EVALUATING POTENTIAL FOR REAL TIME CONTROL CHECKLIST OF FACTORS AND GENERAL GUIDANCE

.

J S Mann, Thames Water Utilities Ltd
A Baldwin, HR Wallingford Ltd

1. SCOPE

This user note describes the factors that need to be considered when assessing the potential for Real Time Control (RTC). It is intended primarily for engineers, planners and modellers who are not familiar with the concept of RTC. The assessment of RTC potential is one of a number of important steps that need to be carried out within the planning phase for sewerage in order to implement a scheme successfully. This user note includes some guidance on the factors that need to be considered when a number of catchments with a potential requirement for RTC are to be prioritised.

2. BACKGROUND

It is now widely accepted that hydraulic modelling is a routine part of the drainage area planning process. Real time control is a next step in this process. Increasingly sophisticated tools are being made available to design and implement appropriate works incorporating RTC. Drainage designs with RTC are therefore becoming accepted as alternative schemes in drainage area plans.

The aim of any RTC scheme should be to maximise the utilisation of any spare capacity within the drainage system in order to reduce current performance problems and costs and to provide opportunities for more flexible control of the system. Except for the completely over- or under-designed system, almost every existing urban drainage system can benefit from RTC. However, most RTC schemes are best implemented in combined sewerage systems due to their varying inputs and performance.

At the Autumn 1993 WAPUG meeting in Blackpool, it was suggested that a "checklist of factors" should be prepared in order to assist users in identifying suitable sites for the application of the RTC techniques. This note is based on experience gained so far in this new area.

3. PLANNING RTC SCHEMES

The process of evaluating, designing and implementing drainage schemes incorporating RTC facilities is based primarily on specialised hydraulic modelling and flow measurement techniques that can be used to define the drainage problems and to design the dynamic control strategies. It is however essential that due consideration is given to the proper planning of the scheme before commencing detailed modelling work.

It is recommended that the planning phase should follow a step-by-step procedure:

Step 1 Assess current situation. This will include the collection of readily available asset and performance data.

Step 2 Define and prioritise overall catchment objectives. Although prioritising of overall objectives may vary from one organisation to another, the following order of priority is suggested as a general guide.

i. Reduction in flooding

ii. Reduction in storm overflow pollution

iii. Reduction in sewage treatment works consent failures

iv. Reduction in operating costs

v. Reduction in capital costs

vi. Reduction in smell, disruption, etc

Step 3 Evaluate initial potential of RTC (see next section for details).

Step 4 Build/convert hydraulic model with RTC modelling features.

Step 5 Verify model.

Step 6 Assess performance of existing system.

Step 7 Identify and select alternatives/options.

Step 8 Evaluate cost effectiveness of all proposed solutions.

4. Initial Evaluation of RTC Potential

Step 3 above identifies the need to conduct an initial evaluation of the potential of using RTC before commencing detailed modelling and design of schemes. The evaluation is based on the assessment of the physical characteristics of the drainage catchment based on the following guidelines:

i. Utilise spare storage and flow transport capacities within the existing system. The fundamental question to ask is whether there is any existing or proposed unused pipe/storage capacity available (whether it is currently in the desired location or not) that can be mobilised by the use of dynamic controls. Where a verified model is available, spare capacity can be determined by viewing model results graphically and identifying pipes that are not surcharged due to lack of capacity or backing-up. The storage can usually be found in drainage systems with the following properties:

   Flat catchments with shallow gradient sewers. In areas where flow has to be pumped, RTC can be used to postpone pumping and thereby avoid high demand/tariff electricity charges.

   Large sewers. RTC benefits increase with the size of the network, both in terms of diameter and length.

Looped systems. These can provide the flexibility required for flow management.

Existing storage tanks. This can be particularly relevant where a number of tanks may be controlled in an integrated manner.

High level weirs at Combined Sewer Overflows (CS0s). The available capacity, however, must be used carefully to avoid any potential flooding upstream.

ii. System Response times (i.e. time of concentration)

Long system response times are required for RTC schemes as these provide time to formulate and implement control strategies.

Varied system response times throughout the catchment are also required as these provide scope for controlling the flows. This situation would normally occur where the distribution and size of the sub-catchments (particularly impermeable areas) is wide and varied. Any significant interaction of flow which creates problems at a particular location/junction downstream should be identified. RTC should allow a reduction in such problems by balancing flows within the drainage system.

iii. Size and topology of catchment. Generally large flat catchments provide greater potential for using RTC techniques.

iv. Spatially varied radar allows significant benefits to be obtained using RTC systems.

v. Flow diversion systems such as bifurcations and pumping stations allow flows to be transported to other parts of the system where there is spare capacity.

vi. Existing control structures that currently provide "static" control may be automated with minimal capital cost whilst providing substantial improvements to system performance. RTC benefits increase with the number of controllable structures. It is important to determine the condition of the existing controls to ensure that they can be automated without excessive cost and risks.

vii. Existing structural condition of the drainage system. RTC schemes exhibit a wide range of flows and depths that increase the risk of structural deterioration of the system. Therefore, systems with minimal structural problems are suitable for RTC application.

viii. Capacity of receiving waters may assist in minimising the pollution effects of discharges from CS0s and sewage treatment works. Where the whole river basin can be considered as one entity, the benefits of flow-smoothing on the sewage treatment works and controlled intermittent discharges on the watercourses can also be assessed at the same time by incorporating rules in the RTC control strategy.

5. FACTORS FOR PRIORITISATION

When prioritising potential RTC catchments, the aim should be to choose those catchments where the benefits are likely to be significantly large compared to the required investment. It is important therefore to give high priority to those areas with significant problems and/or opportunities.

Areas that require consideration and analysis using the appropriate weightings are where:

1. level of service is below the required current or future standard (e.g. flooding);

2. threat of prosecution and strict performance criteria needs to be maintained throughout the whole sewerage system (e.g. CS0s);

3. existing operation and maintenance of drainage system needs to be improved (e.g. energy costs, siltation);

4. major expenditure is planned but can be deferred or phased by the application of RTC.

Another important factor in prioritising catchments is the payback period of the investment required into the planning and implementation of an RTC scheme. An RTC scheme should provide maximum benefit for a minimum amount of investment. For example, it may be possible to minimise the amount of effort into an RTC scheme by choosing catchments where:

1. reasonably good data is already available (e.g. DAP/model already complete);

2. existing controls (Penstocks, etc.) may be suitable for automation to minimise the capital costs of RTC implementation.

6. CONCLUSIONS

The potential benefits that can be obtained from the use of RTC technology in urban drainage systems can be evaluated using the 'check-list' approach described in this paper. If the initial evaluation highlights potential benefits from RTC, then a more detailed analysis using modelling techniques can be conducted to plan, design and cost RTC solutions that may be included within the traditional drainage area planning activities.

Finally, the authors of this paper would like to emphasise that further research and development is currently being conducted by various organisations within the water industry. The general aim of the work is to develop techniques, procedures and software tools to assist engineers in the water industry to analyse, design and implement RTC schemes successfully.

AMENDMENTS

Ver	Description	Date
1.	First Published	October 1994
2.	Editorial amendments	March 2009