Lessons Learned From Over Two Decades of constructed wetland Use for urban stromwater in The Netherlands

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INTRODUCTION

Constructed wetlands are one type of Sustainable Urban Drainage System (SUDS) that have been used for decades in The Netherlands. They provide stormwater conveyance and improve stormwater quality. European regulations for water quality dictate lower and lower concentrations for an array of dissolved pollutants. The increase in the required removal efficiency for these systems imposed in the Netherlands requires a better understanding of the characteristics of stormwater and the functioning of constructed wetlands as SUDs. This paper presents a brief overview of 5 different constructed wetlands from the Netherlands that have been implemented at least more than 10 years ago. Their efficiency and functioning is reviewed and a new method of assessment is described.

METHODS

Several constructed wetlands in the Netherlands have been studied and reviewed in 2015. Key actors in the maintenance phase were interviewed. The interviews focussed on the level of appreciation of the constructed wetlands and general perceptions pertaining to this type of SUD, decades after implementation. The environmental conditions at each of the constructed wetlands, the main design objectives, the wetland dimensions and basis performance, the monetary cost and the results of preliminary monitoring were examined and compared. The predicted removal efficiency for pollutants in typical Dutch stormwater was calculated.
Not surprisingly, most efficiency studies look at inputs and outputs as the main parameter. However, when the removal efficiency needs to be improved, more systems based knowledge is needed. In order to gain a better understanding of spatial issues in constructed wetlands, (eg thickness of deposits and water quality parameters) an innovative monitoring tool is applied. The tool is a semi-autonomous underwater drone. The drone is equipped with sensors for pressure (depth), temperature, conductivity, nitrate, ammonium, dissolved oxygen and turbidity. In addition to the data from the sensors, the drone can also collect video images.

Attached Equipment:
(1) In-situ TROLL 9500 Sensors:
- Nitrate and Ammonium ISE
- Rugged Dissolved Oxygen

(2) CTD Diver :
- Temperature
- Pressure
- Conductivity

(3) Diving light
(4) HD Video Camera (GoPro 3+)

Figure 1. The underwater drone with the attached equipment

RESULTS AND DISCUSSION

The removal efficiency of constructed wetlands derived from existing monitoring results differ from study to study, but are mostly within the ranges of international literature. Nearly all results come from input-output studies. Some actors have questions on how to improve the monitoring, as maintenance of the systems requires more localised knowledge.
The average monetary cost of implementation of vertical drainage wetlands were in the order of 55 euros/field area in contrast to the cost of the horizontal wetlands (15 euros/field area).
It is concluded that constructed wetlands without filtration (horizontal wetlands or vegetated ponds) are likely not to meet the local water quality standards (MAC values) or the ambitions of the Water Frame Directive on all micro-pollutants. This is the results of the fact that the required removal efficiency of current constructed wetlands in general cannot be met for dissolved pollutants. Dutch stormwater contains a relative high amount of dissolved contaminants and small particles that will not settle in non-filtration systems. Filtration systems however lack good monitoring tools for long term maintenance.

CONCLUSIONS

In most cases the constructed wetlands were shown or perceived to be effective. Long-term performance however remains an issue. New guidelines have been set up for the design, implementation and maintenance for Dutch wetlands. Consultants in the field of implementation require cost effective monitoring tools since budgets are low. The underwater drone proved to be cost effective, and gave a quick insight into the spatial variation of selected performance parameters. As a nice side effect, the drone provides video footage of the underwater ecology and biodiversity. These drones can be navigated to areas within the constructed wetland that are usually omitted in monitoring, thus extending the knowledge on the wetland.
Data and videos from several locations where SUDs are implemented, be it true wetlands or more water management features, are available in an online tool (www.climatescan.nl). This tool is available for all, and everybody is encouraged to add functioning SUDs to this public database.

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