GUIDANCE ON MANAGEMENT OF SEWERAGE SYSTEMS

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There is increasing emphasis in the UK on improving the effectiveness and efficiency of the management and operation of sewerage infrastructure. CIRIA therefore set up a scoping study to define the issues and to identify further work to address these issues. The geographic focus was England and Wales although many of the issues are universal. The study was carried out by Montgomery Watson and Reid Crowther.

Information was gathered by literature review and by discussions with sewerage operations staff. The information was then assessed to identify the current issues, future trends that might affect these issues, and the stakeholders involved in each issue. Existing sewerage management guidance and practice was reviewed to see how this dealt with the issues. The barriers to improved operations and management were then assessed and ways to remove them identified. Recommendations for future work were also identified.

Why manage sewers

Sewers are a transport system that is designed with three main facets in their function:

- Avoidance of public nuisance such as odour, rodents, disruption, disease.
- Avoidance of pollution
- Avoidance of flooding

Sewers are designed to meet these three functions, but they are not fit-and-forget infrastructure. They are managed to meet changing needs, to keep them efficient and to stop them going wrong and not meeting their functions.

The problem escalator

There is an escalation of things that can go wrong with sewerage systems and there are several steps at which we can intervene to prevent these leading to problems.

- The first level of the escalator is ongoing faults - things that are wrong all of the time. The three main types of these are:
  - Inadequate assets
  - Inadequate operation
  - Excess input of flow, sediment or pollutants
- The second level is random faults. These can occur anywhere in the system at any time, but they are often triggered by underlying ongoing faults. Typical random faults are:
  - Sewer blockage
  - Pump breakdown
  - Sewer collapse

Many of the mechanisms for causing faults can involve a feedback loop. For example, the initial problem causes slow flow conditions, leading to sediment deposition, septicity and blockage that worsen the fault or can cause other faults that lead to slower flow and more

faults. The occurrence of slow flow and low flow conditions is one of the most important factors to be considered in sewerage system management.

- The third level of the escalator is failure - that is the occurrence of flooding, pollution or nuisance. Not all faults lead to failure.

Some failures may be too small to impact upon sewerage system effectiveness or efficiency.

There may be redundancy designed into the system to help prevent failure; such as standby equipment, alternative flow route, spare storage capacity. For combined systems, the most likely reason why faults do not lead to failure is that they are designed for a return period of 10 or 20 years and have spare capacity for most of the time.

- The fourth level of the escalator is impact - that is something that costs the company money or leads to prosecution or other sanctions.

Failure does not always lead to a complaint or a prosecution. People may not notice minor flooding or a minor polluting discharge, or they may not care if it does not directly affect them. However, public perception is different from place to place and may change rapidly with time, therefore it is desirable to avoid failure.

Problem top ten

The discussions held with sewerage staff during the CIRIA scoping study identified the top ten problems affecting sewerage system management as:

- Flooding (reporting to OFWAT and yielding customer complaint)
- CSO pollution (public concern and failure to meet EA requirements)
- Fats and grease (blockage or reduced capacity and vermin)
- Sediment (reduced capacity and shock loading)
- Roots (blockage and infrastructure damage)
- Sewer derived litter (system interference and aesthetic issues)
- Cross connections (potential overloading of parts of system - hydraulic and pollution)
- Collapses (severe disruption to the system and requiring rapid response)
- Small package treatment plants (inappropriate operation or maintenance frequency and reliability, causing for example pollution to watercourses)
- Slow flow conditions (leading to all sorts of problems in the system)

Management strategies

In order to manage our sewerage systems we can intervene at each stage of the escalator with either capital expenditure or operational expenditure. The difficulty is to develop a strategy which gives the correct balance between cost and function.

To remove ongoing faults investment is needed to improve the assets.

To avoid random faults the ongoing faults can be addressed, for example preventing them forming or reducing the sources feeding into the system.

To avoid faults becoming failures, regular cleaning or maintenance to fix faults before they become significant can be carried out. Monitoring for the occurrence of significant faults and then carrying out maintenance, or investment in additional system redundancy will also help avoid failure.

To help satisfy customers in the event of failures, they should be responded to as soon as they occur. Compensation to anyone who suffers an adverse impact will also help to mitigate impact.

Current situation

The practices of sewerage system management have developed over many years, including regular cleaning and labour intensive routine maintenance schedules. In recent years these practices have tended to be reduced in order to save money. The impact of this change, however, on levels of service is only gradually being identified. As yet there is not a coherent alternative strategy for managing sewers to meet defined levels of service.

There is now a considerable amount of information available on how sewerage systems have been managed and on the frequency of problems. Unfortunately there is not always information on the exact causes of those problems or on how alternative management strategies could have helped. However the information that does exist allows us to identify many ways of improving sewerage system management.

Sewerage systems are a common asset, used by and affecting almost everyone in society. The interrelations between these stakeholders are very complex. Everyone can be affected by problems with the sewerage system, but can also be contributing to the problems.

No-one wants to cause problems in the sewerage system and those responsible for their management want to manage them effectively and at lowest cost. So if there are problems with sewerage systems then it is because there are barriers preventing people from achieving this.

These barriers could be due to lack of knowledge, lack of money, or legal and organisational barriers. The solution to problems of sewerage system management is therefore to remove these barriers and allow all of the stakeholders to play their part. This requires a collaborative approach involving all of the stakeholders and communication between all of those involved to improve their understanding of the whole system.

Recommendations

The project considered the issues and made recommendations on how to remove the barriers to improved sewerage system management. These were divided into five main groups:

- Dissemination of existing information
- Preparation of best practice guidance
- Changes in regulatory framework
- Changes in legislation
- Fundamental research

The main recommendations of each group are described below.

Dissemination of existing information

These recommendations aim at educating those who may be sources of problems to understand the problems that they may be causing. There may still be barriers to them acting to stop causing problems – including that it may cost them more – but understanding may lead to improved behaviour.

Fats and grease are a major cause of problems in sewerage systems and the main source is often restaurants and fast food outlets. An education campaign is needed to publicise

the extent of the problems that are caused. Initially this should be aimed at Environmental Health Officers and they should then be used to carry the campaign to food outlets, building control officers and trade effluent departments.

Building works affect sewerage performance both directly through faulty work on sewer connections, and indirectly through the discharge of sediment, oil and other pollutants. Large contractors are to some extent aware of the problems that they can cause, although further education may help. Small contractors, local builders and the DIY trade are probably unaware of the issues. A publicity campaign aimed at building control officers, associations of building contractors and building material suppliers could raise awareness of these problems.

Preparation of best-practice guidance

A considerable amount can be achieved by integrated use of operational data and sewerage models to identify where problems are likely to occur and how they can best be tackled. A lot is already being achieved in this direction and the need is to make available the best existing practice in collecting data, using data and using models for operational purposes.

Other areas where guidance is needed include the operation of small treatment plants, monitoring of CSOs (particularly for coastal schemes) and techniques for identifying mis-connections to the sewerage system.

Changes in regulatory framework

The investment and operational decisions made by the water companies are profoundly influenced by their response to the framework established by OFWAT. This framework influences the balance between capital and operational expenditure. There has been some imbalance between these in recent years but OFWAT now emphasises that decisions should be based on whole life costs and that for sewers the life is effectively infinite.

OFWAT also influences the relative importance of problems caused by system incapacity and problems caused by operational problems. A more balanced approach to sewerage management would result from giving equal emphasis to all causes of problems.

Changes in legislation

There are several areas in which changes to legislation would provide sewerage undertakers with wider powers to manage what happens to their systems.

A change in scope and enforcement of building regulations could reduce the impact of mis-connections to both foul and surface water sewerage systems.

There is currently a right of connection for surface water to a foul sewer if it is the only sewer provided. This should be reviewed.

One of the most important sources of problems is fat and grease discharged by food outlets and they are currently exempt from trade effluent regulations.

Fundamental research

Some fundamental research is needed into the serviceability grading and collapse of sewers, into trends in flows and loads and into septicity problems due to saline intrusion into sewers.

In conclusion

Through a combination of the above recommendations it is considered that sewerage system management will be improved. This requires all those involved to play their part fully with a common goal of improving efficiency and effectiveness towards financial, technical and environmental reward.

References

The issues raised in this paper are discussed further in the scoping study report[1] which contains a comprehensive list of references and other suggested reading.

1. M Osborne and M Bottomley, (1998), *Sewerage system management: scoping study*, Construction Industry Research and Information Association (CIRIA) Project Report 67

DISCUSSION

Question **Jeremy Lumbers** **Tynemarch**

You did not mention the issue of asset condition vs serviceability.

Answer

We did actually consider serviceability, we know the effects but not always the cause. We recommended the introduction of a serviceability factor.

Question **Ron Salinger** **Such Salinger Peters**

How would you like to see the right to connect to foul sewers changed.

Answer

Developers should not be required to have to lay surface water sewers to solve this problem. Developers should have to provide source control solutions as means to tackle this problem.