The Practical Use of MOSQITO

RJ Armstrong BSc MPhil CEng MICE MIWEM

Montgomery Watson Ltd

MOSQITO is a complex piece of software enabling the tracking of upto 9 different sediment fractions and 11 different pollutants through a sewerage system. In order to simplify the picture this paper deals with only one pollutant namely BOD.

Initially MOSQITO was tested on existing WALLRUS models of sewerage systems. The results from these simulations were difficult to interpret so it was decided to examine the predictions of MOSQITO on a very simple system. A single branch combined sewer was therefore designed to serve a catchment area of about 20 ha. This sewer was designed to have a DWF velocity of 1 m/s and is designated a steep system. An overflow was located at the downstream end with a limiting continuation flow of 6 DWF. A 1 hour design storm was then simulated on the catchment. Pollutant loads in the system were simulated using the default parameters in MOSQITO.

The predicted overflow spill in volumetric terms and in terms of concentration of BOD is shown in Figure 1. This shows a highest concentration of BOD of about 20 mg/l at first spill. The concentration gets weaker as spill continues and then increases as spill decreases, back to a concentration of about 20 mg/l at the point when spill ceases. Perhaps significantly 20 mg/l of BOD corresponds to the old Royal Commission standards for sewage treatment works effluent for discharge into 8 times dilution.

Whilst carrying out the studies it became apparent that the most meaningful way of comparing the pollutant loads passed out of a sewerage system via an overflow was not in terms of concentration but in terms of total pollutant load. A graph for the total BOD load passed over the overflow for the system already considered is presented in Figure 2. The vertical scale for pollutant load has been chosen to be compatible with graphs presented later.

One aspect which affects the pollutant load passed over an overflow has been given as the length of the antecedent dry period before the rainfall event. For this catchment simulation with antecedent dry periods ranging from 1 hour to 250 hours has shown the pollutant load to be relatively unaffected.

The sewerage system was then redesigned to a DWF velocity of 0.35 m/s, designated a flat catchment. The resultant overflow spill in volumetric and total BOD terms from the same 1 hour storm is shown in Figure 3. For a 72 hour antecedent dry period it can be seen that the total BOD graph shows a large pollutant peak at the start of the storm. For a 1 hour antecedent period this peak is significantly reduced.

For the flat catchment the antecedent dry period therefore appears to be significant. The system is predicted to exhibit what has been termed a first foul flush.

MOSQITO allows the total pollutant load to be broken down into constituent components. This breakdown is shown in Figure 4. From this graph it can be seen that the pollutant load due to dissolved components is similar to that for the steep system. The first foul flush is caused by pollutant attached to fine organic sediment deposited in the sewer during the antecedent dry period being scoured out again during the start of the storm.

A comparison of total pollutant load predicted by MOSQITO and by the Interim Procedure in the WALLRUS package for both steep and flat catchments was undertaken and the results are summarised in Table 1.

Table 1

	MOSQITO	**INTERIM**
STEEP	12 kg BOD	169 kg BOD
FLAT	120 kg BOD	180 kg BOD

The comparison was undertaken using the default parameters in both cases. As such it might not be considered totally fair as the default values of BOD in the Interim Procedure are slightly higher than in MOSQITO. However the table does show that the Interim Procedure does not differentiate between the pollutant load from the flat and steep catchments; the slight difference being due to a slight difference in spill volume. By comparison with MOSQITO the pollutant load in the Interim Procedure appears to be weighted towards the worst case of a very flat system.

Another factor which was noted about the MOSQITO predictions was that for both steep and flat catchments it was predicted that about 300 kg of coarse sediment was washed off the surface into the sewers during the 1 hour storm. In the steep catchment MOSQITO predicted that this would be completely flushed through the system whilst in the flat catchment it was predicted that all of it would be deposited as sediment.

Before one becomes too complacent in assuming that the behaviour of the polluting characteristics of different types of sewer system can be easily understood, reference should be made to Figure 5. This shows the total BOD load over the overflow on the flat catchment due to a 5 hour duration storm after a 72 hour antecedent dry period. Although sediment was mobilised by this storm the graph shows that no first foul flush is predicted.

Having obtained some understanding of MOSQITO predictions from simple systems, a trial using default parameters was carried out on a real catchment. This catchment contained many overflows and for comparison three overflows which had relatively similar spill volumes were selected.

The predicted volumetric spill from the three overflows due to a 1 hour storm is shown in Figure 6. From this it appears that the overflows are similar.

MOSQITO now allows a comparison of the pollutant loads and this can be seen in terms of BOD in Figure 7. This shows that the polluting loads are considerably different and the worst case overflow is predicted to exhibit a last foul flush rather than a first foul flush. This last foul flush can be explained by tracking the movement of pollutants through the sewers. The fine sediment causing the effect is laid down in a flat area of the sewerage system about 1.5 km upstream of the overflow during the antecedent dry period. Although mobilised by the early part of the storm it takes over half an hour to reach the overflow.

RJA/PTN/15-Dec-93

Figure 1

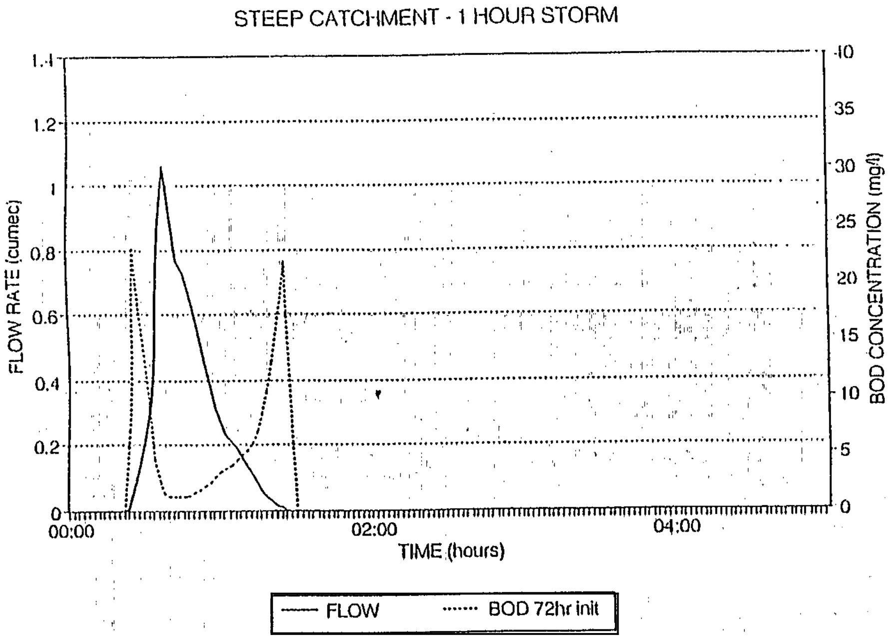


Figure 2

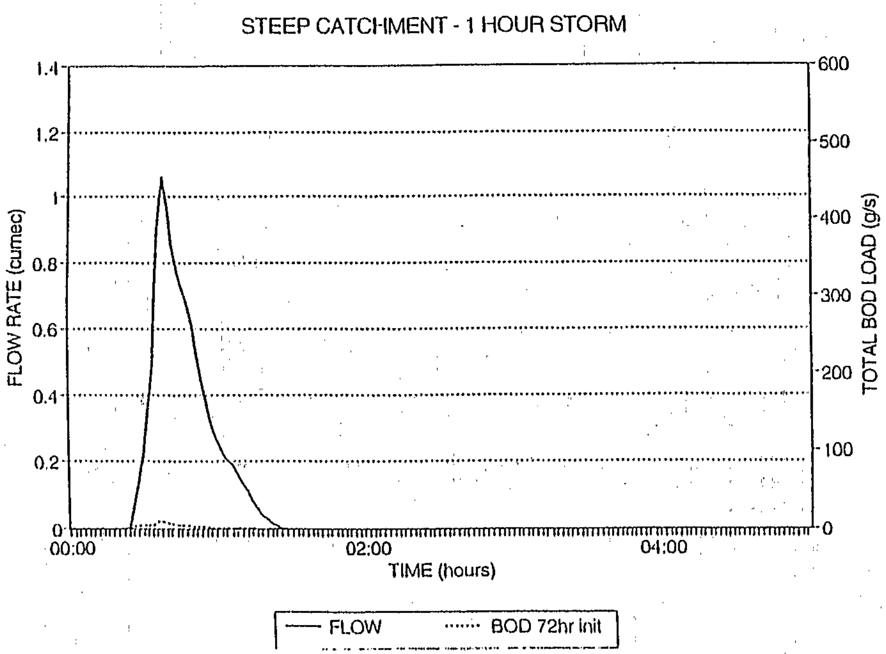


Figure 3

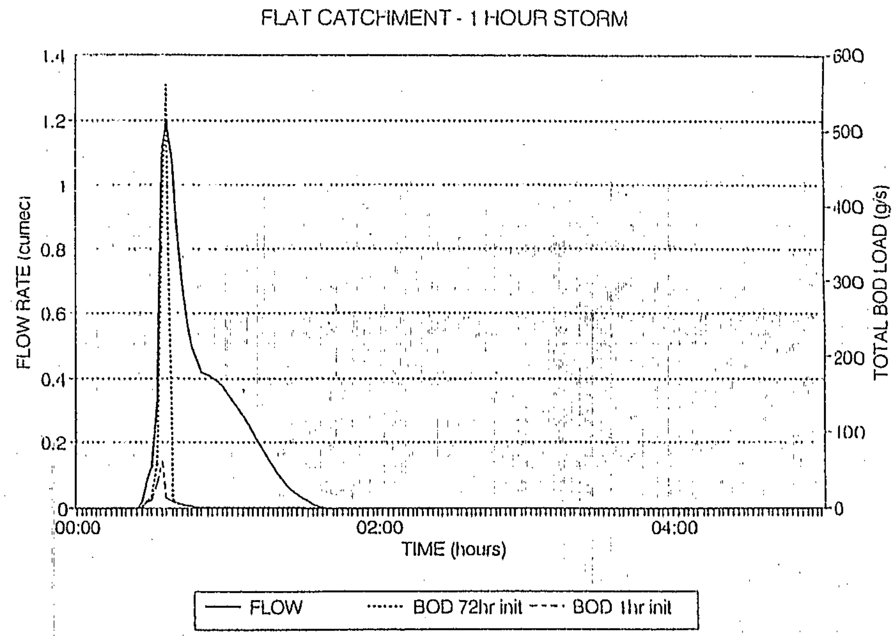


Figure 4

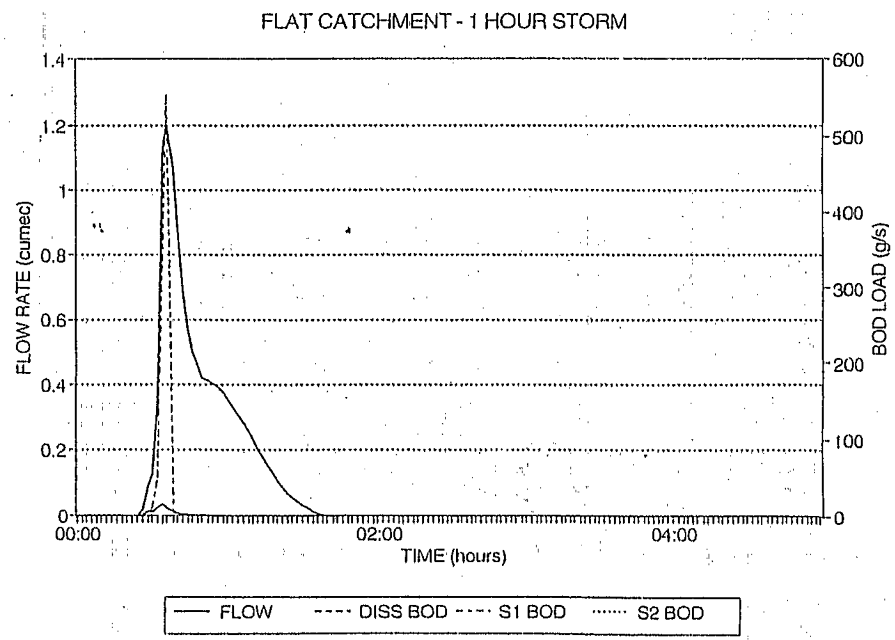


Figure 5

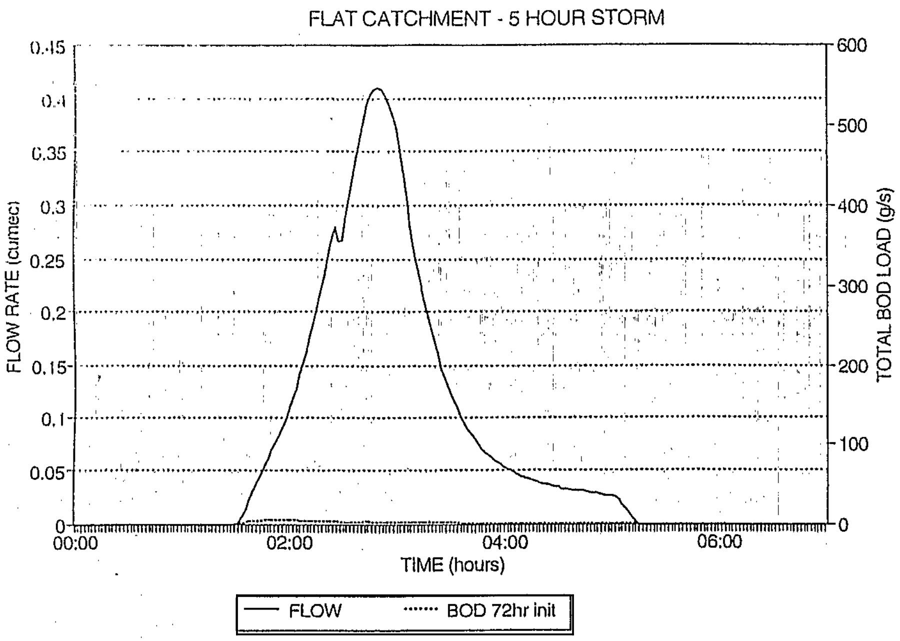


Figure 6

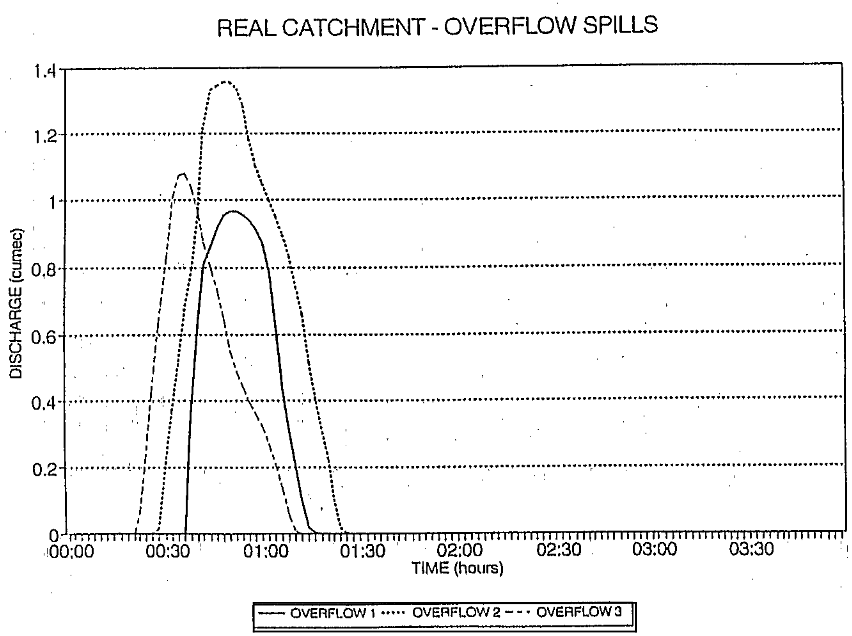
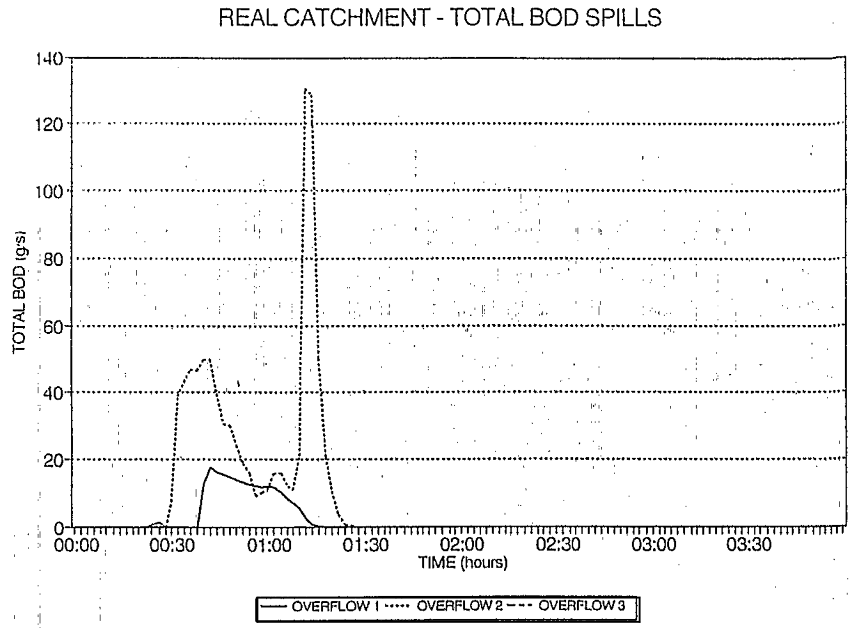


Figure 7



Practical use of MOSQITO
Robert Armstrong Montgomery Watson

Question Jim Allen Severn Trent Water Ltd

Did you model the DWF events to see how the concentration of pollutants were modelled? Did you change the default values?

Answer

No the DWF concentration was not modelled . The model was verified against DWF. The model runs were done with the default parameters.

Question Philip Mason Howard Humphreys and Partners

Could you explain the attenuation of pollutants?

Answer

Pollutant mobilised 1 Km upstream over the length input from side branches will attenuate the sediment peak.

Post Note:

When initially mobilised pollutant hydrograph has very short time base. Only small increases in time base due to attenuation have significant effect on peak to maintain mass.

Question David Beale DHV Burrow Crocker Consulting

Do you need to run the model for long initialisation periods to build up and stabilise pollutants?

Answer

Yes you need to look at long term data. For time series events the dry periods are important.

Comment Martin Osborne Wallingford Software Ltd

The initialisation period in MOSQITO is a single steady state analysis. You can do detailed full runs but the experience is that it gives a similar answer.

Question Dave Walters M W Barber Group

Why did you not look at suspended solids or gross solids?

Answer

Only presented one of the indicators because of time constraints, gross solids will be removed by the coarse screens required by any consent.

Question Bob Crabtree WRc Plc

Why did you look at pollution load rather than the concentration?
Did you look at CSO efficiency factor? This is a deficiency in the model, it is something to look for in the future at improving overflow performance.

Answer

Load is easier to interpret in the plots. In terms of output to river pollution model it is load that is important even if this is done by concentration hydrograph multiplied by volumetric quill hydrograph. Did not look at the differentiation of pollutant movement in the CSO. The site visits showed the overflows to have very poor efficiency factors a efficiency factor of 200 assumed. It may be worth looking at overflow efficiencies in the future.