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Briefing Note

Waste Water and Storm Water Networks

The principles of good sewer network management

Summary

This paper is written for policy makers, practitioners and other stakeholders who want an insight into managing and maintaining the 3 million km of sewers across Europe. Our intention with this paper is to share these ideas and stimulate debate and new thinking on the management of the sewer network.

Our sewer networks are unseen arteries beneath our feet, carrying out the vital tasks of providing sanitation and drainage. They connect our homes, offices and industrial sites to waste water treatment plant. To ensure that those networks are fit for purpose today and into the long term, we need to plan, invest, operate and maintain them accordingly. And yet the nature of our sewer networks across Europe and the challenges they face are diverse, and the pressures they are under are evolving.

Against this background, any management framework needs to be sufficiently flexible to reflect regional and local needs, whilst at the same time showing that principles defined at an EU level are being delivered. This document sets out what EurEau sees as sound, but sufficiently flexible management principles to meet this duality of need.

It is intended that this paper should be read in conjunction with two other EurEau papers:

- What is a sewerage network – provides a basic non-technical background to sewerage networks.
- Overflows from collecting systems – focuses on one specific aspect of our sewerage network. Why they are required, and how the environmental impacts should be managed?

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Table of Contents

1. Background 3
2. Existing and new challenges facing waste water collecting systems 4
3. Nine principles of good sewer network management 4
   3.1. Describing the existing sewer network 4
   3.2. Understanding performance objectives 5
   3.3. Managing the available capacity of the waste water system 6
   3.4. Integrating with the urban environment 6
   3.5. Effective operational and maintenance regimes 7
   3.6. Contributing to city resilience 7
   3.7. Coordinating measures 8
   3.8. Prioritising measures 8
   3.9. Financing and good governance of the sewer network 9
4. Comments on the principles 9

1. Background

Our sewer networks across Europe are diverse, as are the evolving challenges they face. To be able to plan, implement, operate and maintain our networks effectively, from the day to day, to the long-term future, requires any regulatory framework to be flexible in nature, and to set out overall objectives, rather than concentrate on the minutiae of prescriptive detail.

To align with overarching objectives set at EU level, EurEau is proposing a set of **nine overarching principles** of good sewer network management to achieve the following **outcomes**:

- ensuring the protection of public health, the environment and the health and safety of waste water system operators
- ensuring full coordination in the management of the sewer system and the waste water treatment plant, from strategy through to the daily operation
- supporting the planning and design of resilient waste water and storm water networks while creating urban environments for the future which are vibrant and desirable places to live and work
- enabling waste water systems to make a full and valuable contribution to society and the circular economy through the recovery and reuse of resources, including storm water
- making sufficient financial provision for investment in and the renewal of the sewer network; protecting what we have today (assets, equipment and operating systems) so that service provision does not deteriorate AND future services improve where required
- ensuring that financial investments deliver measurable and meaningful benefits for public health and the environment
- providing a foundation for any future EU level legislation which affects sewer networks.
- providing visibility and transparency of the performance of networks, so that customers, communities and society have confidence in how those systems are being operated, maintained and invested in.

EurEau members are now actively exploring what the future of good sewer network management might look like. This paper sets out some of the general ideas from the perspective of waste water system operators. **Our intention with this paper is to share these ideas and stimulate debate and new thinking on the management of the sewer network.**

2. Existing and new challenges facing waste water collecting systems

Operators face many challenges in maintaining the existing sewer network including an ageing asset infrastructure, which is often historic and poorly understood. Sewer systems need to accommodate a large range of flows as they contain both urban waste water and storm water, either as a combined sewer system (both waters share the same pipe) or separate systems (each type of water going into dedicated pipes). All waste water systems have connections (for the users of the sewers), over which operators may have limited controls. In addition, waste water systems can incidentally collect rubbish and litter from a range of sources. Moreover, sewer networks and waste water treatment plants may be subject to multiple governance and operational arrangements in an individual waste water catchment.

Looking to the future, there are **five significant challenges** for the sewer network:

1. **demands for further reduction of environmental impact from sewer networks and waste water treatment plants**
2. **demands for further reductions of untreated waste water discharges**
3. **demands to reduce flooding or flood risk**
4. **enabling urban growth (population and industry)**
5. **improving resilience to the adverse impacts of changing weather patterns and climate change.**

These five challenges require that the physical drainage systems, together with their associated treatment works and operating processes, are adapted to face the future.

With both existing and new challenges in mind, EurEau suggests **nine principles of good sewer network management**.

3. Nine principles of good sewer network management

3.1. Describing the existing sewer network

Our first principle for good management is to **describe the existing systems and to build baselines of assets, their condition and performance**. At its most basic, this is an inventory of the networks, how they connect, including the downstream receiving waste water treatment plant, and the location of key ancillaries on the network, such as combine sewer overflows (CSOs). It should be noted that data are needed for both the drainage network and the associated river basin/natural catchment areas.

Given the scale of data, information and analysis involved, computer systems need to be selected that are appropriate for this scale and complexity of work. This can represent a significant part of an organisations computing capability (both data storage and analysis), as well as a significant component of specialised personnel. In addition, as

management and operation of the network and treatment works may involve several organisations, appropriate arrangements need to be in place for the access of common information.

In some places, the network and the catchment are comprehensively understood (for example through surveys/models and historic data). In other places, data are scarce. This may be because there are few resources or incentives for gathering data, or it may be that systems are performing in an acceptable way so baseline data have never been required. We note that operators usually invest in data gathering in response to one of the five significant challenges. Given the history of the development of sewers, it is disproportionate and impractical to collect data without clear objectives.

The type of information collected may relate to the type of sewer (combined, separate, storm water), hydraulic capacity, the condition of the physical asset (based on inspections for at least the strategic/critical parts of the network), the location of pipes and other key structures (overflows, pumping stations, manholes, nodes, throttle structures, valves) and the operating regimes, connections and users of the system. Network records and maps can then be compiled and the network can be understood in the context of the river basin/catchment area with which it interacts.

In summary, characterising the existing system allows us to assess its performance and to identify hazards and to create a framework for risk management and/or improvement measures. Without this knowledge, what is unknown cannot be properly managed.

3.2. Understanding performance objectives

Managing sewer networks effectively on an ongoing and long term basis requires a clear understanding of the desired outcomes. For example, if the desired outcome is to reduce pollution or achieve a certain level of service (such as protection from sewer flooding) then these outcomes must be known by operators.

In reality, operators often have to satisfy multiple objectives for example, compliance requirements under EU directives (such as the Bathing Waters, Urban Waste Water Treatment and Water Framework Directives) and local/regional requirements.

A principle of good management is that **network operators must be aware of all the performance objectives and the desired outcomes**, so that sewer designs and their associated management systems can be optimised. An integral part of this involves understanding risks, their likelihood and the consequent impact if the risk is not adequately managed. Moreover, in cases of multiple network operators on the same sewer network, performance objectives and desired outcomes must be based on mutual cooperation and understanding of the involved operators.

Monitoring performance of the waste water system, including flows and operation of assets (such as CSOs and pumping stations) is becoming increasingly common in order to demonstrate compliance with objectives. This can be either a temporary or permanent solution, simple or highly-technical in nature, depending on requirements. Again, operators must be fully appraised of the objectives and desired outcomes in order

to implement appropriate and affordable monitoring.

In addition to monitoring, water quality modelling of receiving waters can be used to demonstrate compliance with water quality performance objectives and, where appropriate, may allow Member States to utilise collective capacity in the receiving waters without compromising the achievement of Water Framework Directive objectives.

3.3. Managing the available capacity of the waste water system

Understanding the current and future hydraulic performance of systems is key to managing current and future impacts of networks on people and the environment. There are many different types of tools available, from simple calculations to sophisticated and detailed hydraulic models of network performance and receiving water quality, under a wide range of conditions.

Available capacity management is a primary tool of operators to achieve the objectives of resilience, preventing loss of untreated waste water and managing flood risk. In case of multiple network operators, capacity management should be coordinated as much as possible. These challenges, and solutions, apply to both combined and separate systems.

New waste water systems can be designed for greater capacity, but it must be noted that new investments are rare at least in the EU15; and given the 3 million kilometres of waste water pipes already in place across Europe, it is more likely that the existing system would be modified or innovative/smart control systems would be applied rather than new sewers being built.

Intermittent discharges from CSOs can be managed in a number of different ways. The principle of managing CSO discharge is to establish the required objective (whether it is compliance with water quality objectives, reduced flood risk and/or other objectives) as this allows a range of technical solutions to be investigated and costs to be proportionate. This includes evaluation for combined systems of whether partial separation, for example through the use of Sustainable Urban Drainage Solutions, offers a viable solution.

3.4. Integrating with the urban environment

It is important to ensure that the sewer network is appropriately located and connected to the greater urban environment in a holistic manner, which allows for the coordination of plans, measures and implementation to deliver sustainable and resilient cities. Each sewer network must be connected to the waste water treatment system which complies with the UWWTD requirements.

Proper integration ensures that future access to the sewer network is possible, in often crowded urban environments with multiple utilities.

Integration with soft drainage features (blue-green infrastructure) to balance flows and provide biodiversity benefits is becoming widely practised in Europe. EurEau sees many

opportunities to enhance the urban environment and maximise the benefits provided by waste water systems, when the principle of integration is applied.

Looking to the future, integration of systems to recover and reuse water, energy, heat and nutrients in accordance with the Circular Economy may need to be considered more widely in urban areas. Integration of the waste water system with the circular economy in cities offers many potential benefits.

3.5. Effective operational and maintenance regimes

Our fifth principle is to equally ensure that the existing network is properly operated and maintained. This includes practical day-to-day operation and maintenance, such as **cleaning regimes for sewers** and **repairing collapsed and blocked pipes**. These activities place considerable demands on operators and sometimes the work can be hazardous.

Cleaning to remove inappropriate items from sewers (fats, wet wipes) could be significantly reduced if sewers were not used as bins. Waste management could be improved if consumers were informed on how to best dispose of litter, wipes and fats e.g. by improved labelling of consumer products or clear waste recovery schemes. This type of consumer information and awareness-raising is crucial.

Day-to-day management and maintenance of the sewer network (including finding and rectifying cross-connections between storm and foul systems where there are separate sewers) mitigates pollution impacts. Additionally, repair of collapsed sewers helps to protect groundwater resources from pollution. Whilst technology advancements can assist in the early warning of problems, prevention is always better than cure.

3.6. Contributing to city resilience

Different approaches to resilient cities extend from ideas about response and recovery after significant events (such as flooding or storms, storms after a long period of drought), to holistic models of urban resilience, recognising the interdependent complexities and unique value of cities.

Waste water systems contribute to the resilience of cities in terms of providing drainage, preventing flooding and protecting public health. In coordination with the principle of integration, waste water systems can also provide other benefits, making cities resilient and sustainable. This may lead to the wider application of sustainable urban drainage systems.

Within the principle of resilience, we note the requirement for security. This may be the physical security of waste water assets, or data security for our systems and personal data relating to customers and citizens we serve.

As a comparatively new concept, city resilience is generating many new ideas on the structure and functioning of the urban environment. The principle of resilience is not yet fully defined in all aspects, but we see this principle informing cooperation and collaboration at city-level and also informing city-level objectives, priorities and

motivation for action. For waste water operators, the concept of resilience is changing the stakeholders we work with and informing ideas about the management of, and improvements to, the sewer network.

3.7. Coordinating measures

Often sewer networks contribute to multiple objectives, ranging from compliance with EU directives to city-specific objectives. These objectives also span a variety of timeframes, from the immediate to the very long term. The latter is particularly important for sewer networks, as below ground investment is generally for very long timescales. The challenge of satisfying multiple objectives with one network of sewers is a reality for waste water operators. As noted above, operators must be fully aware of all the performance objectives and the desired outcomes.

Coordination of measures become more complex when sewer networks and waste water treatment plant are subject to multiple governance and operational arrangements in an individual waste water catchment. In some cities, for example, the sewer network is managed by several independent entities, which also differ from the entity managing the waste water treatment plant. This requires entities to have common, clearly communicated objectives and coordinated operational strategies.

Finally, we note that the entities responsible for the management of the sewer networks and the waste water treatment plant also need to coordinate with multiple stakeholders (urban planners, land owners, utilities, regulators, developers, citizens…) to achieve multiple objectives and ensure that capital works can be prioritised and scheduled in the most cost-effective manner. For example within an urban environment, blue-green infrastructure requires significant cross-sector coordination in order to implement effective solutions.

3.8. Prioritising measures

As we note in our position paper on overflows from collecting systems:

The priorities for action must be agreed at the local, regional or Member State level. At the same time, the costs of action must be acceptable and affordable and set within the context of investment plans which are financed and implemented at the local or Member State level.

The sewer network comprises assets with long lifespans (from tens to hundreds of years). With approximately 3 million km of sewers already in the ground, it is first necessary to maintain them. This includes renewal and renovation, modernisation and adaptation to the future requirements[1]. As it is not financially or practically possible to make all the desired changes, it is therefore necessary to prioritise investment.

Typically, investment arrangements for improving and/or new sewers are decided at local and regional levels. This local or regional perspective allows flexibility in order to

[1] This may include renewing or repairing existing pipes, enhancing the available capacity of the network, new or improved storage, upstream measures to reduce inflow or sustainable urban drainage solutions.

satisfy the objectives, whether they are reducing pollution and/or flooding, additional capacity for urban development or climate change.

Making the transition from current performance to new/different levels of performance to satisfy future flow and loads coupled with the desire for resilient cities is a significant task for sewer network operators. Notwithstanding legal obligations, the prioritisation may take account of:

- the existing sewer network, its condition and performance requirements
- the measures which produce the most benefits
- the cost of any proposed measures including affordability for those who have to pay
- the desired outcomes of the multiple stakeholders
- the best delivery methods and optimal integration of sewer networks into the urban environment.

3.9. Financing and good governance of the sewer network

The main challenge for the European waste water sector will be finding sufficient financing to address the five challenges identified above. This must be seen in the context that there is often insufficient financing for the existing sewer network to maintain current service levels and to protect the environment to the standards which are already established. Without a doubt, sufficient financing for network renewal, modernisation and adaptation to the future requirements needs to be secured. Whatever the administrative arrangements for sewers within a region or Member State, careful consideration to the future financing requirements and appropriate governance systems is essential in order to ensure sustainable and resilient urban environments.

EurEau anticipates that there are unlikely to be simple or quick solutions to resolving the future financing burden. However, we note that maximum benefits will be achieved at the lowest cost when sewer networks are integrated into the urban environment and actively contribute to the city resilience, and when measures (renewals, adaptation of the sewer) are coordinated and properly prioritised (i.e. when principles 5 to 8 are properly applied). Affordability and distribution of the burden of these future costs is the subject of governance within regions and Member States and requires careful consideration.

4. Comments on the principles

Sewer networks, by their nature, are open systems receiving variable inputs and flows, therefore it is appropriate to set principles for management, with in-built flexibility. The nine principles set a sound basis upon which existing and future demands placed on our sewer networks, including protection of public health, protection of the environment and managing flood risks in the built environment, can be met.

The aim of the principles set is to provide the link between the overarching requirements set at European level, and their implementation at regional and local level. For operators, the nine principles support strategic planning for sewer networks and their integrated operation with waste water treatment plant.

It should also be noted, that the nine principles remain valuable whether operators of the sewers are highly advanced in all their management techniques for all parts of their networks, or whether they are just starting to understand the sewer network at principle number 1.

The principles enable enhanced co-ordination both internally with the treatment works, and externally with other key stakeholders, including city planners, flood risk managers and citizens.

As the challenges of the future will be more complex and inter-related than those we faced in the past, EurEau sees that the nine principles ensure decisions made for sewer networks are robust, resilient, sustainable and affordable.

About EurEau

EurEau is the voice of Europe's water sector. We represent drinking water and waste water operators from 29 countries in Europe, from both the private and the public sectors.

Our members are 32 national associations of water services. At EurEau, we bring national water professionals together to agree European water sector positions regarding the management of water quality, resource efficiency and access to water for Europe's citizens and businesses. The EurEau secretariat is based in Brussels.

With a direct employment of around 476,000 people, the European water sector makes a significant contribution to the European economy.

Glossary

Separate systems: collecting systems have separate pipes for storm water and waste water.

Combined systems: collecting systems that collect both storm water and urban waste water in the same system of pipes.

CSO: combined sewer overflow; combined systems incorporate overflow devices (CSO's) to ensure that when storm water flows are high, the excess flow can spill into a receiving water body at a designated location. CSOs are part of the normal operation of combined collecting systems, with the intention of preventing spills and flooding at undesirable locations or overloading of waste water treatment plants (WWTP). Overflow events are, by their nature, intermittent local discharges, which are weather dependent.

Sewer network: the system of drains, manholes, pipes, tanks, conduits, pumps and pumping stations, screens and associated equipment for control and monitoring, which gather and convey waste water and storm water to a treatment facility. The sewer network may collect and transport a mixture of urban waste water, industrial effluent, rainwater and/or snowmelt or may be confined to urban waste water only. Within the Urban Waste Water Treatment Directive, the sewer network corresponds to the definition of the "collecting system". This network may have different governance and administrative controls along its route and those connected to it. The sewer network may comprise combined systems, separate systems or a mixture of both.

Blue-green infrastructure: natural and semi-natural landscape elements that are implemented on an urban waste water catchment to flow entering the sewer network (grey infrastructure). It can refer to parks, infiltration ditches, natural rivers, etc.