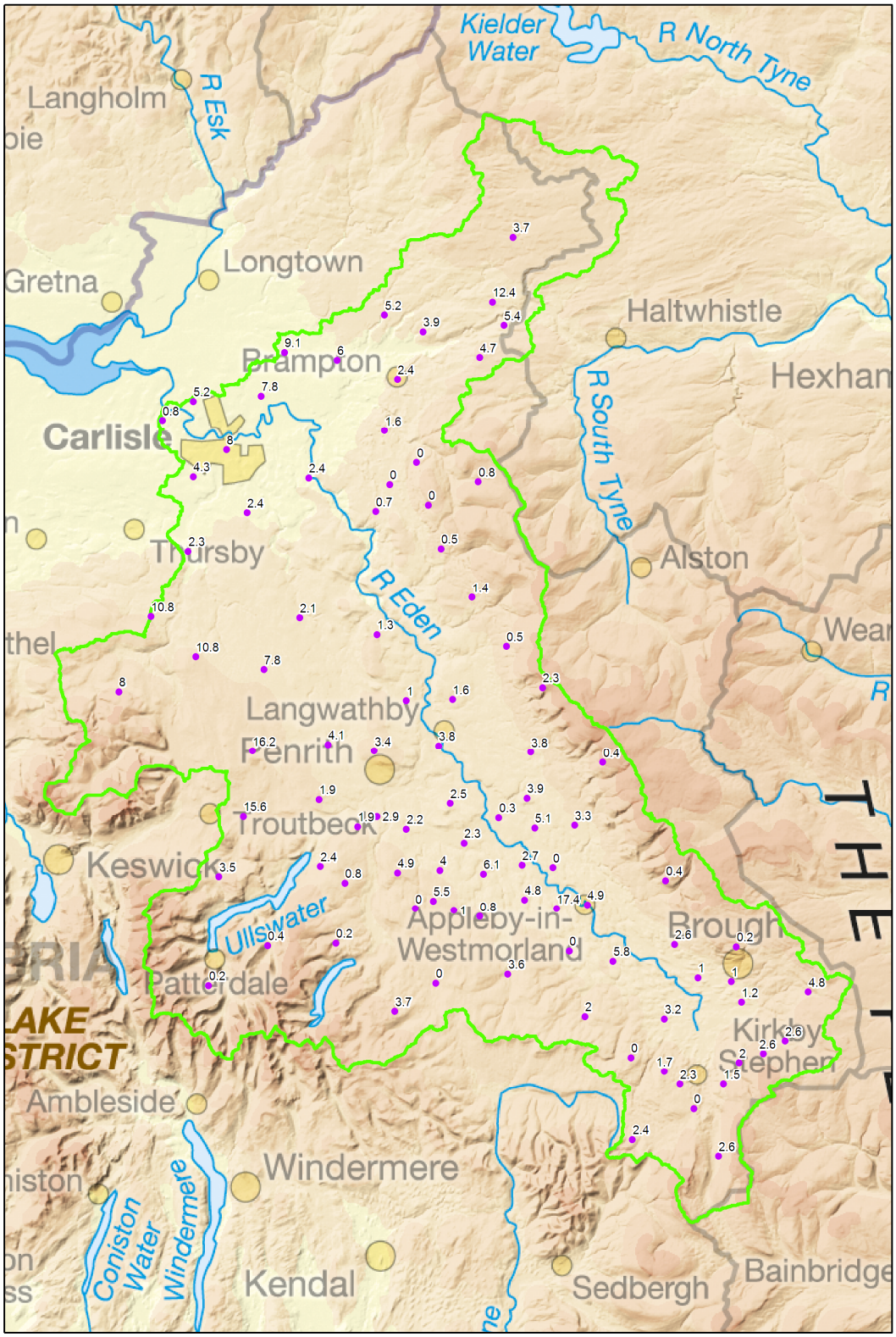

Figure 4b: Eden geology ***(British Geological Survey datasets. © NERC. Based upon © Crown Copyright 100017897 2005).***

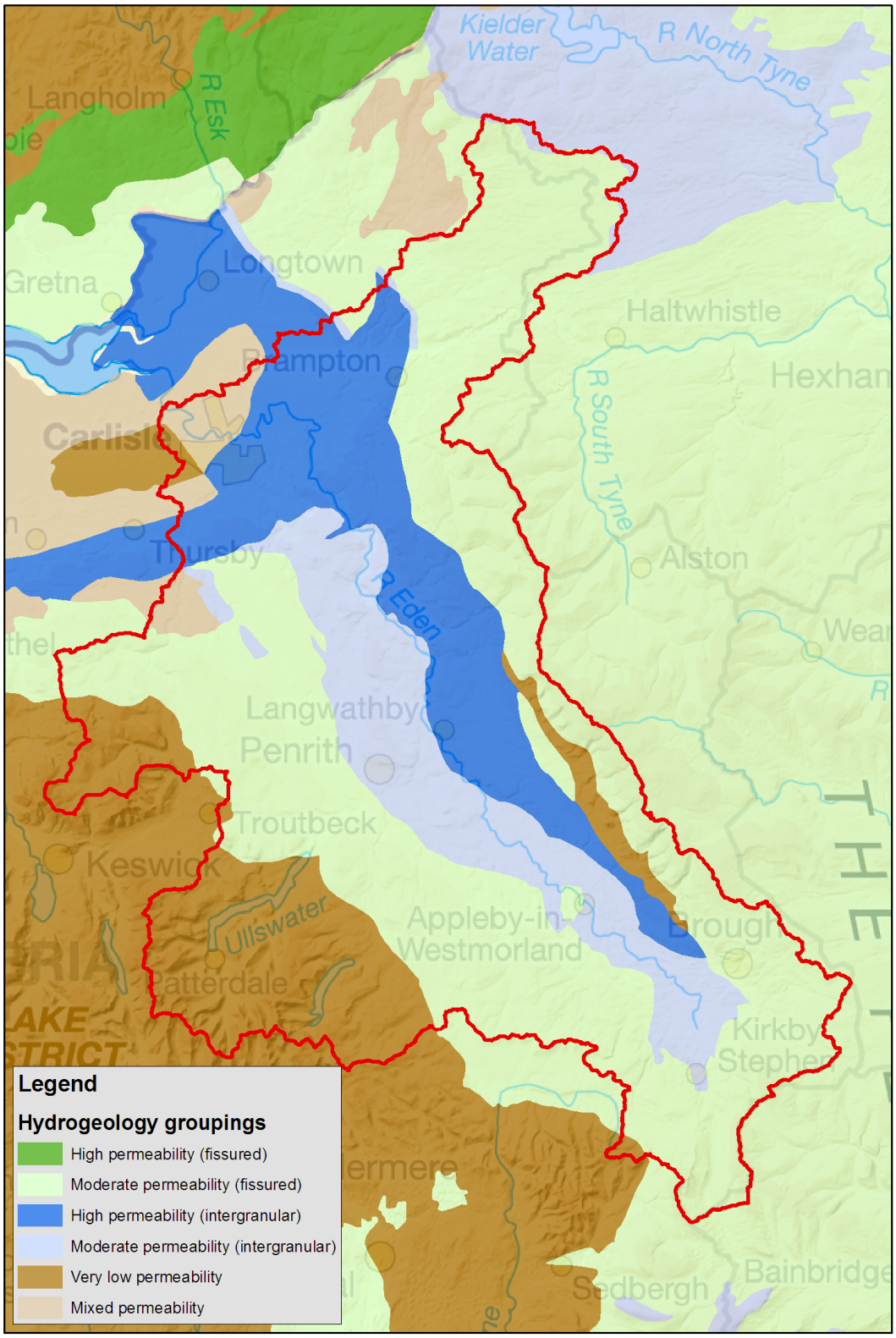

Figure 5a: Wensum parish data

Figure 5b: Wensum geology ***(British Geological Survey datasets. © NERC. Based upon © Crown Copyright 100017897 2005).***

Conclusions and summary

The ADAS/CEH parish drainage data for 1971-80 indicate that Demonstration Test Catchments do not encompass any of the known drainage 'hotspots', although the Wensum has a drainage profile that almost matches the national average. The Avon had little drainage due to its high permeability chalk geology and the Eden has a mostly grassland economy.

References

Armstrong, A.C. (1981) *Drainage statistics 1978-80*. Field Drainage Experimental Unit Technical Report 80/1.

Green, F.H.W. (1973) Aspects of the changing environment. *Journal of Environmental Management*, 1, 377-391.

Coppock, J.T. (1976) *An agricultural atlas of England and Wales*. Faber and Faber. London. 267pp.

Robinson, M., Armstrong, A.C. (1985) Maps of underdrainage, 1971-80. Land and Water Service, Research and Development Report RD/FE/28.

Robinson M (1986) The extent of farm underdrainage in England and Wales, prior to 1939. *Agricultural History Review*, 34, 79-85.

Robinson, M., Armstrong, A.C. (1988) The extent of agricultural field drainage in England and Wales, 1971-80. *Transactions of the Institute of British Geographers*, 13(1), 19-28.

Robinson, M. 1990. Impact of improved land drainage on river flows. *Institute of Hydrology Report 113*, Wallingford, 226pp. (www.ceh.ac.uk/products/publications).

Robinson, M., Rycroft, D.W. 1999. The impact of drainage on streamflow. Chapter 23 in: Skaggs, W. & van Schilfgaarde, J. (eds) *Agricultural Drainage*. Agronomy Monograph 38. American Society of Agronomy, Madison, Wisconsin. pp 753-786.