2. <u>Design values of catchment wetness in mixed urban/rural catchments</u>
<u>J. C. Packman, Institutes of Hydrology</u>

Synopsis:-

As part of the development of the Wallingford Procedure an extensive study was made of the relationship between the return periods of rainfall depth and the resulting peak flow. The relationship depended on rainfall duration, rainfall profile and the initial catchment wetness condition.

Recommendations were based on analyses of urban catchments. In particular, percentage runoff and the effect of initial conditions were estimated from the usual Wallingford equation.

$$PR = 0.829\ PIMP + 25.0\ SOIL + 0.078\ UCWI - 20.7 \quad (1)$$

This equation is based on data from 17 catchments, each less than 2.5 km^2 in area, and having "impervious" areas of 20% to 70%. The data will have been derived almost exclusively from summer storms. The applicability of the equation to catchments containing significant rural areas is suspect. Runoff from rural areas differs markedly for urban areas. In particular, true overland flow is rare; more common is the much slower shallow-subsurface flow. Also, while intense summer storms yield high runoff from urban areas, on dry rural areas they mainly replenish soil moisture and yield little runoff. High rural runoff derives from the less-intense winter storms on ready wetted catchment areas.

Percentage runoff from rural areas in the UK would usually be derived from the equation in the Flood Studies Report.

$$PR = 95.5\ SOIL + 0.22\ (CWI-12) + 0.1\ (P-10) + 12\ URBAN \quad (2)$$

These equations are based on data from 130 catchments (or more), but few of less than 10 Km^2 in area. Most of the data will have been derived from winter storms. The differences between these two equations and their respective data sets cannot be over stressed. The design choices of UCWI and CWI make no seasonal distinctions.

To try and resolve this problem, typical UCWI and CWI values have been analysed for summer and winter periods. Using 37 of the Meteorological Office's Soil Moisture Deficit Stations, 20 years of end-of-month values of UCWI and CWI have been derived. For each station, median values for the summer (May to October) and winter period have been found and plotted against average annual rainfall, SAAR.

These figures suggest a departure from the design values of UCWI and CWI using a two season approach. Normally it is not recommended that the design storm or antecedent conditions should be varied without extensive simulation studies. However, it would seem reasonable when estimating summer runoff from rural catchments to use a summer CWI value in preference to the F.S.R. annual value. Similarly, when estimating winter runoff from urban catchments a winter UCWI would seem preferable.

Discussion:-

Session Chairman.
A straw poll showed that only 3 delegates had experience of mixed urban/rural catchments and only 1 had made use of the F.S.R.

J. Packman.
Expressed surprise at the low response. A mixed catchment may be defined as one having greater than 30% of both rural and urban contributing area.

D. A. Wall, Watson Hawksley.
There is further confusion over which equation (WASSP or FSR) to apply due to the significant response time differences of urban and rural runoff.

J. Packman.
Agreed that there is a significant difference, urban runoff times being measured in minutes and rural in hours, and peak runoffs do not usually coincide.

B. Luck, Southern Water Authority.
Experience of model verification using winter storms has given rise to concern at the low values of UCWI applied. Should winter storms be used with WASSP and are UCWI values calculated from SMD accurate?

J. Packman.
Surprised at low UCWI values in winter - zero SMD values usually occur from December to March, resulting in high UCWI values. The UCWI calculation based on SMD values from the nearest available station is the only method currently available.

B. Luck.
A UCWI of 13 has been used based on SMD of 130. Are these values satisfactory?

J. Packman.
Similar values were used in the original data sets and there should be no problems.

B. Nussey, Sheffield City Polytechnic.
Requested advice on which design storm to use?

J. Packman.
The 50% summer profile should still be used for sewerage networks but new research is necessary.

2. Design values of catchment wetness in mixed urban/rural catchments.
J. C. Packman, Institute of Hydrology.

Synopsis:-

See Bristol meeting notes.

Discussion:-

R. G. Amster, Binnie and Partners.

a) Has this work been verified by flow survey information?
b) Can the summer and winter periods be accurately defined?
c) Expressed concern at the use of 50 year return period storms. Does a 50 year return period flood necessarily result?

J. Packman.

a) The work is based on data from small catchments which was collected during the development of WASSP. However, due to a lack of funding data collection did not continue and there is a need for more long term data. Short duration surveys are inadequate for WASSP improvement purposes.
b) Summer is defined as May to October and Winter as November to April. However, 4 month seasons may improve accuracy.
c) A 50 year return period rainfall should produce a 50 year return period flow, but no catchment data is available and there is little confidence in return periods greater than 10 years.

T. Webster, Severn-Trent Water Authority.
These discussions should emphasise to delegates that WASSP should not be treated as a 'Black-Box'.

D. Walters, Bolton MBC.
Very high UCWI values, e.g. 300, have been encountered during data verification. Does this seem reasonable?

J. Packman.
Such values are quite possible and were used in the original WASSP data sets. However, UCWI should not be artificially amended in order to improve the fit between measured and predicted hydrographs.