THE DANGERS OF FORCE-FITTING

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1. INTRODUCTION

The objective of the verification of a sewer system model before its use as an analysis and design tool is to ensure that a satisfactory representation of the above and below ground drainage system has been achieved. There has been much debate regarding the actual verification procedure, but the use of a short-term monitoring strategy is now an accepted common practice (Ref 1).

Verification should be regarded as a data-checking exercise in which the results of a field survey are compared with the models performance to provide checks along with flooding and surcharge records, of the models reliability. In this way it is possible to highlight errors in the input data or in the application of the model.

Readers should also refer to the Code of Practice for Hydraulic Modelling.

2. FORCE FITTING

When force-fitting the assumption is made that the field survey data is correct. Arbitrary adjustments are then made to the input data so that the models response matches as closely as possible the results of the field monitoring. Little or no checking of data takes place. The result is a model which appears to be an excellent representation of reality, and which requires comparatively little effort to produce. However, the force-fitted model may not in fact be a true representation of existing conditions, this is because it is not possible without checking, to ascertain whether or not the adjusted input data itself correctly reflects reality. There is a real danger that the resultant model can only be relied upon for the conditions present during the monitoring period and is therefore unsuitable for use with design events. This situation occurs because the program utilises algorithms which are based on relationships that have been formulated from a large amount of hydrological and hydraulic data. A short-term monitoring strategy cannot emulate the derivation of these algorithms. Similarly, it is possible that storm events of sufficient magnitude to create heavy surcharge or activate overflows will not occur during the survey period, and so the performance of the model will not be checked under these critical conditions. Force-fitting also places too much emphasis on the results of the field monitoring and can therefore ignore inaccuracies in the measurement process.

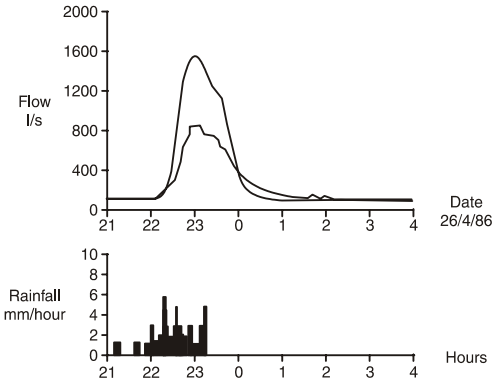

Figure 1

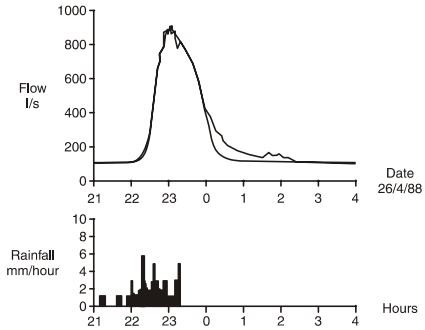

Figure 2

It is even possible for a force-fitted model to be only representative for the one particular storm event, within a survey period, to which it was fitted. In the following example an initial poor fit (Figure 1) was remedied simply by making an appropriate change to the contributing areas (Figure 2). As can be seen an excellent fit has been obtained and the initial reaction is that the model must be a very good representation of reality. However, when this revised input data was subjected to a storm event of quite different attributes but from the same survey period a poor match was evident (Figure 3) and it was found that the unaltered input data provided the better fit (Figure 4). In this case the original data is to be preferred as there is no justification for making any changes to it.

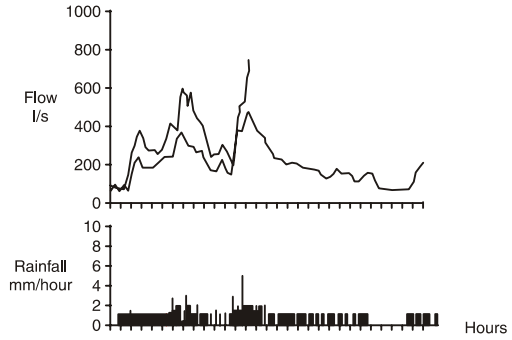

Figure 3

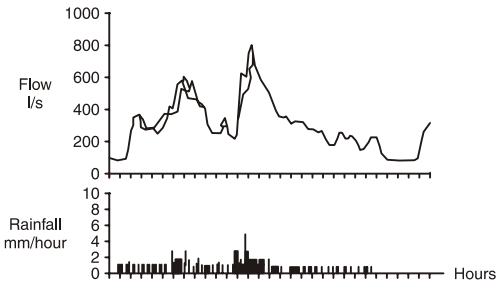

Figure 4

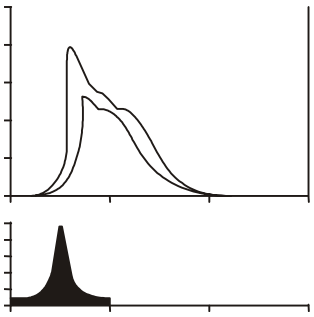

Figure 5

The difference between the results produced by these two data sets on a 20 year design storm, which would be used as a criteria for design is shown in Figure 5. The upper hydrograph is from the original data and the other is that produced from the forced model. The error that would be present from using the forced data is clearly very large, and it is likely to prove expensive to correct the initial under-design.

3. CONCLUSION

If a truly verified model is to be obtained it is vital that the verification process is regarded as a data checking exercise, and that no changes are made to the input data unless good reason is found. If this is not done and the model is force-fitted then the dangers are that the final model may not be representative of the existing drainage system and will only be reliable for the conditions of the monitoring period. It will, therefore, be of little use and unable to fulfil its role as a design tool.

4. REFERENCES

1. Eadon, A R and Williams, D W (1986) 'Sewer System Performance Monitoring – The Options' Paper 2.2 in Developments in Storm Sewerage Management, a two day Symposium held at Sheffield City Polytechnic, 24-25 March 1986.

AMENDMENTS

Ver	Description	Date
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