SPRING MEETING 1987

WaPUG - 1987 SPRING MEETINGS

Storage Compensation in Simplified Catchments

by R Chapman, WRc

1 INTRODUCTION

When simulating the behaviour of drainage networks using the WASSP-SIM program, the system is normally represented in a simplified form. This is necessary for three reasons. Firstly to reduce computer run times; secondly to facilitate understanding of the system; and thirdly to avoid modelling difficulties. This means that not all of the storage available in the drainage system is included in the model. This unmodelled storage includes connections, gulley pots and unmodelled pipes and manholes. If this storage is not added to the model, it will overpredict the flooding occurring during storm events.

Accurate measurement of the unmodelled storage is extremely difficult. The information available usually consists of 1:1250 scale record sheets. These will normally show the location of the sewers in the roads and their depths and sizes. The volume of these can be measured from the maps although this is a time consuming business. Normally, manholes will also be marked and the volume of these can be estimated by assuming a standard diameter. The volumes associated with gulley pots and pipes connecting gulley pots and properties to the sewer cannot be measured from the maps. The lengths of the connecting pipes can be measured but the numbers of the gulley pots and the size of the connecting pipes can only be ascertained by fieldwork. Carrying out such fieldwork would require an enormous amount of effort.

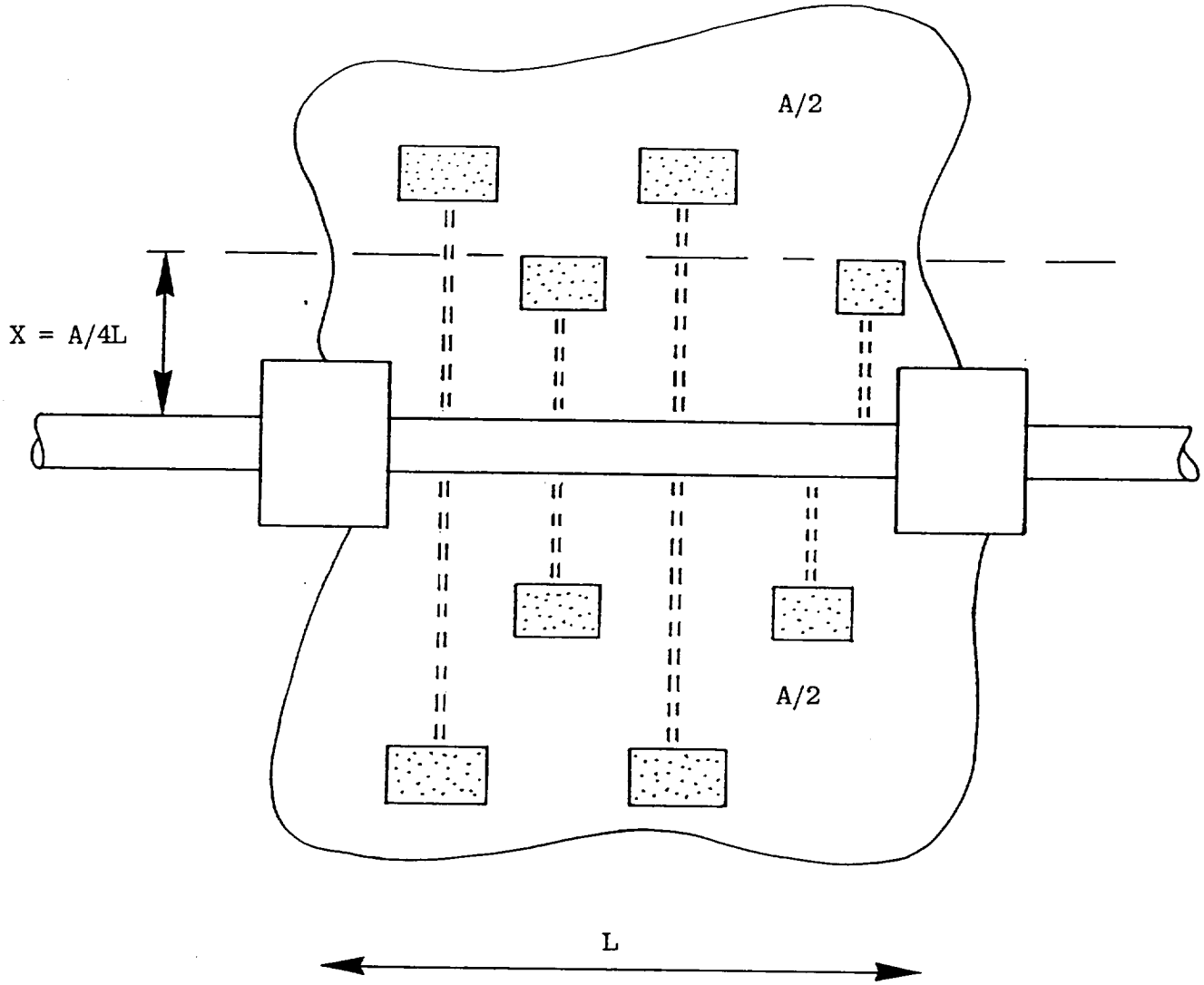
The problem is further complicated by the fact that not all of this measured volume is available as storage since some of it will be taken up by flows in the pipes. The volume available will therefore be different for every storm event. Another complication is that not all of the system connected to a surcharged pipe will fill to ground level and so some storage will not be mobilised.

As no realistic user of WASSP-SIM would expect the program to predict volumes of flooding to the nearest cubic metre, it is not worth attempting to accurately define the additional storage available. What is needed is a method which provides a realistic estimate of the available additional storage without requiring any information other than the pipe datafile for WASSP-SIM.

2 DEVELOPING A METHOD

Two years ago the author developed a method for predicting the volume of storage that was being omitted from a WASSP-SIM model. The volume of storage was assessed from the contributing area data and a housing density figure which had to be supplied. The essence of the method was that, whatever the actual layout of drainage network in the contributing area, it would be equivalent to a series of individual connections from each property (see Figure 1) and that paved areas were associated with properties. The predictions from the model compared favourably with estimates of unmodelled storage included in four existing WASSP-SIM models. The method was embodied in a software package and has been used internally by WRc for the past two years. The software package adds the storage as additional manholes and cannot be used if there is significant below soffit storage. The method has never been published as it had never been rigorously tested. However the method was made available to WASSP-SIM modellers outside WRc who approached the author personally.

During the past two years a number of shortcomings within the method have been highlighted. The method is only satisfactory for fully combined networks, it requires additional data to the WASSP-SIM data and it has not been calibrated by reference to measured data.



	Impervious area
A	Total connected area
L	Length of modelled pipe
X	Average hypothetical connection length

Figure 1 Conceptualisation of unmodelled network

To overcome these shortcomings a new method is being developed. An outline of the proposed new method will be given in this paper and any suggestions or useful data that can be supplied by WaPUG members would be gratefully received. In particular any estimates of storage that WaPUG members have made and that could be used for comparison with the new method would be very useful. It is planned to present the method finally developed at the First National Hydrology Symposium in Hull in September and it will subsequently be published.

3 OUTLINE OF METHOD

The new method will be based on the original idea of representing any drainage network by a series of individual connections. In order to make the method applicable to a wide range of drainage system types it will treat the storage associated with roof, paved and foul connections separately.

From the connected roof area, the number of roof connections will be calculated assuming a standard area per roof. The hypothetical length of each connection will be calculated by assuming that the roofs are randomly distributed throughout the total contributing area. The effect of ground slope will be taken into account by limiting the maximum length of the hypothetical connection.

A similar procedure will be followed for paved area. A standard area per gulley will be assumed to allow the number of gulley connections to be calculated.

Finally, for foul only connections, the number of these will be calculated assuming a fixed foul flow per property. The number of roof connections will be deducted from this total to avoid double accounting. The length of these connections can be calculated as before by translating the number of connections into a total area by assuming a fixed housing density.

These calculations will be carried out on a sub-area by sub-area basis. The method will be embodied into a software package to automatically amend a standard WASSP-SIM file without any further data requirements.

The predictions from the model will be compared with measured storage volumes which will be obtained for a range of contributing area sizes (say 1ha to 20ha) and for drainage networks varying from foul only to fully combined. This data will be used to calibrate the method. Finally the method's predictions will be compared with estimates included in existing WASSP-SIM models for a range of drainage network types.

This new method will overcome all of the shortcomings of the early version.

4 SUMMARY

Drainage networks are represented in a WASSP-SIM computer model in a simplified form. The missing storage needs to be added back to the model to ensure that its predictions are accurate.

A method developed by the author two years ago to estimate the missing storage from the WASSP-SIM datafile had three main shortcomings:

- It applied to fully combined networks only
- It required additional information
- It was not rigorously tested.

A new method is proposed which overcomes these shortcomings. Any comments or data to test the new method would be welcome. The new method will be presented at the First National Hydrology Symposium in Hull in September and will subsequently be published.

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(c) Storage Compensation in Simplified Catchments

- Ron Chapman, WRC

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Disscussion:-

P Deakin, Northumbrian Water

When calibrating the proposed programme would it be of use to consider a graded series of low intensity storms.

R Chapman

Unlikely, as low intensity storms do not generally mobilise storage in the system. It would also depend on the confidence attached to the flow survey data.

D Sellers, Leeds City Council

To what extent were average conditions including storage embodied in the original data set.

R Chapman

The volume run-off calculations, i.e. PR equation was derived for whole catchments however routing coefficients were derived from gulley meter data and therefore included no storage.

D Custance, Manchester CC

The proposed programme does not appear to take account of "below soffit storage" which is lost in "pruning" simplification.

R Chapman

Providing the system is not oversimplified, this type of storage should not be significant. If this is not the case it could be allowed for as a tank.

B Wilkinson, Yorkshire Water Authority

What size of connecting pipe will be used in the method.

R Chapman

The size will be assessed during the calibration stage and only that one fixed size will be embodied in the programme. Data is requested from members who have built verified models including storage so that the programme can be calibrated on real data.

d) Storage Compensation in Simplified Catchments

R. Chapman, W.R.C.

See Leeds Meeting for Synopsis

Discussion:

..... London Borough of Newham

Is there any preliminary guidance available in the interim.

R. Chapman

Can supply the initial informal note on request.

A. Leeson, Borough of Ipswich

The proposed method will assume areas of housing, will method hold true for industrial areas.

R. Chapman

Connections may not be as frequent but will in general be larger and therefore the method should hold true.

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D. Wilkins, Sir Frederick Snow and Partners

Are there plans to build the programme into WASSP - SIM.

R. Chapman

The method would be freely available though not necessarily incorporated in WASSP. It is a possibility however.

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P. Barker, Havant D.C.

Could the method be used in design programmes.

R. Chapman

Since design programmes such as HYD do not model surcharge it would not be applicable.

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P.N. Luu - Borough of Harringay

Have adjusted the percentage run-off to improve results with respect to modelling of flooding. Would it be more appropriate to use manhole storage.

R. Chapman

Adjusting the percentage run-off without good cause can be very dangerous. Using the storage compensation method will not alter total volumes.