RIVER MISBOURNE – NOTES ON THE GEOLOGY

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Introduction

Chalk streams or winterbournes such as the River Misbourne frequently dry out and disappear during the summer due to a lowering of the water table and/or seepage into the underlying chalk strata, either through swallow holes or simple percolation. In order to understand the potential reasons for the disappearance of the River Misbourne south of Amersham some consideration has to be given to the geological history that the area has undergone and how this might affect the present day hydrogeology.

This geological history falls into two distinct periods, first the deposition and nature of the underlying Chalk and secondly, the late Pleistocene (Ice Age) history of the area

The Chalk of the Misbourne Valley.

We are very fortunate that the geology of the Beaconsfield area was re-mapped and re-documented as recently as 2005 (Morigi *et al*., 2005) in which Geological Survey (BGS) have used the "modern" chalk lithostratigraphy as defined by Mortimore (1986). The Survey agreed that this would be used as standard in 1997 and it has been subsequently applied to the mapping of all Chalk subcrops. This is extremely useful as it tells us a great deal about the nature of the chalk sediment we are dealing with even if it is not exposed at the surface.

The Chalk of the Beaconsfield area is divided into three lithostratigraphic units (See Figure 1); these are the New Pit Formation, the Lewes Nodular Chalk Formation and the Seaford and Newhaven Chalks. This latter unit has not been subdivided into its two constituent formations as they cannot be separated in this area, but to all intents and purposes for the area of interest, we are considering the Seaford Formation.

Despite all being "chalks", the New Pit, Lewes and Seaford Formations have very different lithological characteristics which may impact on water flow in the area both above and below the surface.

The **New Pit Chalk** is described by Morigi *et al*. (2005) as a "massively bedded, non-nodular chalk, with fairly regularly developed marl seams and sporadic flints". It is the presence of the marl seams which characterises this unit, as these argillaceous clay seams, often less than 1cm thick, are extremely widespread, being recognised across the whole of southern England and in a number of cases even across to Germany.

The New Pit Formation underlies the Misbourne valley below Amersham Old Town and continues to subcrop to the southeast as far as the disused Quarrendon Mill. The BGS

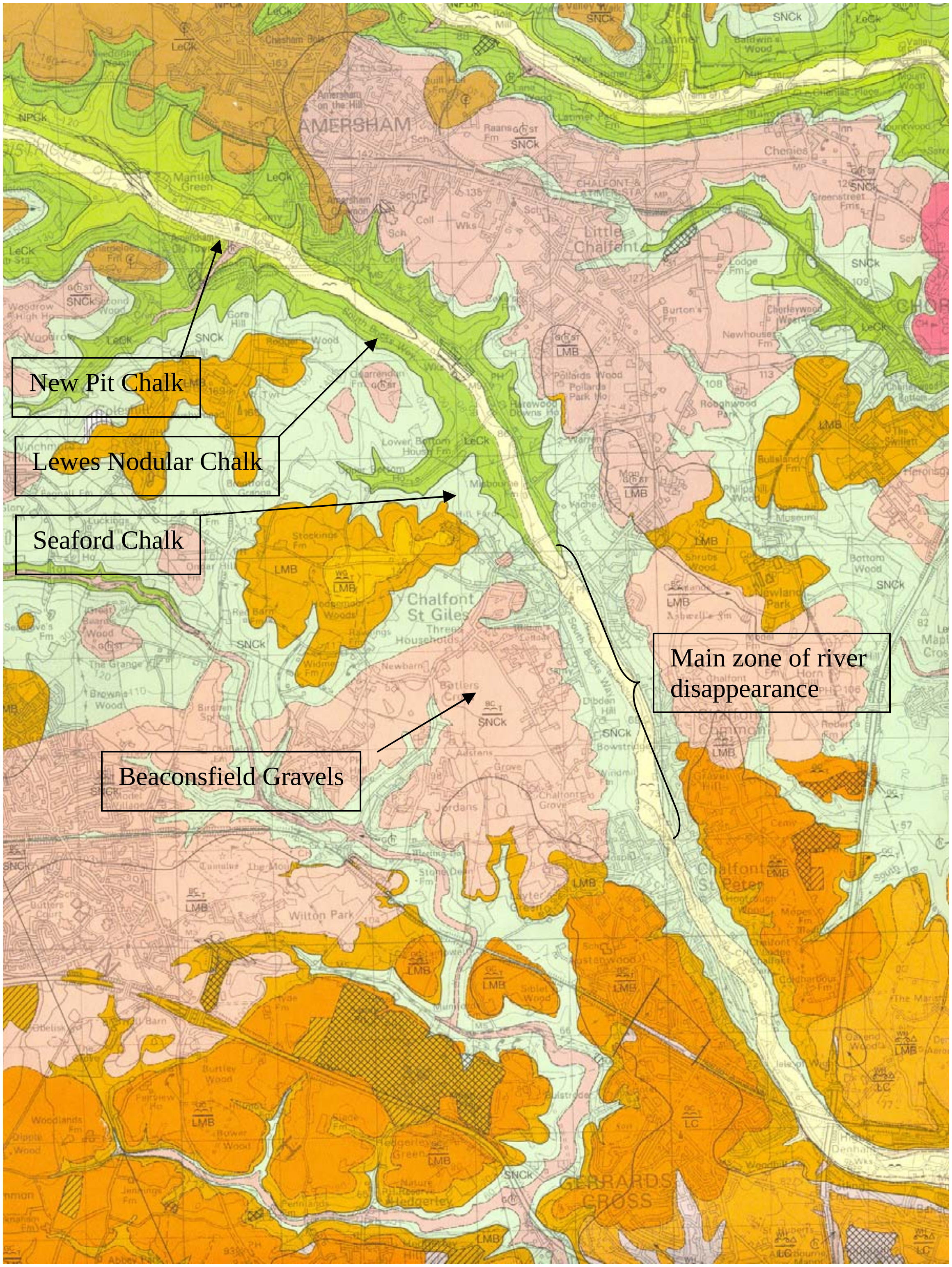

Figure 1: Geological map of the Misbourne valley; BGS Beaconsfield Sheet 255

interpretation places the boundary between the New Pit Chalk and the younger (overlying) Lewes Chalk just to the southeast of the mill (SU978960), between it and the Works shown on the OS map.

The **Lewes Nodular Chalk** has very different characteristics to those described for the New Pit chalk. The Lewes Formation comprises "a hard nodular chalk, with conspicuous regularly developed flints, thin marls and hardgrounds." (Morigi *et al*, *op.cit*.). The hard nodular chalks occur as a series of condensed hardgrounds, principally the Chalk Rock and the slightly higher Top Rock, both of which occur throughout the Chiltern area. The beds are extremely hard and were often used as quarry floors in old quarry workings regionally. The typical Chalk Rock of the Chilterns is described well from the working quarry at Kensworth, Bedfordshire where this "chalkstone is penetrated by an extensive *Thalassinoides* burrow system, mostly filled by either friable, granular chalk or else empty of sediment." (Mortimore *et al*., 2001). Whilst the younger Top Rock hardground lacks the open tubular burrows described from the Chalk Rock, it is penetrated by burrowing back filled with soft granular chalk sediments. The indurated character of the Lewes Chalk makes it much more liable to fracturing when compared with the underlying New Pit marly chalk. In fact in chalk cliff sections, joints and fractures which pass readily through hard lithified chalks can be seen to terminate at clay seams.

The Lewes Chalk is present beneath the Misbourne valley from just south east of Quarrendon Mill, effectively as far as the main road passing through the village centre at Chalfont St. Giles. From this point southwards to Denham the river valley overlies chalk of the Seaford Formation.

According to Morigi *et al*. (*op.cit*.) "The **Seaford Chalk** is typically a soft, flinty chalk with local shell rich horizons" and "the base of the Seaford chalk is marked by the Upper East Cliff Marl." This marl is another of the widespread clay seams recognised across much of southern England. The Seaford Formation comprises a uniform very fine chalk with a relatively high microporosity, making it a major aquifer through southern England (Mortimore *et al.,* 1990).

For the purposes of these notes it is critical to recognise that over the interval of the river valley where the Misbourne is most prone to disappear, it is flowing over the Lewes Nodular Chalk, with its characteristic open or highly porous burrows and potential fractures. In contrast, upstream of this where it continues to flow, it does so over the more clay rich New Pit Chalk. Downstream, below Chalfont St. Peter where it also flows; this is over the firm soft chalks with occasional clay seams of the Seaford Chalk. The problematic zone is principally over the Lewes Chalk, known to be a major aquifer across southern England (Mortimore, pers. comm.).

The Pleistocene history of the Misbourne Valley

The recently published (2005) Beaconsfield geological map (Sheet 255) goes to some length to illustrate the complex history of the Thames valley (see Figure 2 below), particularly during the Anglian ice age. Prior to this time the proto-Thames flowed north eastwards across the Beaconsfield district, roughly in a line running from Marlow through Beaconsfield and on to the north of Watford, along the line of the M25.

This major river deposited coarse clastic sediments (pebble beds and gravels) along its route which now occur as a series of terraces. The proto-Thames was dammed by the Anglian ice sheet in the Vale of St. Albans approximately in the area of the present day M1/M25 junction where glacial lake varve deposits were exposed during the excavation of the motorway junction. This glacial lake eventually spilled out southwards through the present day Colne Valley and established the current river valley through Slough and on to London.

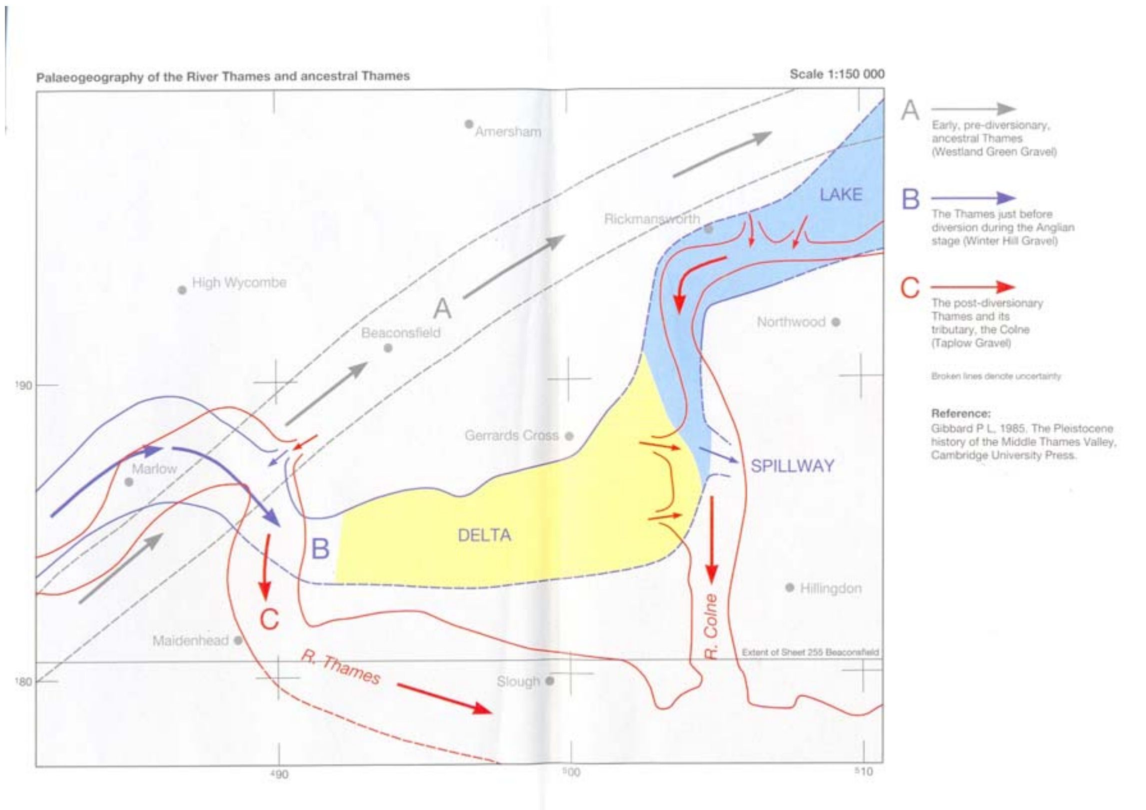

Figure 2: The development of the Thames Valley across the Beaconsfield area during the Anglian ice age; from the Geological Survey 1:50 000 Beaconsfield Solid and Drift map (Sheet 255).

In the current area of interest, the River Misbourne has cut through the Beaconsfield Gravels and now runs directly over the Chalk. However, it must be recognised that the complex ice age history outlined briefly above will have had a major impact on the water bearing qualities of the chalk, with the flow of a major river over it and no doubt through it via karst pipes (see Plate 1, taken from Morigi *et al., op. cit.*), combined with the inevitable action of freeze/thaw breakage and damage. Consequently the chalk immediately underlying the present day river valley between Chalfont St. Giles and Chalfont St. Peter has been deeply eroded by the proto-Thames river and disaggregated and shattered by later repeated freeze and thaw episodes. This all took place prior to the establishment of the current Misbourne valley.

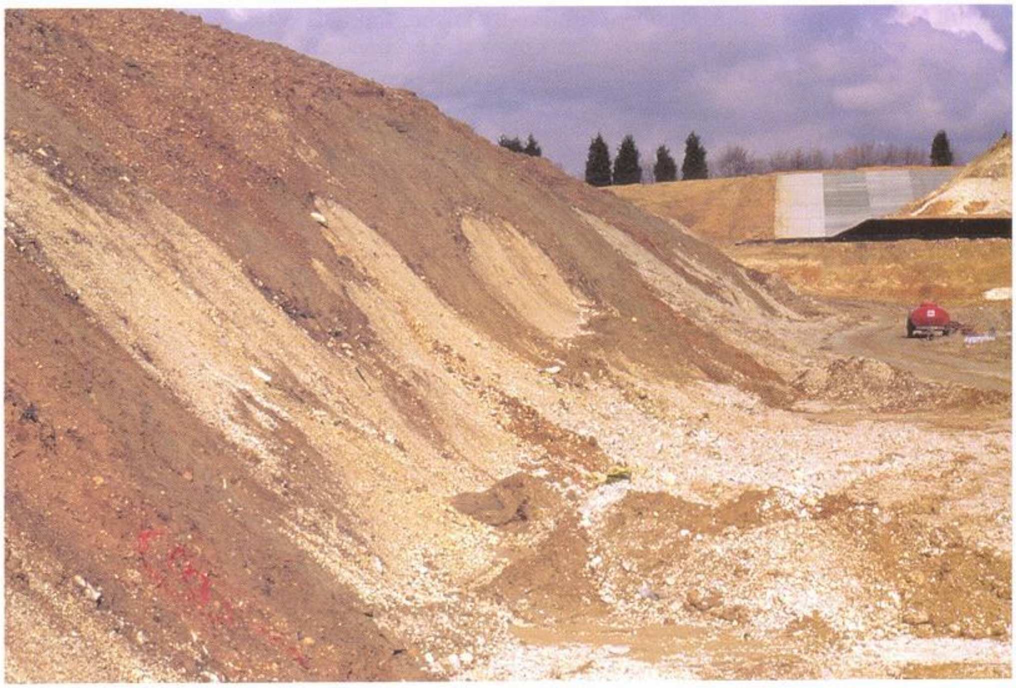

Plate 1: Beaconsfield Gravels resting directly onto the Chalk at Springfield Pit near Beaconsfield (SU 930 894). Note the heavily incised clay filled pipes which cut down into the chalk surface.

Conclusions

The post-Anglian removal of the Beaconsfield Gravels by the Misbourne means that the river has, in its past, flowed over and eroded into, a ?fractured nodular chalk already deeply incised by a karstic topography (see Plate 1).

In reality it is little short of amazing that the river has flowed freely across this part of its route at all during its natural development. The underlying Lewes Chalk bedrock was never the most reliable substrate over which a river might be expected to flow unless the water table was maintained at a relatively high level.

Add to this the affects of a major river valley development over the chalk, followed by a complex peri-glacial history, then the patch of ground between the Chalfonts probably acts more like a sponge in relation to water flow.

Finally the actions taken by water consumers must be the final straw as far as Misbourne flow is concerned. The following two photographs (Plates 2 and 3) were taken on the afternoon of September13th after a prolonged period of heavy rainfall. The flow beneath the footbridge just to the southwest of Misbourne Farm was fast and continuous. Contrast this with the dry ford at Chalfont Mill, Mill Lane, just 500 metres to the south.

Plate 2: Flow beneath footbridge, south west of Misbourne Farm.

Plate 3: Totally dry ford, Mill Lane

The underlying geology does very little to support water flow through this area, but it not helped by the presence of a major pumping station extracting water from the underlying chalk immediately adjacent to Chalfont Mill on Mill Lane.

Plate 5: Three Valleys Water Pumping station at Chalfont Mill, Mill Lane.

Only when water extraction is further reduced at this pumping station can I envisage the re-establishment of permanent water flow through the Misbourne valley from Chalfont St. Giles to Chalfont St. Peter.

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15.08.09

References

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