

<p>Start-end date: 14/02/2022 – 30/06/2022</p>	 	
<p>Student name: Luiz Rigotto</p>		
<p>Course in the Netherlands: Water Management</p>		
<p>Internship Department/Company: Water Technology Research Group</p>		
<p>Brazilian Professor/Supervisor: Aníbal da Fonseca Santiago</p>		
<p>Dutch Professor/Supervisor: Hans Cappon</p>		
<p>Authors: Luiz Rigotto; Larima Mendonça; Hans Cappon.</p>		

Problem / assignment

The operation of a wastewater drainage system is a complex process, requiring constant observation of multiple flow sources in order to maintain the system's stability and efficiency. Due to the dynamical supply of both household wastewater and rainwater to the system, there is unevenness between the daily, weekly, and monthly cycles.

The constant fluctuation in flow transport can lead to disturbances in the operation of the system. This can translate into inappropriate usage of controlling devices and, ultimately, poorer wastewater treatment performance. Aiming to avoid this type of problem, it is beneficial to create mathematical modeling of the wastewater drainage system. The creation of a model can provide greater insight into the system, which leads to better-founded decision-making in various areas.

In order to create a mathematical model of a wastewater drainage system, it is necessary to define the technical framework needed to do so. This technical framework is composed of the different steps, tools, and knowledge that go into the formation of the desired model. The proposed research aimed at defining the main components in this technical framework, with special regard to data collection and treatment. A case study was conducted using data from the Ede wastewater treatment plant (WWTP).

Used methods / project phases

- Literature and Technical Review

In order to answer the proposed research questions, first, a literature and technical review was made. The main goal was to build knowledge about modeling, data-processing, Python operations, and filling-in possible knowledge gaps among related topics. The literature and technical review was held throughout all of the proposed research period, adapting the investigation focus according to the most recent findings.

Used methods / project phases

- Analysis of Available Data

All the information regarding the Ede WWTP drainage system was provided by the Vallei en Veluwe Water Board. As the project was being developed, different data sets and information were provided, and the research focus was pivoted towards what set of information and data would be the most valuable.

Aiming to determine the course of action regarding data analysis and processing, it was necessary to simplify and categorize the drainage system's distribution scheme. This was done by drafting simplified diagrams of its distribution with key information.

Multiple flow data-sets were provided by the water board. An analysis of each data-set was made, aiming to determine which would fit best the proposed research aims. Data sources for precipitation were also assessed in this part of the project.

- Data Manipulation and Interpretation

The first action taken to manage the chosen data-set was to extract and assort it. This was done in order to facilitate data processing, which consisted of organization into different segments, clean-up of missing data/outliers and calculations. After the processing of data was done, it was possible to move into plotting and interpretation.

All the plots made for analysis were assembled using Python programming language (version 3.10.5). Python was used through the Jupyter Notebook application inside Anaconda Navigator. The main tool used to conceive the plots was Plotly, an open source graphing library for Python.

To analyze the flow patterns observed in hourly, daily and seasonal time-frames, different graphs were plotted, relating the specific time recorded and flow fluctuations. The impacts related to precipitation were observed through comparison of plottings during dry periods and wet periods. Different volumes of precipitation were assessed to investigate its influence on the system's flow pattern.

Results

The manipulation and examination of data provided by the Vallei en Veluwe Water Board provided meaningful insights into the drainage system's operation. After thorough observation of patterns among the system in various conditions, it was possible to attest the significant influence of precipitation. This influence can be perceived in daily, weekly and monthly flow distributions. The time-response of the system was also heavily influenced by precipitation conditions. This big impact from precipitation shows that it is a very important parameter to take into account in the modelling of a wastewater drainage system

Extra info / advice / link to final document and presentation

This internship was part of a bigger project aiming to assemble a digital twin of the Ede Wastewater Treatment Plant. This project is a collaboration between two departments in HZ University of Applied Sciences and the Vallei en Valluwe Water Board. The two departments involved are Data Science and the Water Technology Research Group. The project started on February 2022 and is scheduled to have a duration of 2 years in total.

Extra info / advice / link to final document and presentation

The project encompasses modelling of multiple steps in the treatment process, including flows, wastewater quality parameters and discharge. The internship was focused on pre-treatment and visualization of flow data in order to assemble the digital twin.