

REPORT

Trent valley geology and flooding

In November 2000, major flooding affected the whole of the Trent valley, as well as its larger tributaries such as the rivers Soar, Derwent and Dove. It was the type of flood estimated to occur about once every 50 years (the 'return period'), although it was of slightly lesser magnitude than that of 1947 (source: the Environment Agency). The media gave much prominence to the consequences of this event, emphasising the severity of the damage caused where flood protection was inadequate or non-existent. Housing and farmland were inundated, and important communication routes (Fig. 1), which should have been defended against flooding, were disrupted for days afterwards. The floods occurred as the Midlands region was experiencing its wettest autumn on record, receiving 214% of the normal October rainfall (source: The Meteorological Office), and this after the ground was saturated following an abnormally wet September. But geology also played a role in determining the extent of the flooding.

In the catchment areas much of the terrain consists of mud-rich rocks of Carboniferous, Triassic and Jurassic age, covered by expanses of Quaternary till (boulder clay). These impermeable clay substrates have minimal capacity for retaining or absorbing the water, and in combination with an efficient field and urban drainage network this contributed to the extremely rapid rates of runoff to the valley floor.

On the floodplain the permeable Quaternary alluvial deposits, that normally act as 'sponges' during elevated seasonal rainfalls, became saturated. With the water table at or near the surface, and the main river channel filled to capacity and overflowing its banks, the entire floodplain was now fulfilling its natural function of accommodating excess runoff and widespread submergence was inevitable. By November 9th, when the flood-peak was at Newark, the whole of the Trent floodplain had been converted into an extremely long ribbon lake.

It is an oversimplification to say that every part of the Trent floodplain was devastated. Man-made defences, such as embankments, embanked canals and raised urban sites, saved many parts from inundation although probably contributing to constriction and ponding elsewhere. Parts of the valley also remained dry due to protection afforded by the natural topography inherent in the floodplain. This topography was determined by the complex geological and geomorphological history experienced by the Trent drainage system (Posnansky, 1960; Brandon and Sumbler, 1988) since its inception following the retreat of the Anglian ice-sheet about 425,000 years ago.

A good illustration of the way that geology influences floodplain topography, and hence determines flooding limits, is the Trent valley around Gunthorpe and Caythorpe, about 10 km due east of Nottingham. In the photograph of this area (Fig. 1), the dry land closely corresponds to outcrops (Fig. 2) of sand and gravel belonging to the Holme Pierrepont Terrace of Charsley et al. (1990). These deposits were originally part of the active Trent floodplain as it was about 26,000 years ago (Brandon, 1996), but since then the East Midlands region has experienced gradual uplift. As a result the Trent channel cut down into its earlier floodplain, dissecting it into remnants that in the case of the Holme Pierrepont Terrace now stand up to 2.5 m above the alluvium of the modern floodplain (Howard et al., in prep.). Geologists working at times of normal river flow can map out the modern floodplain alluvium boundaries (Fig. 2) by observing the commonly subtle feature that marks the slope-change surrounding the older and more elevated river terrace deposits. On the rare occasions when the whole of the modern alluvial tract is under water, a rather different perspective is presented, and it is the actual 'water line' of the maximum flood limit that forms an easily observable division between the low and the relatively higher parts of the floodplain (Fig. 1).

Can geological maps make a contribution to flood-risk assessment?

This question can be addressed by showing just one of the many examples of places where the mapped boundary of the modern alluvium (Fig. 2) corresponded closely to the maximum extent of the November floods (Fig. 1). Caution must be exercised, however, because man-made barriers, such as large housing estates or embankments, either existing or planned for the future, can cause the waters upstream to pond and expand beyond the natural floodplain limits represented by the alluvium boundary. Furthermore, the modern alluvium boundary is a subtle, feather-edge that represents only the preserved deposits of maximum flood events – the floodwaters that laid down the alluvium could have travelled further than the actual deposits left behind. For this reason historical accounts of past flood limits, and predictions as to the effect of future infrastructure development on flooding, must also be considered.

Geological maps nevertheless explain the reasons behind topographic variation on floodplains, so providing essential earth-science data that underpins historical and topographically-based flood-risk assessments of the type issued by the Environment Agency. Geological maps are also versatile; for example, there are digital versions that can be combined with DTM's (Digital Terrain Models of topography), or air photographs, to produce on-screen 3-dimensional manipulations of floodplains and their catchment areas. It is the integration of

such information, including geology, which enables a holistic approach to be made to the problem of constructing models for accurately predicting the effects of future floods.

References

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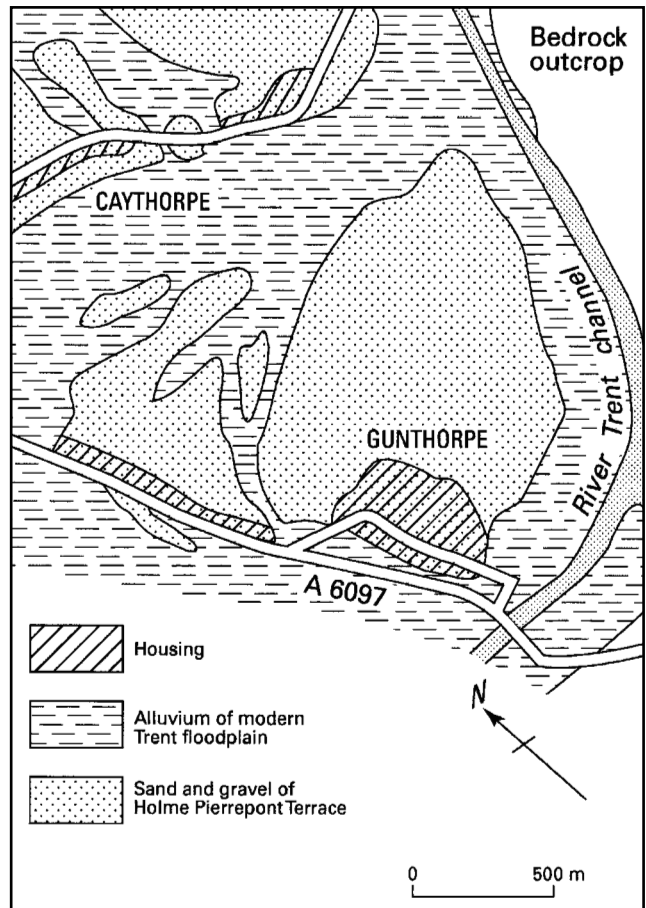


Figure 1. Aerial view of the Trent valley between Gunthorpe and Caythorpe (SK680450) looking downstream, towards the northeast, at midday on November 9th, 2000. (Photo: A. Forster, BGS).

Figure 2. Geological map of part of the Trent floodplain, including the area photographed in Figure 1 (after BGS, 1:50,000 Sheet 126, Nottingham, 1996)

