



# **FLOW CHARACTERISTICS AND MASS BALANCES OF A FULL SCALE VERTICAL FLOW CONSTRUCTED WETLAND**

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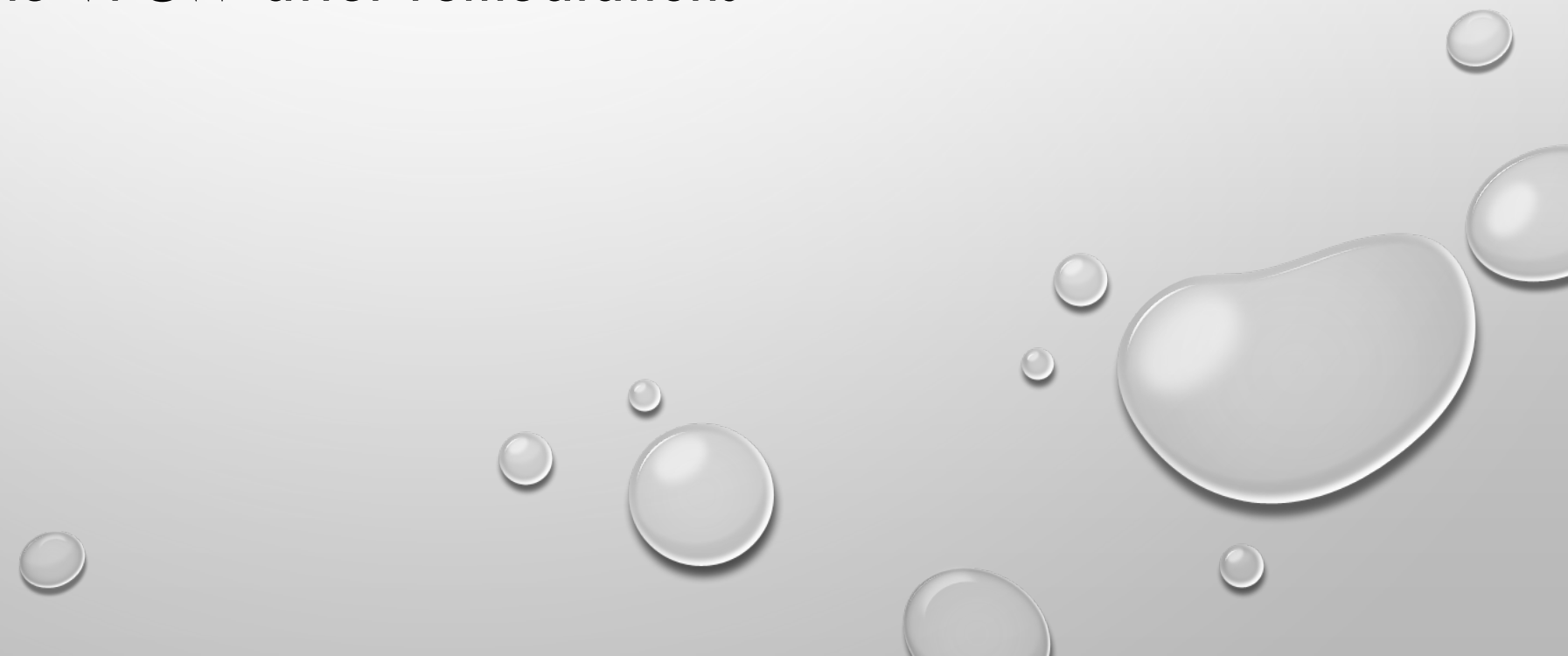
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# AIM OF STUDY

- To determine the problems with the existing VFCW
  - To recommend remediation on the VFCW
  - To monitor the VFCW after remediations
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# RESEARCH QUESTIONS

1. Is the VFCW performing efficiently?
2. Is the HLR sufficient?

# OBJECTIVES

## **FULL SCALE**

- To monitor flow distribution onto the VFCW
- To measure effects of evapotranspiration
- To determine nutrient removal efficiency

# BACKGROUND OF STUDY

- The DEWAT plant is located at Newlands, Durban
- VFCW forms part of a DEWAT polishing step
- Plant has been operational since 2010
- Property of eThekweni municipality
- Used as a research site by students from UKZN, DUT and international students
- Designed according to BORDA standards to treat domestic wastewater from 84 households

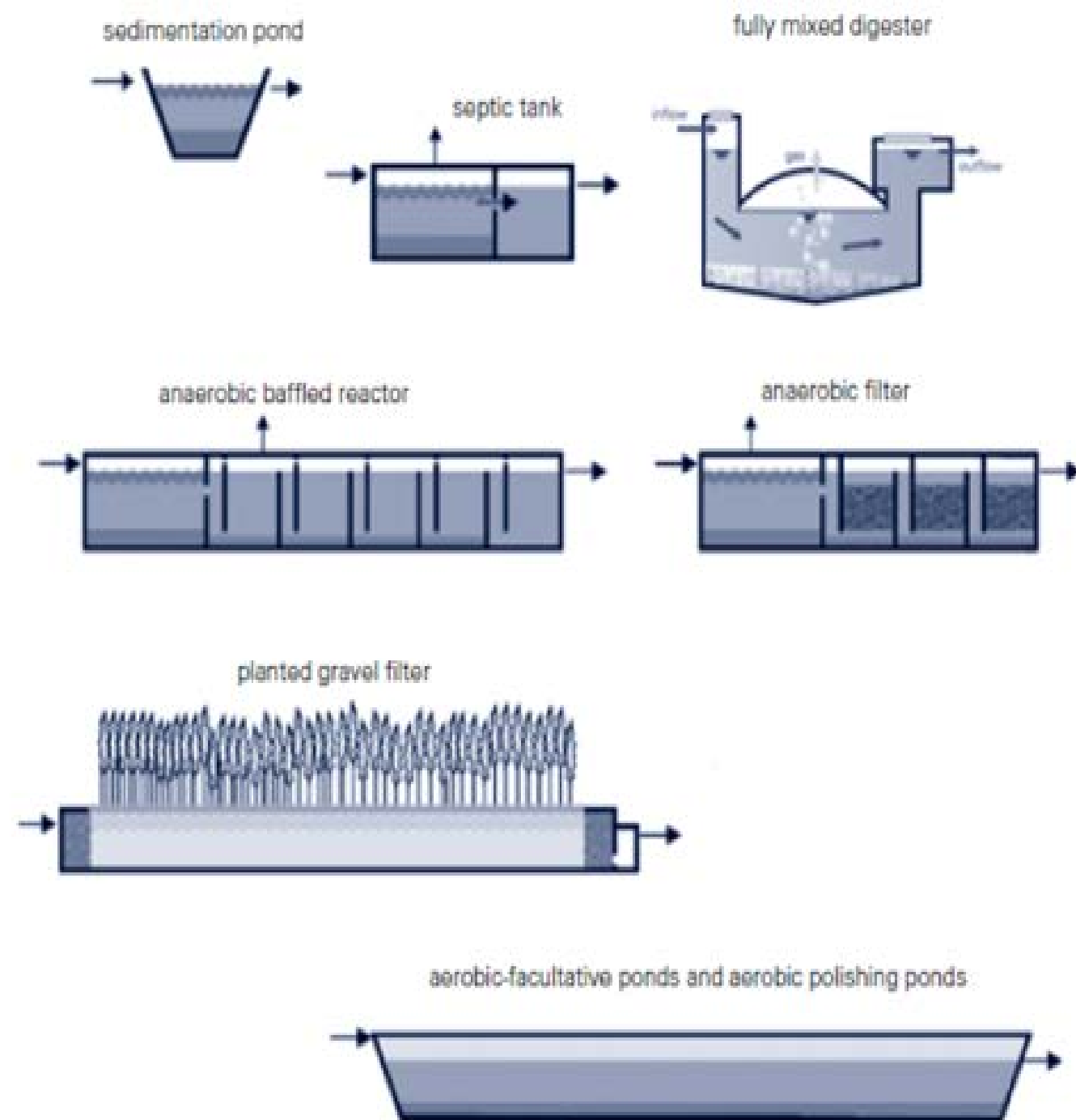
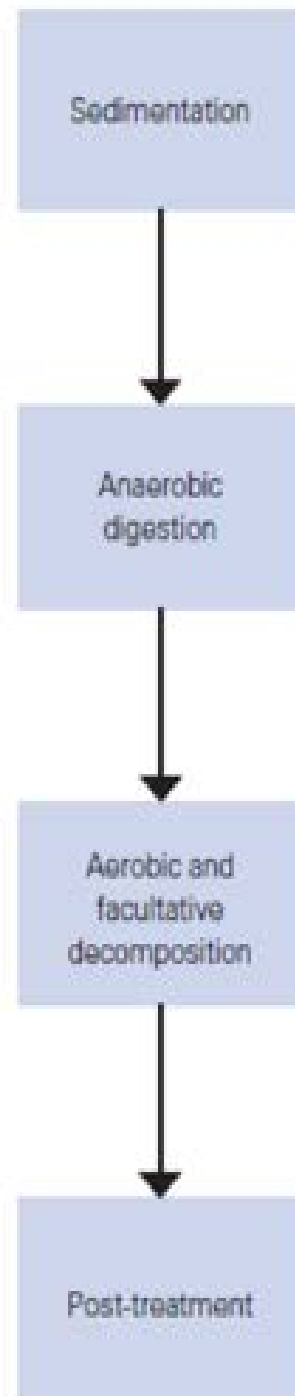


# WHAT IS A DEWAT SYSTEM?

- Historically centralised WWTPs have been used to treat wastewater
- However, population growth exerts pressure on WWTPs alternatives like DEWATS are being used
- DEWATS are decentralised wastewater treatment systems

## Advantages of DEWATS

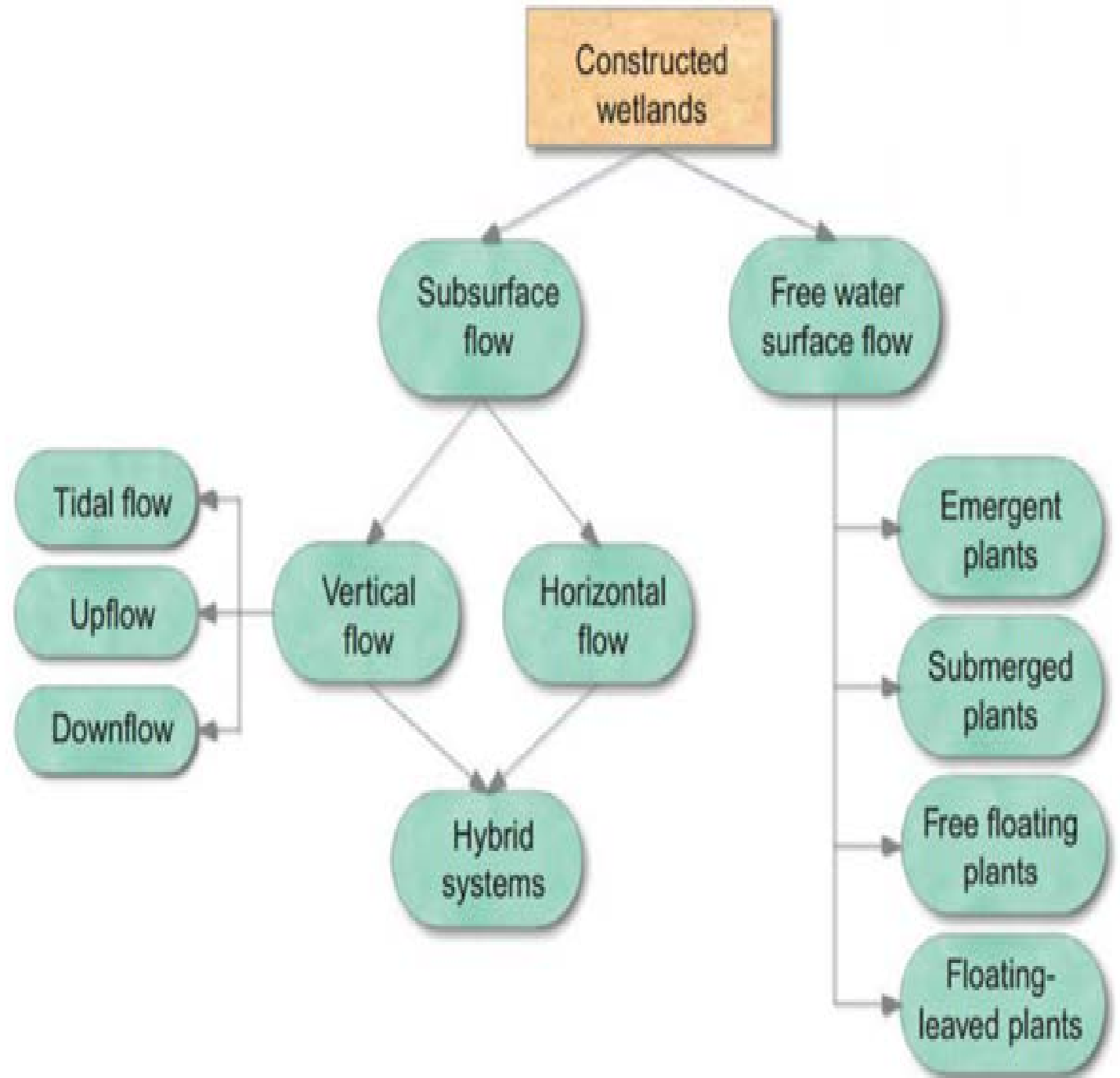
- Appropriate for low population communities
- Have less energy requirements
- Require less , capital, operational and transport costs





# CONSTRUCTED WETLANDS

- Mimic natural wetlands by making use of microorganisms, plants and filter media
- Remove pollutants through physical, chemical and biological processes



# WHY CONSTRUCTED WETLANDS?

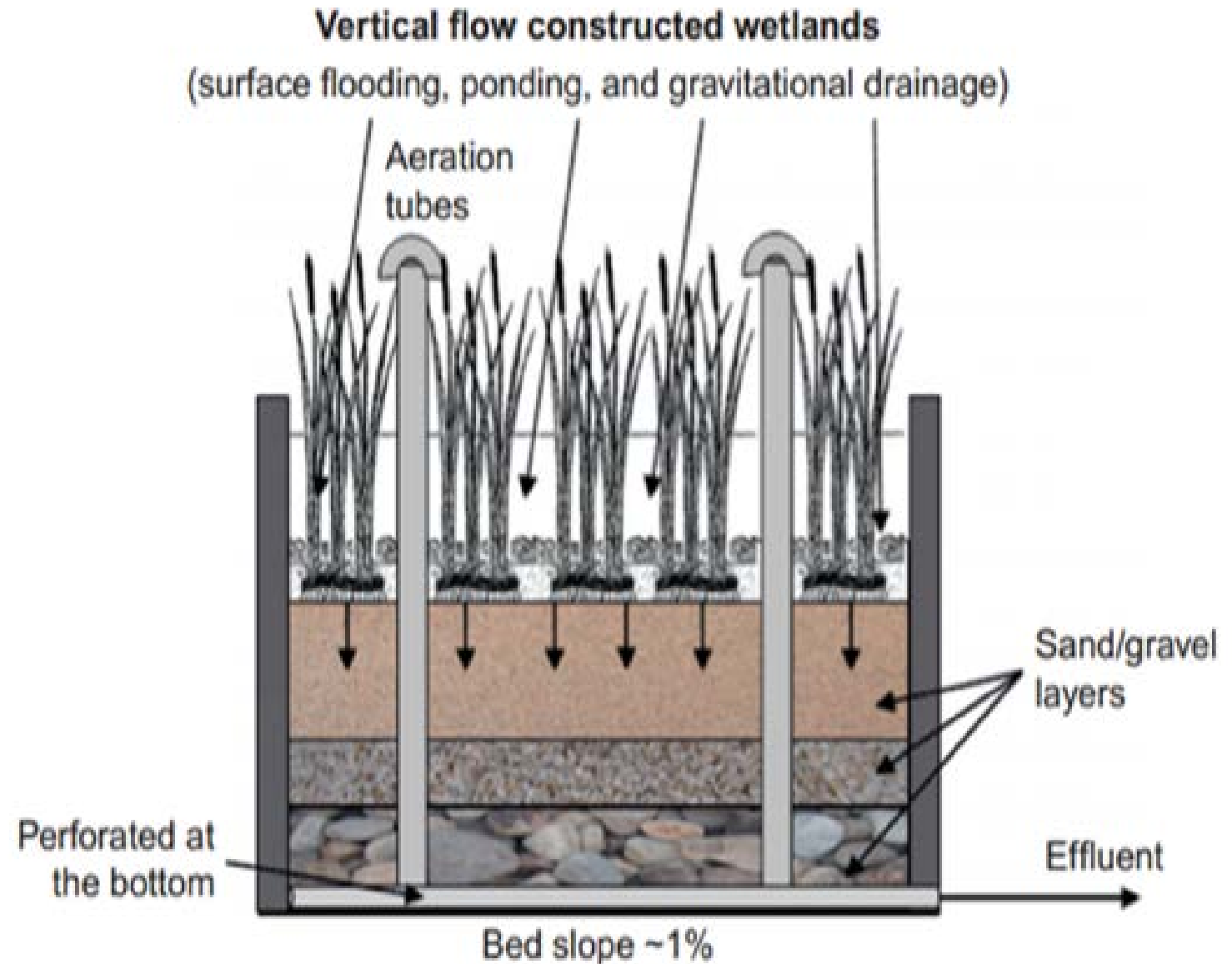
- Low operational and maintenance costs
- High tolerance on load and flow
- Few impacts on the environment
- Habitant for organisms
- Aesthetic appearance





# VERTICAL FLOW CONSTRUCTED WETLANDS

- Are intermittently fed creating aerobic and anaerobic conditions
- Water flows vertically down

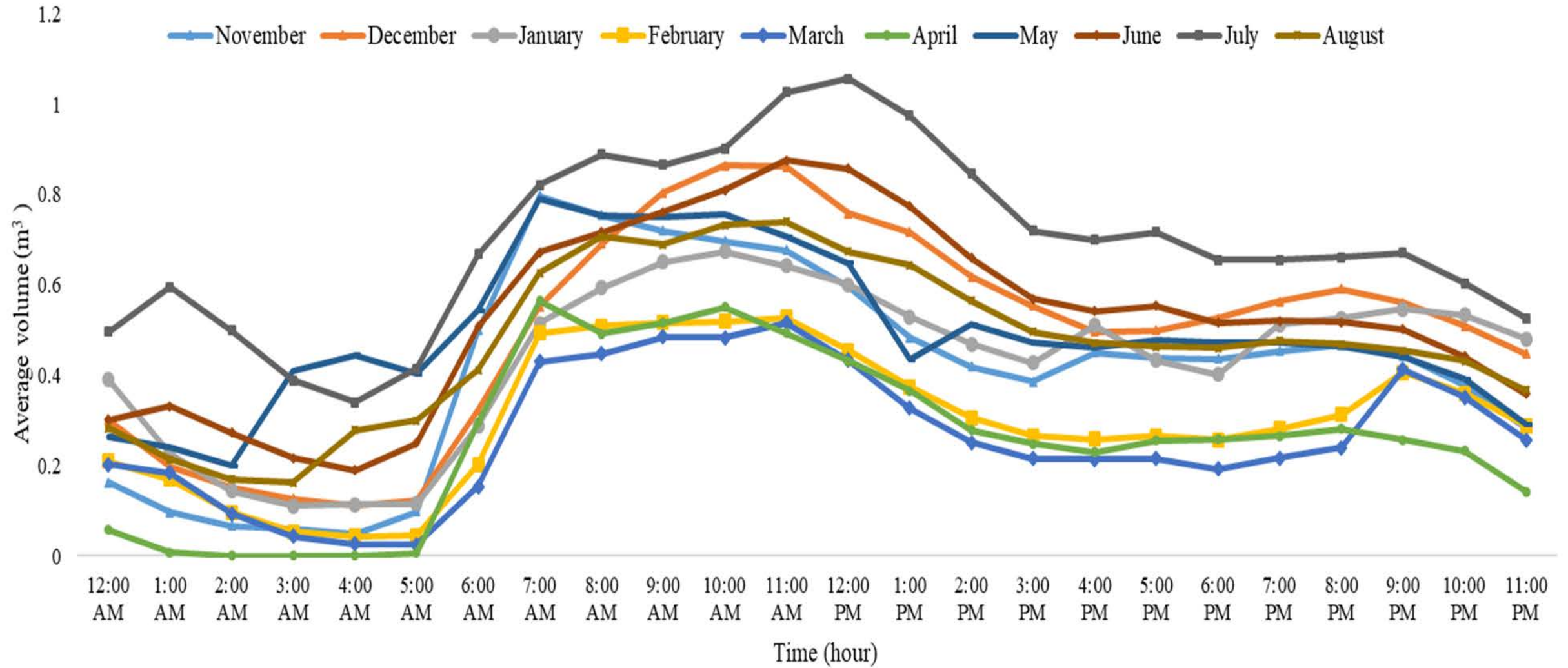


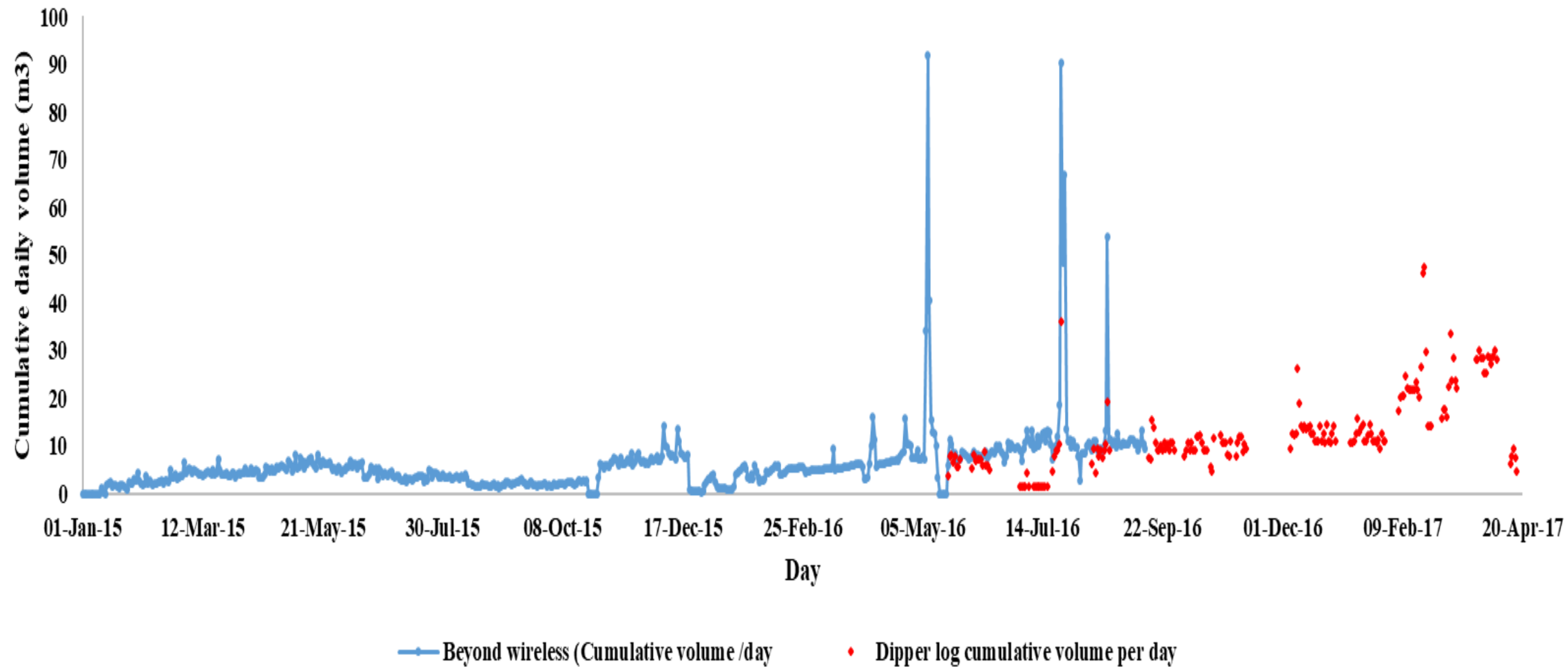
# DISTRIBUTION SYSTEM



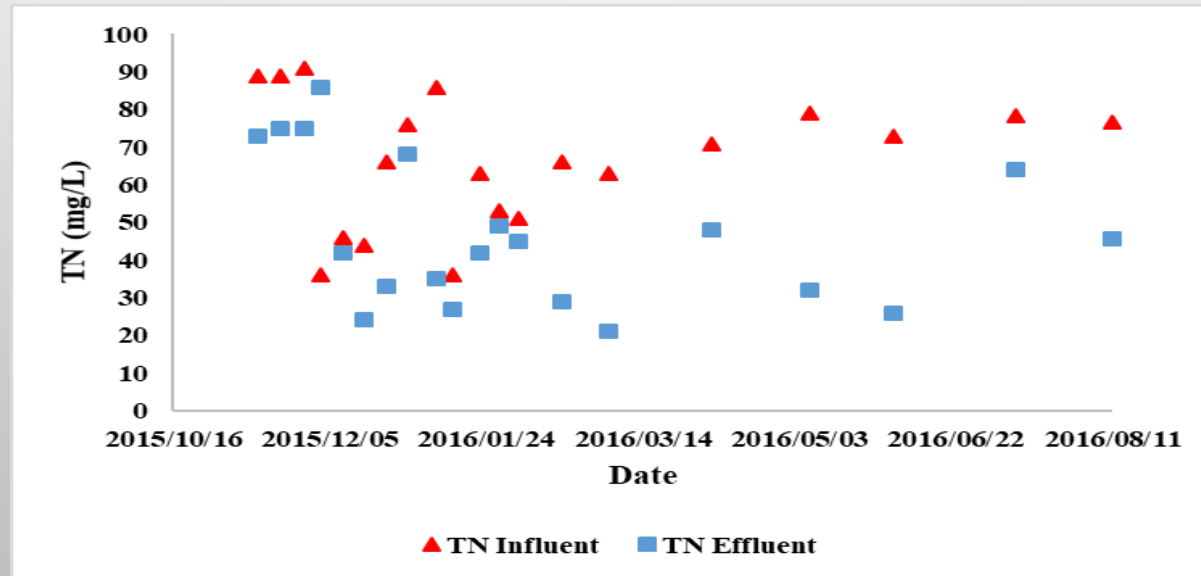
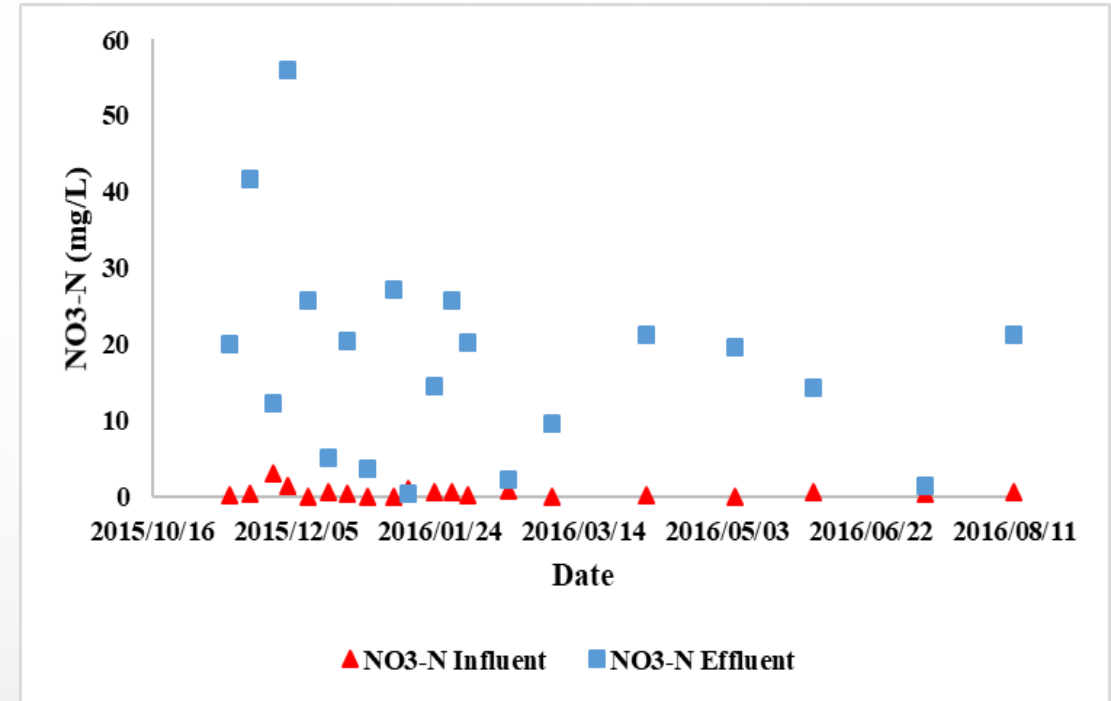
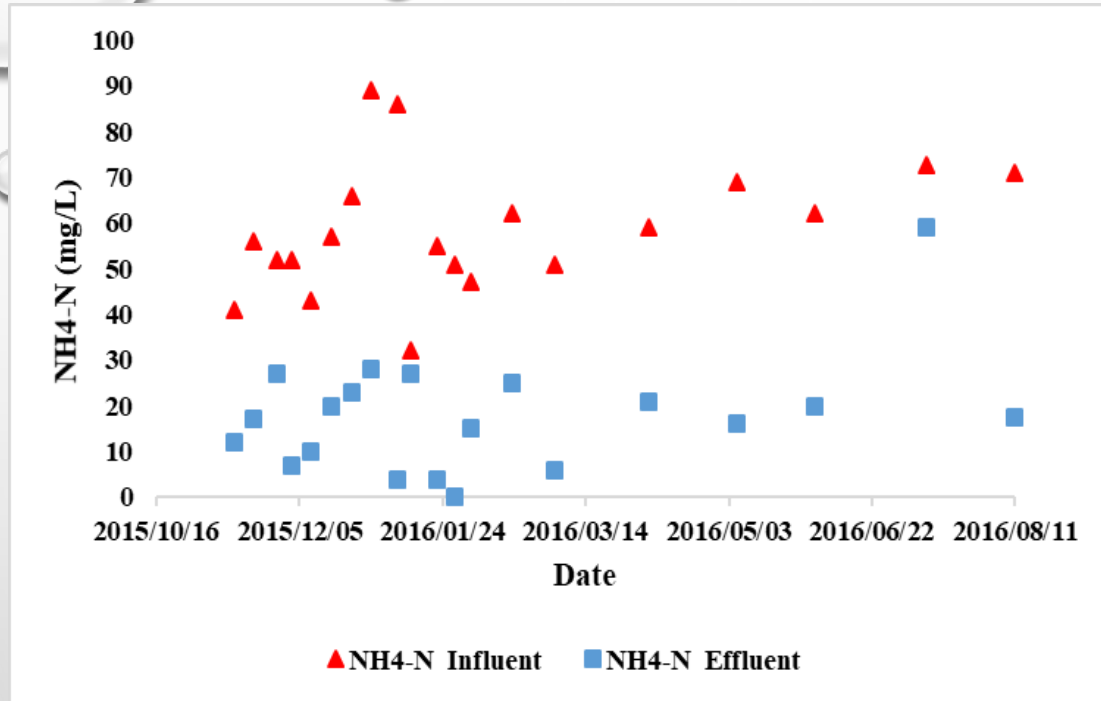


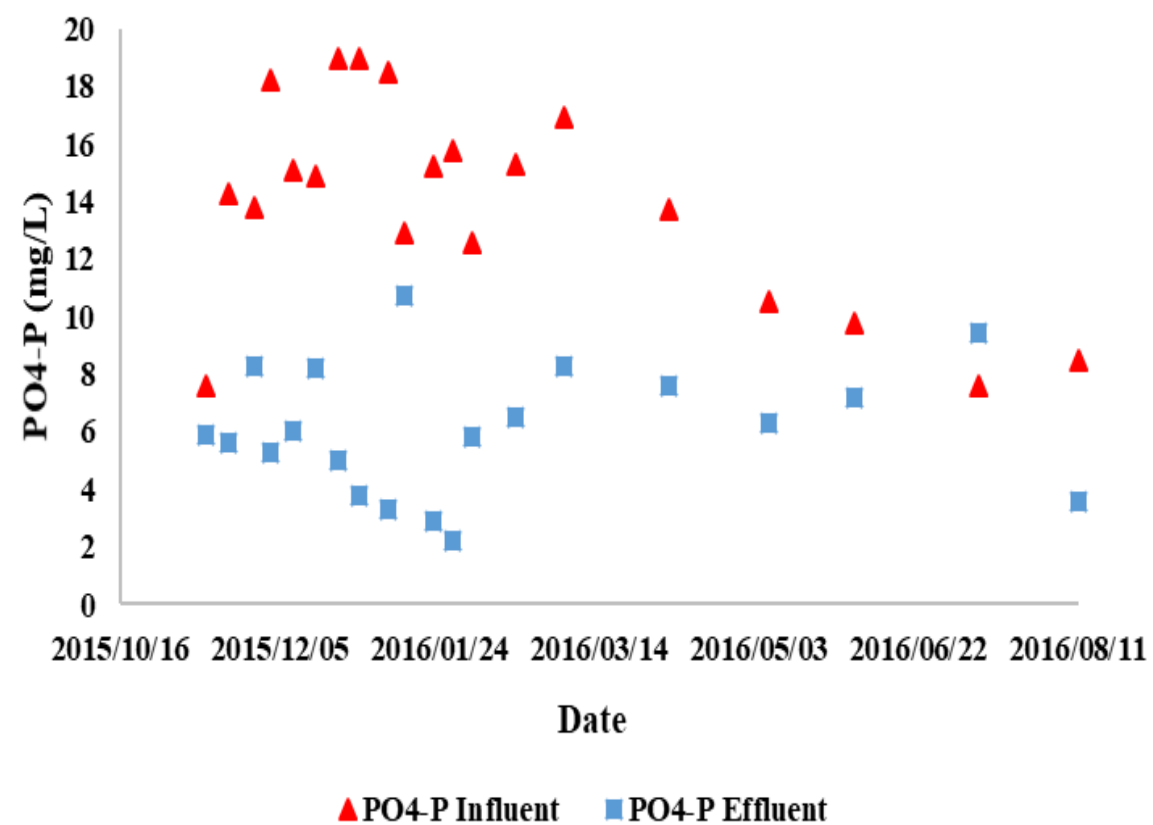
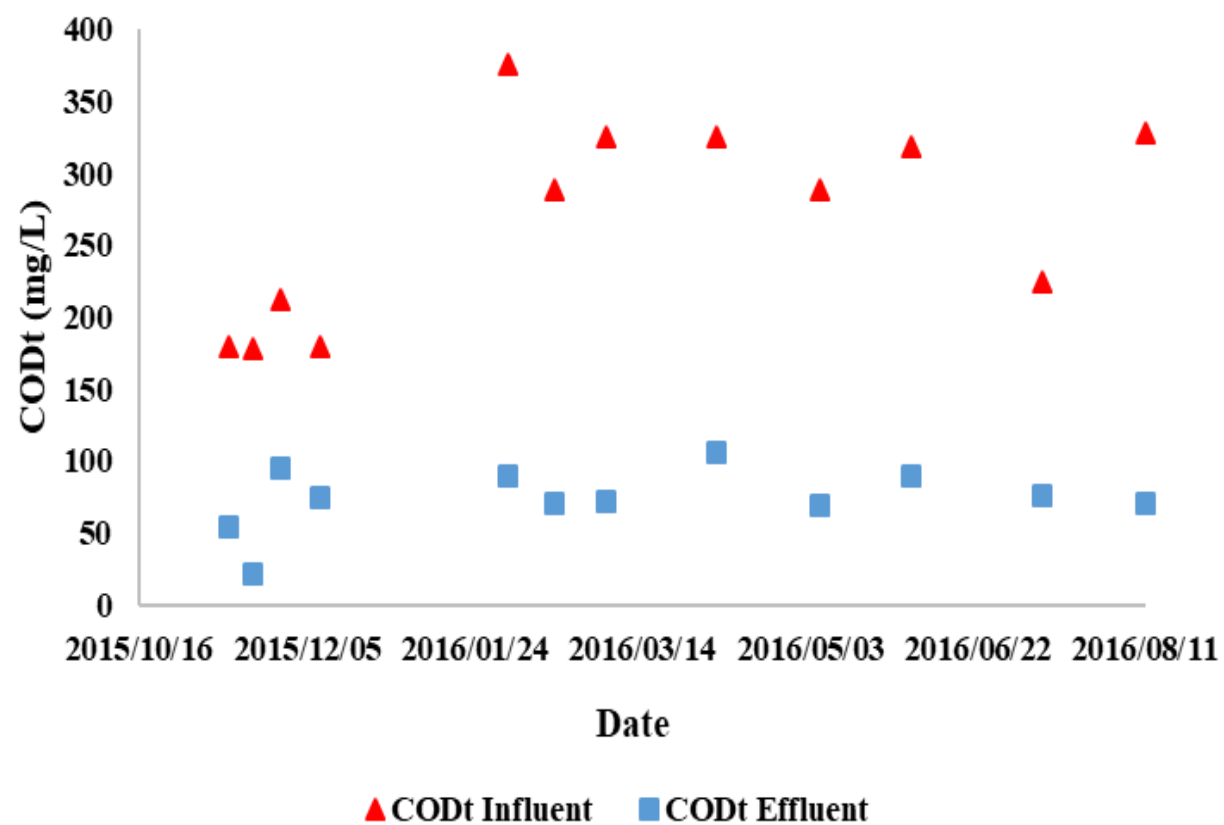
# FULL SCALE FLOW CHARACTERISTICS





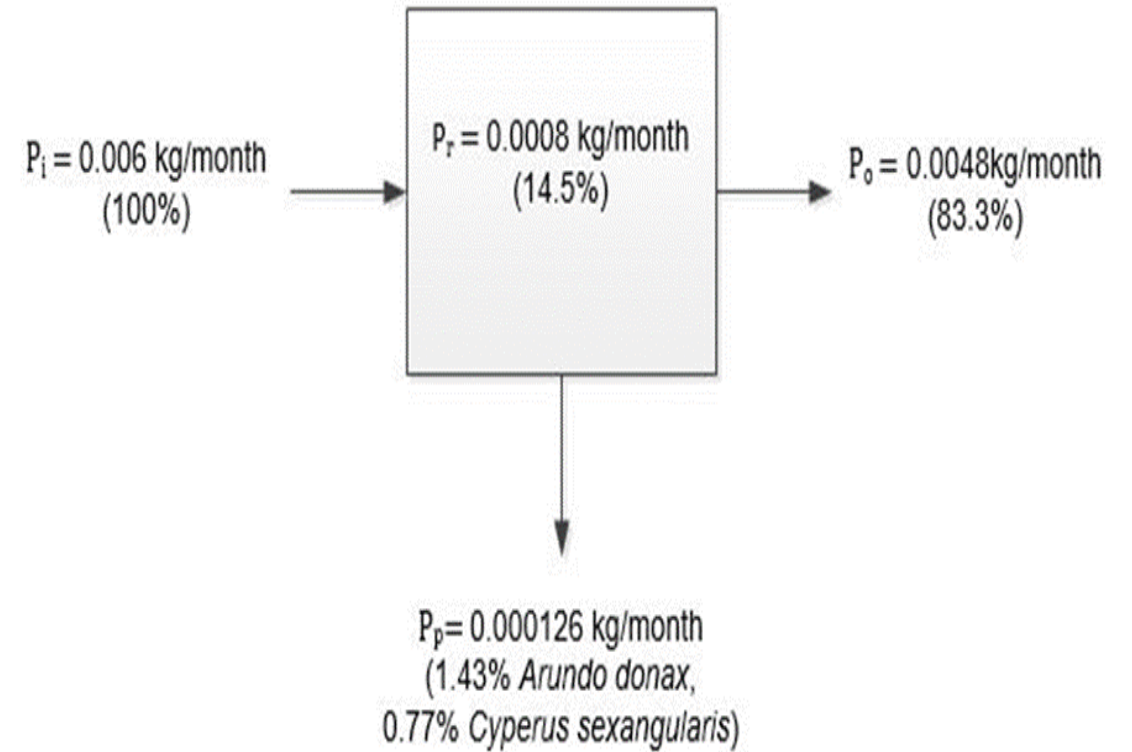
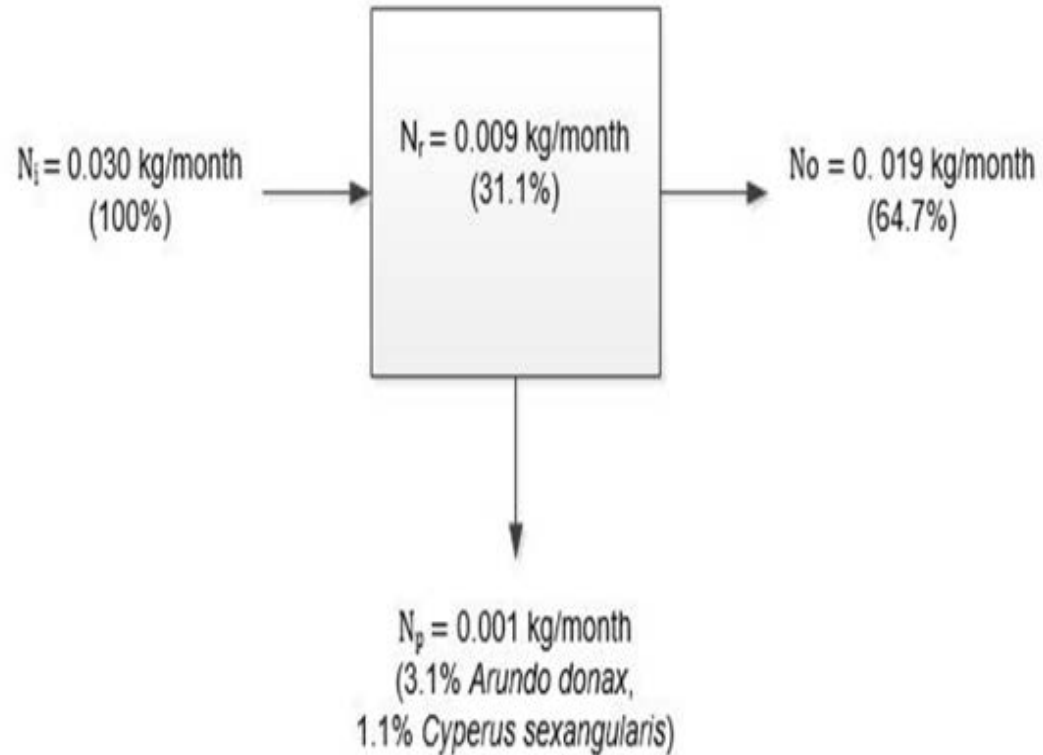
# FULL SCALE INFLUENT AND EFFLUENT CONCENTRATIONS







# FULL SCALE MASS BALANCES



# PROBLEMS ASSOCIATED WITH FULL SCALE VFCW

- Inconsistent operation of the siphon
- Poor layout of the distribution pipes
- Incorrect construction of the VFCW outlet sump
- These problems lead to construction of pilot trials and remediation on the distribution pipes

## PILOT SCALE VFCWS

- Different media types
- Increased depth
- Controlled influent distribution
- Outlet flow rate measurements





## **FUTURE WORK**

- Monitoring of effluent chemical parameters after remediation





## SIPHON AND VFCW AFTER REMEDIATION



# CONCLUSIONS BEFORE REMEDIATION

- VFCW operating under low HLR
- Underutilisation of the VFCW bed
- Effluent not meeting discharge limits
- VFCW acting as a nitrifying bed



## REFERENCES

1. GUTTERER B, SASSE L, PANZERBIETER T and RECKERZÜGEL T (2009) Decentralised wastewater treatment systems (DEWATS) and sanitation in developing countries. *Leicestershire, UK: Water, Engineering and Development Centre (WEDC), Loughborough University, UK, in association with Bremen Overseas Research (BORDA), Germany.*
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3. LEE S, MANQUIZ-REDILLAS MC, CHOI J and KIM L-H (2014) Nitrogen mass balance in a constructed wetland treating piggery wastewater effluent. *Journal of Environmental Sciences* **26** (6) 1260-1266.
4. STEFANAKIS A, AKRATOS CS and TSIHRINTZIS VA (2014) *Vertical flow constructed wetlands: Eco-engineering systems for wastewater and sludge treatment*, Newnes.

The background is a light gray gradient. In the top-left corner, there are several realistic water droplets of varying sizes, some overlapping. In the top-right corner, there is one large droplet and one smaller one. In the bottom-right corner, there is a cluster of droplets, including a large one and several smaller ones. In the bottom-left corner, there are a few small droplets. The text "Thank you" is centered in the middle of the slide.

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