Low river flows and wetlands

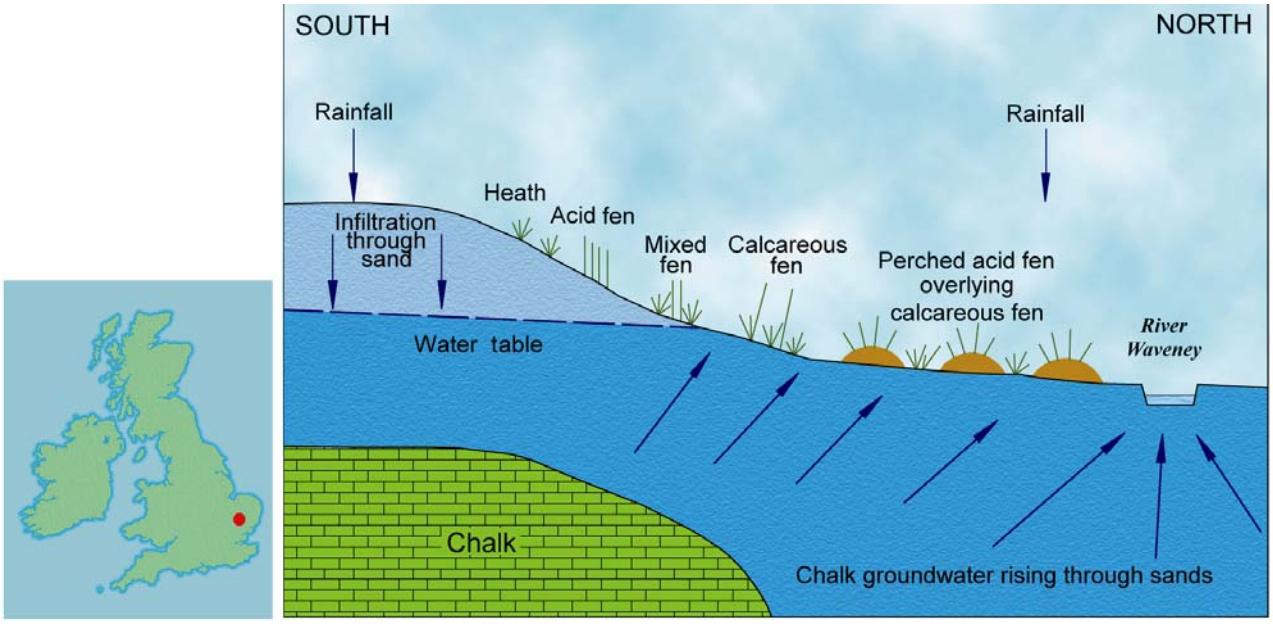
Most rivers derive their flows from both surface runoff and groundwater discharge. Surface runoff from impermeable ground occurs mainly in winters, is intermittent and of relatively short duration. In summer and autumn, when river flows are low, much of the base flow is groundwater.

Rivers draining areas that consist entirely of permeable rocks (e.g. the chalk downlands of southern England) obtain virtually all their water from aquifers. Flows are at a maximum at the end of winter or in early spring, when groundwater levels are high, and decline progressively from late spring to autumn. As the water table falls in the Chalk aquifer, streams may dry up as the point of discharge of groundwater moves downstream. Such streams, referred to as winterbournes (or simply bournes), may remain dry for extended periods during droughts such as those experienced in 1933 / 34, 1975 / 76, 1988 – 1992 and 1995 – 1997.

Wetlands are formed in valley floors by flows of groundwater from springs and seepages. Wetland soils are saturated periodically and plants adapt to saturated conditions, resulting in habitats which depend on an excess of water for much of the year. These environments generally occur on, or at the margins of, floodplains where aquifers are overlain by superficial deposits (such as alluvium or glacial deposits) or where organic silts and peats have accumulated. Preservation of wetland habitats and the wildlife they support thus depends in many areas (e.g. eastern England) on maintaining groundwater flows from natural outlets.

Effective management of groundwater involves a balance between abstraction for water supply and the maintenance of adequate river flows. The deleterious effect of excessive groundwater abstraction has been recognised since the early 1960s, after the drought of 1959 focused attention on the problem. One solution involves conjunctive use of groundwater with surface runoff to meet projected demand for water supply and to maintain residual flows in rivers at acceptable levels. Basically the object has been to optimise the use of water resources by abstracting surface water when available in preference to groundwater, and drawing on groundwater reserves at other times. In many situations groundwater is pumped into rivers during extended periods of dry weather to maintain flows both to preserve the aquatic environment and, if necessary, provide for the abstraction of water downstream for water supply. Nevertheless, the flow of a number of rivers continues to give cause for concern because of low base flows at certain times of the year.

While abstraction of groundwater has been identified as an important factor in relation to low flows, the situation is complicated by other influences such as variability in rainfall intensity and rate of evaporation, changes in land use (e.g. by agriculture, and by urbanisation and



Section through Redgrave and Lopham Fen. The section shows the natural groundwater flow situation. Abstraction of groundwater from boreholes in the Chalk aquifer reverses the flow direction.

afforestation), land drainage, the control of discharge of effluents (domestic and industrial) and cooling water.

Revitalising a wetland

Redgrave and Lopham Fen is a spring-fed wetland in the headwaters of the River Waveney in East Anglia. It is designated as a wetland of international importance and is likely to become a Special Area of Conservation under legislation of the European Union. It covers some 125 hectares and is the largest fen of its type in lowland England.

Wicken Fen, Cambridgeshire. A wetland maintained by groundwater

Until the late 1950s, groundwater rose under artesian pressure into the fen from the underlying Chalk. The water issued from springs and seepages around the edge of the fen and within the peat subsoil, and flowed over the surface even during the summer. This kept the peat waterlogged with a lime-rich water, low in nutrients. An acid wet heath was also maintained by more-acidic rainfall at the higher margins of the fen.

In the late 1950s, two boreholes were drilled close to the fen to provide public water supplies. As a consequence of the pumping, the upward and lateral movement of the Chalk groundwater was replaced by downward movement of rainwater. The fen began to dry out and the quality of the fauna and flora deteriorated; in particular the number of species preferring calcareous conditions declined.

Recently, steps have been taken to encourage a recovery of the ecology. The boreholes will be relocated at a site some distance from the fen, the restored flow of water through the fen will be managed so that flood-flows and water levels are controlled with the aid of a small sluice, extensive scrub clearance will be undertaken and traditional fen management practices re-introduced.

These changes, the result of cooperation between the Environment Agency, Essex and Suffolk Water, English Nature and the Suffolk Wildlife Trust, will successfully balance the need for public water supply with concern for the survival of an importance wetland.

Preserving the River Darent

The River Darent rises from springs in the Chalk and Lower Greensand west of Sevenoaks, and flows over the Chalk to discharge into the Thames at Dartford. Groundwater abstraction from public supply boreholes in both the Lower Greensand and the Chalk is at the expense of the springs, and hence the river. Historically, during dry periods the flow has been unacceptably low and for long periods the lower reaches have been completely dry. A number of steps have been taken recently by Thames Water and the Environment Agency to remedy this. The object is to maintain sufficient flow in the river to sustain natural fisheries, particularly Brown Trout.

Thames Water has developed its distribution network to allow it to use the resources of the River Thames in conjunction with the groundwater in the Chalk and Lower Greensand to reduce the impact of groundwater abstraction on the Darent. Surface water from the Thames is used during the winter thereby allowing maximum natural replenishment of groundwater storage. Abstraction of groundwater for public supply from six boreholes in the Chalk adjacent to the river and from boreholes in the Lower Greensand has already been reduced by 30%. Currently, during severe droughts, the use of groundwater is increased but, because boreholes are used to a lesser extent overall, groundwater levels are higher and the impact on the river is less. Shallow boreholes have been drilled, by the Environment Agency, into the Chalk near the river to act as artificial springs, enabling groundwater to be pumped into the river at times of dry weather.

The next stage of the plan to preserve the Darent will be to reduce abstraction even further at two more sources in the lower part of the catchment. These sources will be replaced by development of new groundwater resources in the area to the south of the large quarries near Dartford. These comprehensive measures should maintain the flow of the Darent and at the same time make the best use of both groundwater and surface resources. It is an example of how, by innovative management, groundwater can provide both a water supply and meet obligations to maintain the river environment.

Dry winters produce dry bournes. Winterbournes drain groundwater from the Chalk and they dry up naturally in the summer and autumn when the water table falls below the bed of the stream. After extremely dry winters they are dry for much longer periods.

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