



**HAL**  
open science

## Urban drainage asset management – also for blue-green infrastructures!

Jeroen Langeveld, Frederic Cherqui, Franz Tscheikner-Gratl, Tone Muthanna, Marina Fernandez-Delgado Juarez, Joao P Leitão, Bardia Roghani, Karsten Kerres, Maria Do Céu Almeida, Caty Werey, et al.

### ► To cite this version:

Jeroen Langeveld, Frederic Cherqui, Franz Tscheikner-Gratl, Tone Muthanna, Marina Fernandez-Delgado Juarez, et al.. Urban drainage asset management – also for blue-green infrastructures!. Novatech 2023 11e Conférence internationale sur l'eau dans la ville, Jul 2023, Lyon, France. hal-04168218

**HAL Id: hal-04168218**

**<https://hal.science/hal-04168218>**

Submitted on 16 Aug 2023

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

## Urban drainage asset management – also for blue-green infrastructures!

### Gestion patrimoniale des systèmes d'assainissement urbains – n'oublions pas les infrastructures vertes et bleues

Jeroen G. Langeveld\*, Frédéric Cherqui Franz Tscheikner-Gratl, Tone Merete Muthanna, Marina Fernandez-Delgado Juarez, Joao P. Leitão, Bardia Roghani, Karsten Kerres, Maria do Céu Almeida, Caty Werey, Bénédicte Rulleau

Tu Delft, [j.g.langeveld@tudelft.nl](mailto:j.g.langeveld@tudelft.nl); INSA Lyon, [fcherqui@gmail.com](mailto:fcherqui@gmail.com), NTNU [franz.tscheikner-gratl@ntnu.no](mailto:franz.tscheikner-gratl@ntnu.no), NTNU, [tone.muthanna@ntnu.no](mailto:tone.muthanna@ntnu.no), NTNU, [marina.f.d.juarez@ntnu.no](mailto:marina.f.d.juarez@ntnu.no); EAWAG, [JoaoPaulo.Leitao@eawag.ch](mailto:JoaoPaulo.Leitao@eawag.ch), NTNU, [bardia.roghani@ut.ac.ir](mailto:bardia.roghani@ut.ac.ir), FH Aachen, [kerres@fh-aachen.de](mailto:kerres@fh-aachen.de); LNEC, [mariaceualmeida.ol@gmail.com](mailto:mariaceualmeida.ol@gmail.com); INRAE, [caty.werey@inrae.fr](mailto:caty.werey@inrae.fr); INRAE, [benedicte.rulleau@inrae.fr](mailto:benedicte.rulleau@inrae.fr)

## RÉSUMÉ

Les systèmes d'assainissement urbains se sont développés bien au-delà des traditionnels réseaux unitaires ou séparatifs. De nombreux "nouveaux" systèmes sont en cours d'introduction, allant des solutions d'infiltration des eaux pluviales aux toitures végétalisées. La gestion patrimoniale des réseaux d'assainissement est, malgré ses défauts, bien établie pour les canalisations, tandis que les infrastructures vertes et bleues largement préconisées sont généralement négligées par les gestionnaires, ce qui aura très probablement des effets néfastes sur leur performance et leur durée de vie. Dans cette contribution, le groupe de travail *Urban Drainage Asset Management* (UDAM - <https://udam.home.blog/>) du comité conjoint de l'IWA et de l'IAHR examine si les connaissances actuelles sont suffisantes pour mettre en œuvre la gestion patrimoniale des infrastructures bleues-vertes. La discussion est structurée autour des 5 conditions préalables à un contrôle/une gestion efficace.

## ABSTRACT

Urban drainage systems have developed way beyond the traditional piped combined or separate sewer systems. Many 'new' systems are being introduced, ranging from stormwater infiltration facilities to green roofs. Sewer asset management is, despite its shortcomings, well established for piped systems, while the widely advocated blue-green infrastructures are typically overlooked by asset managers, which will very likely have detrimental effects on their performance and service life. In this contribution the working group on Urban Drainage Asset Management (UDAM - <https://udam.home.blog/>) of the IWA and IAHR Joint Committee on Urban Drainage discusses whether the state-of-the-art knowledge is sufficient to develop asset management for blue-green infrastructures. The discussion is structured around the 5 preconditions for effective control/asset management.

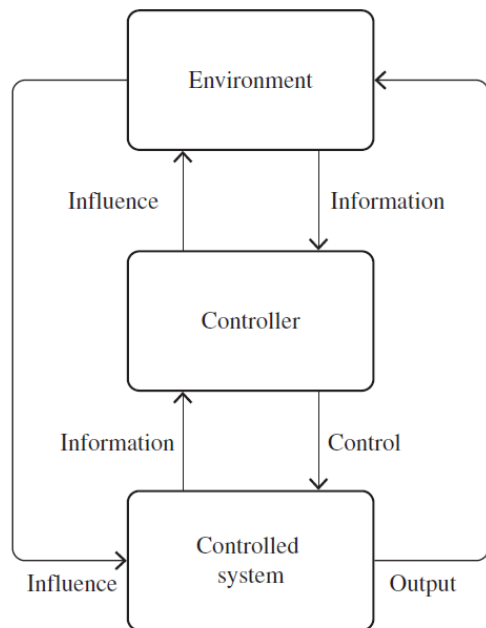
## KEYWORDS

asset management; blue-green, urban water infrastructure

---

## 1 INTRODUCTION

Asset management can be defined as coordinated activities of an organization to realize value from assets (ISO 55000). Asset management of piped infrastructures, such as drinking water and sewers, has been extensively investigated over the last decades, while stormwater control facilities has only recently received the first research consideration for their operation and maintenance and their long-term performance (Werey et al., 2017). The aim of this paper, based on the experiences of a working group on Urban Drainage Asset Management, is to discuss whether current knowledge suffices to introduce the asset management principles for blue-green infrastructures by assessing whether the 5 prerequisites for effective control / (asset) management (De Leeuw, 1974) can be met.



Condition 1. The controller has an objective and an evaluation mechanism to check whether the goals are met.

Condition 2. The controller has a model of the controlled system to predict the effect of potential control actions.

Condition 3. The controller has information about the environment and the controlled system.

Condition 4. The controller has sufficient control actions to cope with the variability of the system.

Condition 5. The controller has sufficient information processing capacity to transform incoming information into effective control actions in line with the objectives.

Figure 1. Control Paradigm of De Leeuw (1974)

This abstract is a short version of the full paper published in Blue-Green Systems (Langeveld et al., 2022) which describes the research questions and challenges to be met to fully benefit from the potential added value of asset management.

### 1.1 Condition 1. The controller has an objective and an evaluation mechanism to check whether the goals are met.

Many urban drainage systems are expected to fulfil several functions related to the city or the environment. Such expectations have emerged from the concept of Sustainable Urban Water System (SUWS) and have been translated in terms of functions (Belmeziti et al., 2015). However, there is still an important gap between these functions and the means (indicators) to assess them, either because of lack of knowledge or because of lack of monitoring methods and capabilities. Some recent initiatives are trying to answer this issue (Soerup et al., 2019), while some of the objectives of blue-green infrastructures, such as resilience or contributing to climate proofing, are still hard to evaluate.

### 1.2 Condition 2. The controller has a model of the controlled system.

The last decade has seen the emergence of guidelines dedicated to stormwater control measures (<https://mind4stormwater.org/2018/10/25/om-guidelines-for-stormwater-control-measures/>). However, there is still a strong need for a better understanding of these complicated systems in order to justify the actions, and to adapt them to the context. It is, for example, still not possible to accurately predict the evolution of hydraulic

parameters such as filter-media permeability (Gonzalez-Merchan et al., 2012).

**1.3 Condition 3. The controller has information about the environment, and the controlled system.**

Information about the environment and controlled system can be difficult to obtain for non-piped systems such as infiltration facilities due to their inaccessibility. Regular inspection techniques and schemes are still missing for nature-based solutions.

**1.4 Condition 4. The controller has sufficient control actions to cope with the variability of the system.**

For sewers, operators have a large number of well-known control actions to deal with issues such as a blockage or cracks. For blue-green systems, this is less obvious. For example, recent research on infiltration via pervious pavement showed that many cleaning techniques cannot restore the initial infiltration capacity, while others even destroy the top layer. The lack of attention for maintainability has regularly resulted in a situation where the operator has no other options than to replace the pervious pavement.

**1.5 Condition 5. The controller has sufficient information processing capacity to transform incoming information into effective control actions that are in line with the objectives.**

Blue green solutions are often applied at a small scale, e.g. on household level where operation and maintenance (O&M) must be taken care of by the house owner, who thereby becomes the controller. O&M requires the capability to interpret current performance and to address signals of various kinds to predict future performance or maintenance needs. Thus, the level of complexity of the blue green infrastructure easily goes beyond the capacity of the controller.

**2 APPLICABILITY OF TRADITIONAL ASSET MANAGEMENT TO BGI**

Table 4 gives an overview of the comparison of the state of the art of asset management for sewers and for blue green infrastructure. Clearly, current state of the art in operation and maintenance is insufficient to translate sewer asset management concepts into concepts for BGI as none of the conditions for effective control is (fully) met, which is partly due to inherent difficulties in matching the controlled system, the infrastructure, with a dedicated controller. For sewer systems, the utility is typically the controller, while for BGI the situation may be rather ambiguous. Depending on the situation, inhabitants, property owners, different departments of the municipality or a water utility could act as controller or sometimes even as co-controller controlling only a subset of components or functions of the BGI. Unclear, divided or shared responsibilities could be problematic with respect to maintenance, while the large diversity in responsible actors (controllers) does not facility easy uptake of novel approaches.

Table 4. Comparison of asset management for sewers and for blue-green infrastructure

Condition	Sewer systems	BGI
1. clear objective and evaluation mechanism	Well established with respect to condition assessment of pipes, less established with respect to sewer system performance	Hampered by the large diversity of criteria, which are only partly quantifiable
2. model of system	Well established for hydraulics, less established for asset deterioration	Models describing BGI performance and condition deterioration are very limited

---

3. information on environment and system	Well established standards	Strongly lacking
4. sufficient control actions	Widely available via textbooks and manuals	Limited availability of control actions for restoring condition and performance
5. sufficient information processing capacity to select effective control actions	Utilities (or their contractors) have sufficient capacity to process inspection and monitoring data and to select effective measures	The diversity of involved actors and the broad range of aspects to be take into account result in difficulties in selecting appropriate actions

---

### 3 CONCLUSION

The confrontation of the state of the art on management practices and knowledge of blue green infrastructures revealed that currently the preconditions for effective control and asset management cannot be met. However, as the deterioration processes of blue-green infrastructures may be significantly faster than those of piped infrastructures, the learning curve in asset management of blue green solutions may be much faster than the decades it took to develop sewer asset management. This development is supported by the revolution happening in the monitoring field supported by falling costs, miniaturisation, easy-to-access, modularity and open-source programming (Cherqui et al., 2019). Remaining key challenges are dealing with the diversity of solutions and conditions and the lack of resources to conduct the necessary dedicated research in this emerging field.

### LIST OF REFERENCES

- Belmeziti, A., Cherqui, F., Tourne, A., Granger, D., Werey, C., Le Gauffre, P. & Chocat, B. 2015 Transitioning to sustainable urban water management systems: how to define expected service functions? *Civ. Eng. Environ. Syst* 1–19.
- Cherqui F., Szota C., James R., Poelsma P., Perigaud T., Burns M.J., Fletcher T., Bertrand-Krajewski J.-L. (2019) Toward proactive management of stormwater control measures using low-cost technology, 10th international conference NOVATECH, 1-5 July, Lyon, France.
- De Leeuw, A.C.J., 1974. *Systeemleer en organisatiekunde. Een onderzoek naar mogelijke bijdragen van de systeemleer tot een integrale organisatiekunde*, Thesis (PhD). Eindhoven University of Technology.
- Gonzalez-Merchan C., Barraud S., Coustumer S. L. and Fletcher T. (2012) Monitoring of clogging evolution in the stormwater infiltration system and determinant factors, *European Journal of Environmental and Civil Engineering*, Taylor & Francis, 16(1), 34-47.
- ISO 55000, 2014. *Asset management - Overview, principles and terminology*. International Organization for Standardization, Geneva, Switzerland.
- Langeveld, J. G., Cherqui, F., Tscheikner-Gratl, F., Muthanna, T. M., Juarez, M. F. D., Leitão, J. P., Roghani, B., Kerres, K., do Céu Almeid, M., Werey, C., & Rulleau, B. (2022). *Asset management for blue-green infrastructures: a scoping review*. *Blue-Green Systems*.
- Sørup H. J. D., Fryd O., Liu L., Arnbjerg-Nielsen K. and Jensen M. B. (2019) An SDG-based framework for assessing urban stormwater management systems, *Blue-Green Systems*, 1(1), 102-118.
- Werey C., Garnier R., Cherqui F., Le Nouveau N, Fletcher T. D., Barraud S., Le Gauffre P. (2017) Research and operational needs to improve the asset management of stormwater control measures, 7th Leading-edge conf. on Strategic Asset management. IWA (Int. Water Assoc.), 20-22 June, Trondheim, Norway.