Mimmshall Brook at Water End, Hertfordshire

[TL 230 043]

Highlights

The swallow holes at Water End are of national significance, being the only major sinkholes which are a permanent feature of the landscape, draining the largest enclosed karstic basin in England. Changes in water and sediment fluxes entering the river system have occurred through catchment developments, which have led to the environmental deterioration of the swallow holes, but these effects have now been ameliorated.

Introduction

The swallow holes at Water End have fascinated researchers for over a century. Often a feature of upland limestone areas, the swallow holes at Water End are some of the most accessible in southern England. The Mimmshall Brook, flowing northward, drains a catchment of 52 km^2 which has been progressively developed (Figure 6.37). Increases in water and sediment fluxes have increased the incidence of flooding at the site, which also boasts unique flora and fauna.

Description

The swallow holes at Water End are the result of a unique combination of geological and hydrological factors (Roberts, 1989). The Mimmshall Brook catchment lies on the boundary of the Chalk in Hertfordshire and the London Clay and Reading Beds of the London Basin (Darby and Thorne, 1992). In zones of low resistivity in the Chalk, jointing and fissures caused by earth movements develop into swallow holes (Walsh and Ockenden, 1982). Solution processes and turbulent flow processes enlarge the fissures into channels, and eventually the channel may collapse, forming a swallow hole (Harold, 1937; Wooldridge and Kirkaldy, 1937).

Fluorescein tests indicate that water absorbed into the swallow holes reappears in the adjacent Lee catchment at springs on the New River northeast of Water End, flowing over a distance of 16 km in approximately three days (Harold, 1937). However, once the swallow holes reach their capacity, estimated to be 0.4 m^3s^{-1} by Roberts (1989), a lake forms over the whole area and spills through a channel to the west of Water End, directly into the surface drainage of the River Colne (Figure 6.37). In (Figure 6.38) is shown an active hole in September 1994, which consumed all of the low-flow discharge at that time. The funnel-shaped depression, approximately 6 m across and 3 m deep had a fissure hole, offset from the centre, measuring approximately 1 m by 0.6 m. When the capacity of this hole had been reached, an upstream overflow channel led to a much smaller hole of diameter 0.35 m, beyond which the channel linked up to the overflow channel leading into the Colne catchment.

Interpretation

The number and location of swallow holes have been well documented and shown to fluctuate. Holes have also been observed in the channel bed of the Mimmshall Brook upstream of Water End, and in the Potteralls Stream and Catherine Brook tributaries. Historical maps indicate that between 1898 and 1919 the river channel shifted eastward away from an area which currently comprises three large 30 m diameter depressions (Roberts, 1989). Channel sinuosity between 1898 and 1973 has increased, with the development of a new swallow hole system between 1938 and 1973. These changes can be attributed to an increase in discharge. Historical evidence also suggests that the swallow holes were larger and more extensive than at present. Hopkinson (1892; cited in Whitaker, 1921) described the holes as 'large enough to carry a man', while Wooldridge and Kirkaldy (1937) reported 28 upstream of Water End and 14 at Water End (pools in the river were also counted in this figure, but even excluding these the number of holes would have been greater than today).

The observed increase in the incidence of flooding at Water End can be attributed to an increase in runoff in the catchment and an increase in sediment transport which is threatening the existence of the current hole formations. Flow into the Colne catchment has become associated with more frequent discharge events, compared with exceptional ones in the past. The increases in water and sediment have resulted from the changing nature of the catchment. From previously being a dominantly rural catchment, urban expansion, industrial development, road and motorway construction, land drainage and channelization have all contributed to increasing the sediment and water fluxes (Roberts, 1989). X-ray diffraction has attributed the fine sediments accumulating at Water End to those derived from bank erosion upstream (Darby and Thorne, 1992). Rubbish and litter are also catchment-wide concerns, as they are threatening to contribute to blockage in the swallow hole system.

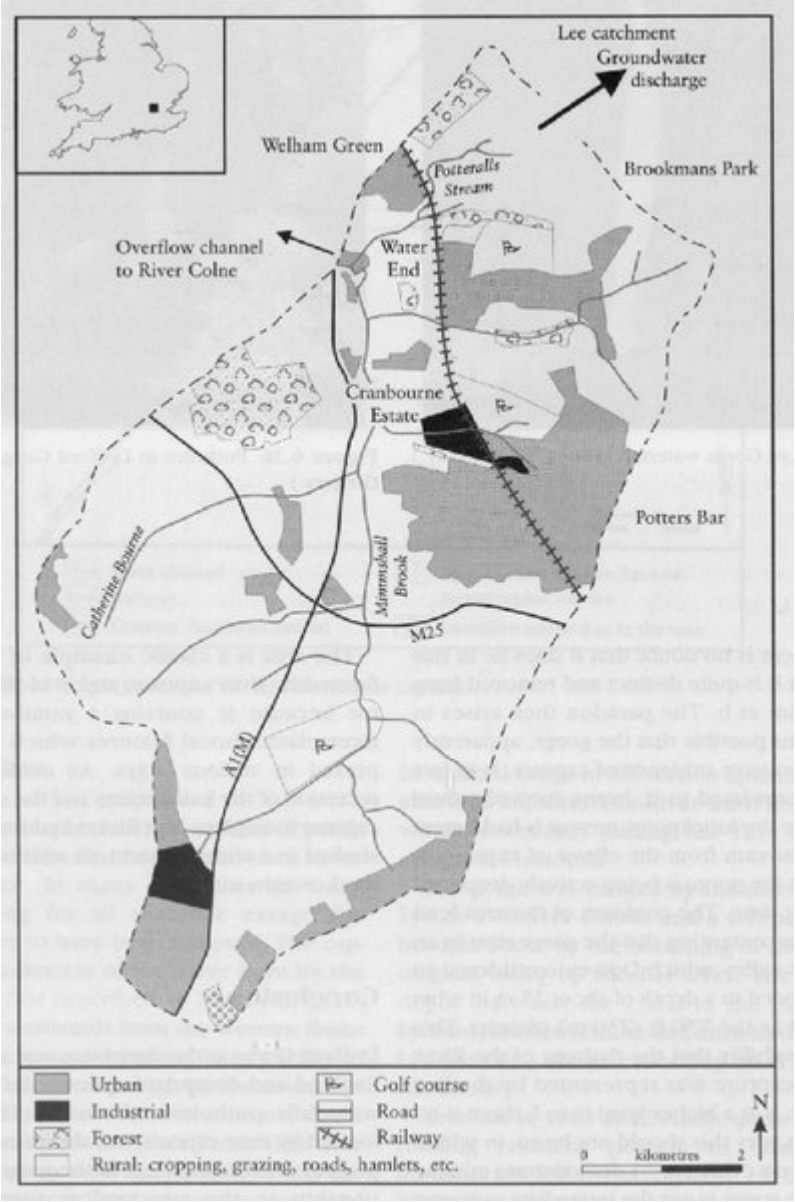
Sear *et al.* (1994) have advocated a catchment management approach to address the sedimentation problems at Water End. Measures suggested include regrading banks and the installation of drop structures and gravel traps, while a trash screen immediately upstream of the site may reduce the litter problem (Roberts, 1989; Darby and Thorne, 1992). Such a restoration scheme of the Mimms wash would function as a silt trap and improve the water quality of the motorway runoff entering the brook. Also, the restoration of a meander belt in the channelized reach would increase water and sediment storage potential.

The swallow holes at Water End represent a unique site in lowland southern England on the interface of the Chiltern Chalk and the London Clay and Reading Beds. Evidence suggests that the swallow hole complex may be contracting in response to changing sediment and water fluxes from the catchment. Mitigation measures to prevent the blockage of remaining holes through environmental deterioration are needed at the catchment scale to preserve this important site.

Conclusion

Swallow holes are solutional features which develop in limestone rocks. These are good examples of such features but they are also in a unique geological setting in southern England. The swallow holes have developed in the bed of the Mimmshall Brook, but recent changes in the water and sediment flow from the catchment threaten to block them. A restoration scheme will help to prevent this.

References



(Figure 6.37) Land use in the Mimmshall Brook catchment. (After Darby and Thorne, 1992.)

(Figure 6.38) Water End swallow hole. (Photo: R.J. Davis.)