A hydrological classification of the soils of England and Wales

R. B. PAINTER

F. J. Kaul and F. M. Law, Binnie and Partners

The Author's attempt to provide those working on flood and drainage studies with a complete and consistent set of soil infiltration rate figures is most welcome. The limitations, when covering the whole of England and Wales are understandable, but it must be questioned whether the figures given are not serious underestimates for most purposes. The simple description of them as minimum values is rather vague; if this means a limiting value after several hours' rainfall it severely restricts the quantitative use of the Author's map. It would be helpful if the experimental source of the infiltration ranges could be given for the major soil types quoted, and any qualifying conditions that apply.

18. The evidence for higher loss rates is wide-ranging. Dry valleys exist not only in the chalk downland of the south, but also in the Bunter pebble bed areas of Devon,⁴ the Oolitic limestone of the Cotswolds, the Breckland area of Norfolk and in the Peak District.⁵ All experience rainfall intensities exceeding 25 mm/h occasionally, yet show no sign of surface flow even if rainfall is prolonged. Characteristically they have thin soils and it may be suggested that infiltration rate decreases as the soil horizons thicken. However, even the way in which bare chalk will accept high percolation rates needs explanation compared with the rates given by the Author. In the great storm of July 18, 1955 in Dorset, when over 280 mm of rain fell mainly in 6 h over an area of several square miles, it is clear that little or no surface run-off occurred on the chalk hillsides.⁶

19. Given the scarcity of information on infiltration rates for the UK, we found the review paper by Pilgrim⁷ of great value. Subsequently, for spillway flood studies in the traditionally impermeable parts of upland Britain, we have often used infiltration rates of 4 mm/h when creating catastrophic flood inflows from maximum rainfall intensities; an example of this approach was published recently.⁸

20. Conceptually it would seem that infiltration rates might be most adequately predicted from the knowledge of soil type, depth and initial moisture state. This would involve a wider range of soil survey maps, and data based on sampling down either to a free-draining stratum under the surface soil or to the water table, whichever is higher. In carrying out any study involving infiltration during a long wet spell, allowance should be made for the rise in water table that will occur. After all the upper limit, waterlogged land, occurs frequently over much of the country and then surface infiltration rates really are low! The important distinction between the rate at which soil will allow water to percolate and the rate at which an underlying aquifer can accept it has been discussed by Schoeller.⁹

R. B. Painter

It was interesting to learn of the experience of Messrs Kaul and Law, in applying infiltration values to flood studies. Always conscious of the areas of imprecision within the classification I did stress its preliminary nature in the conclusion, and the comments of Messrs Kaul and Law on their own experience are exactly of the nature I hoped the Paper would encourage.

22. The term minimum infiltration rate has the conventional meaning, i.e. the limiting value, occurring when all available storage in those horizons of the soil profile above that horizon possessing the lowest permeability has been taken up. At this

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condition, of course, the effects of varying vegetal cover on the infiltration characteristics of the soil are minimized. In § 8 of the Paper I had hoped to make it clear that the soil associations had been classified on the basis of their qualitative physical characteristics. Naturally, field measurements of infiltration rate would be extremely valuable, but I would suggest that the field techniques available lack one or other of the twin requirements of realism and portability, and so preclude obtaining not only absolute values of infiltration rate but also the numerous sets of data required for statistical significance.

23. Messrs Kaul and Law give three parameters; soil type, depth and initial moisture content, which could be used to predict infiltration rate. Recent work carried out under my supervision into simple field measurements of infiltration rate on soils derived from glacial drift in north-east England has indicated that when soils show marked structural cracking during dry weather, the direct effects of texture and initial moisture content are insignificant. Thus in dry weather infiltration takes place down the structure face between the peds, with little movement through the ped which may often have a relatively high moisture content. Then during the winter the structural cracks close, due to clay swelling when wet, and infiltration is limited to the pore spaces in the ped. This obviously gives tremendous variations in infiltration rates, the prediction of which would be improved if a quantitative measure of the degree of structural cracking could be devised.

References

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