MANAGEMENT OF ABOVE GROUND DATA FOR PARTIALLY DRAINED CATCHMENTS - ISSUES FOR CONVERTING OLD MODELS

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1 INTRODUCTION

The area and type of ground surface is a fundamental input to drainage models. The comparative density of paved and roof surfaces generates the percentage run-off and the actual area of each surface with this percentage generates the run-off volumes for each input node. The percentage run-off for early versions of WASSP was calculated as an average for the whole model and it was not realistic to accommodate sub-catchments with significantly different paved and roof densities within the same model.

Recent software packages have addressed this limitation and sub-catchments with individual run-off characteristics can be combined into composite models.

The situation is further complicated where more than one surface drainage system serves an area. The fundamental equations which relate run-off volumes to paved and roof densities in WASSP applied strictly to a single system serving an urbanised area. They are particularly suited to a single combined sewerage system or to the storm sewer system of an area which is entirely separated.

The occurrence of partially separate sewer systems and some roof and paved areas with independent drainage facilities (e.g. soakaways) is common in urbanised areas. Therefore, calculating the correct run-off volumes for the particular sewer system which is being modelled, requires careful management of above ground data. Further advice on this is included in WaPUG User Note No 21 and, since actual connected paved, roof and pervious areas can now be entered with independent percentage run-off factors, there is no limitation on the uniformity and size of recent models.

Conversion of WASSP and WALLRUS Models for use with recent software

Since the early versions of WASSP were strictly limited to homogeneous catchments which were served by a single drainage system, advice was given in earlier versions of this Note on how to adapt above ground data for partially separate sewer systems. Therefore, the simple conversion of these models will create some anomalies if the adaptions are overlooked. This advice may also have been applied to models subsequently converted to WALLRUS.

Two methods were suggested and the detail is given below. Whereas **Solution 1** is likely to regenerate comparable results in more recent software packages, where **Solution 2** was used, care must be taken to include the input PR or to re-input the pervious areas for each node using the advice given in WaPUG User Note No 21.

2 PREVIOUS ADVICE

Relevant Assumptions of WASSP

To calculate the volume of runoff WASSP and WALLRUS assumed that:

1 there is only one storm sewerage system serving the whole area and all paved and roof surfaces are formally connected to it, as for a fully separated system;

2 the total area required in the Sewerage System Data (SSD) file does not extent beyond that served by the system. The boundary is as defined in the manuals, and in WaPUG User Note No 21.

3 the surface runoff sub model allows for variations in catchment characteristics and antecedent conditions. In extreme conditions a contribution from previous surfaces is allowed for.

In addition WASSP assumed that:

4 the percentage runoff (PR) is calculated as an average for the whole area served by the sewer system.

whereas WALLRUS assumed that:

4 the percentage runoff (PR) is calculated for the subcatchment contributing to each sewer.

The Problem

The problem lays with the calculation of PR from equation 7.3 Volume 1 of the Wallingford Procedure which can only be used with the above assumptions.

The values of SOIL and UCWI are a direct input, whereas the percentage impervious area (PIMP) is derived from the percentages of paved and roof areas entered in the SSD file.

A partially separate system may collect runoff from rear roofs and backyards in the foul sewerage system, and runoff from front roofs and highways in the storm sewerage system. Both systems serve the same area, but if the Total Area is input into both of the SSD files with the respective paved and roof areas for each system, WASSP and WALLRUS will derive values for PIMP which are too low. This will result in runoff volumes and peak flows being under estimated by the simulation.

Similar problems arise when only part of an area is formally drained or where some impervious areas drain to soakaways.

The solutions recommended below preserve the true value of PIMP for the catchment or subcatchment as a whole whilst using in the SSD file only those impervious surfaces which have a formal connection.

Solution 1 (for both WASSP and WALLRUS)

For developments drained on the partially separate principle, some typical areas for a 20 ha development are: 4 ha of paved and roof to the storm system and 1 ha of paved and roofed to the foul system. This gives a combined PIMP of 25%. Therefore to preserve the true value of PIMP, the Total Area which is used in the SSD file should be factored by the proportion of paved and roof area which is connected to the study system, i.e.

for the storm system Σ Total area = 16 ha
for the foul system Σ Total area = 4 ha

This method makes the further assumption that PIMP is consistent for the two systems. This is not unreasonable unless the roof drainage forms a large proportion of the total area connected to one system. In the latter case refer to User Note 21 and apply the following procedure independently for both systems.

The procedure is therefore to assess the true value of PIMP for both systems combined from OS maps by sample squares. The paved and roof areas connected to the study system are then measured, divided by PIMP/100 and entered as Total Area in the SSD file. The percentages for paved and roof must then be calculated so as to give the correct actual areas.

Solution 2 (for WASSP only)

A simpler method than Solution 1 is available by assuming that PIMP is uniform across the catchment and using the global PR in the PCD file. The program will still derive PIMP from SSD file however and use this value to generate the derivatives of PR for each surface type.

The following procedure avoids this difficulty

1 Estimate the overall true value of PIMP for the catchment as a whole by sampling, and by reference to User Note 21 where appropriate.

2 Calculate PR from equation 7.3 using this value of PIMP and appropriate values of SOIL and UCWI.

3 Measures individual paved and roof areas for each record in the SSD file.

4 Enter the sum of paved and roof for each record as Total Area in the SSD file, and percentages for paved and roof to give the correct individual areas for each (i.e. % paved + % proof = 100% for each record).

Then for the storm system Σ Total Area = 4 ha
for the foul system Σ Total Area = 1 ha

5 Instead of SOIL in the PCD file give the value

$$\frac{PR}{PIMP} * 100$$

and leave UCWI blank. Therefore in the example given, if PR is 17%, the value to be given = 68. This is in fact the true value of the derivatives PR_{PAV} and PR_{ROOF}

When PR_{PAV} is greater than 70% a discontinuity occurs which amounts to an extra contribution from previous areas. At first it might appear that, since previous areas have been omitted from the SSD file, this contribution would be missed. Fortunately this is not the case since WASSP automatically reads PIMP as 100% and increases the contribution from paved surfaces to compensate.

Amendments

Ver	Description	Date
1.	First Published	April 1986
2.	Revision	July 1990
3.	Revision	February 1998
4.	Amendments	March 2009