Enhancing the Resilience of Houston's Wastewater System Under Wet Weather Using Emerging Technologies

Jarrett Morrison[1], Lu Liu[1]*, Jeseth Delgado-Vela[2], Andrew Shaw[3], Lauren Stadler[4], Priyanka Ali[4]

1 Department of Civil, Construction and Environmental Engineering, Iowa State University 2 Department of Civil and Environmental Engineering, Howard University 3 Black and Veatch in Houston Texas 4 Department of Civil and Environmental Engineering, Rice University

What is the Issue?

- In 2017 Hurricane Harvey hit Texas causing massive amounts of damage resulting in wastewater treatment plants (WWTP) being unable to preform vital removal processes efficiently. Figure 1 shows the operation status of WWTPs during Harvey.
- Implementing new technology such as the moving bed biofilm reactor (MBBR) and the membrane aerated biofilm reactor (MABR) can improve removal rates during increased rainfall. Figure 2 shows the performance of an activated sludge WWTP.

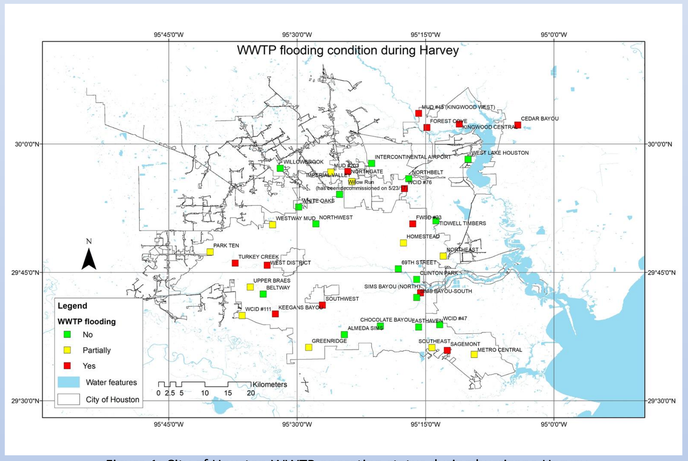

Figure 1: City of Houston WWTP operation status during hurricane Harvey

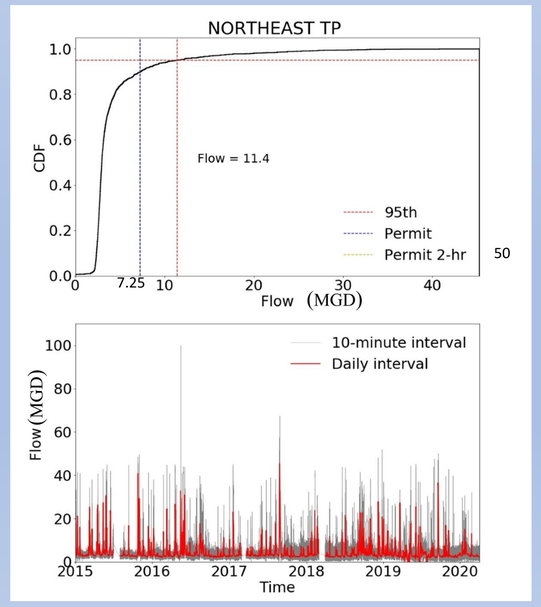

Figure 2: Activated sludge WWTP performance between 2015 and 2020

Objectives

- Objective 1: Build a wastewater treatment model that evaluates the implementation of biofilm technologies as noted in Figure 3.
- Objective 2: Investigate tradeoffs between process intensification and the resilience enabled by emerging technologies.

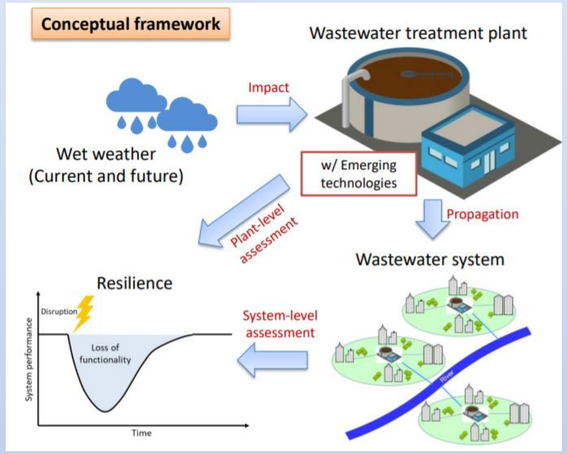

Figure 3: Project overview

Method

- First we will use EPA's **Storm Water Management Model** (SWMM) for 9 of Houston's sewersheds and run hydrologic and hydraulic simulations for said sewersheds. Figure 4 shows some input data that will be used.
- Second we will use R or Python to **post process model outputs** including inflows, outflows, concentrations of constituents, etc.
- Third we will **design various scenarios** using synthetic rainfall intensity (low, mid, and high intensity) and wastewater treatment technologies (e.g., activated sludge, MBBR, and MABR).
- Finally we will **evaluate the resilience** of the system performance based off of the water quality measurements and complete the performance across scenarios.

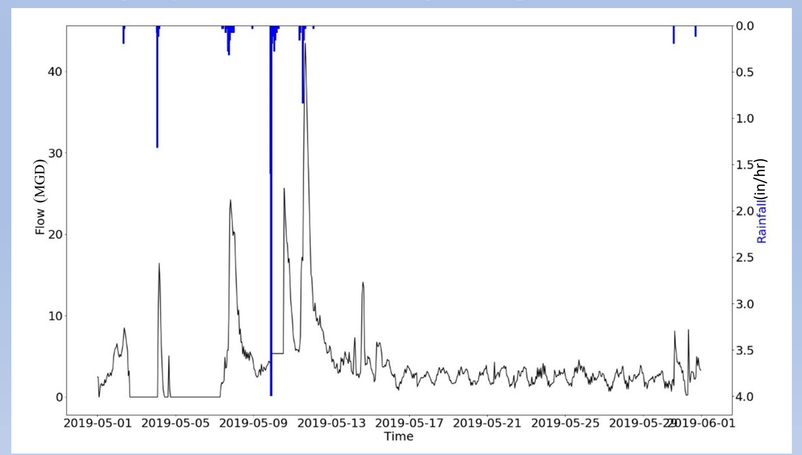

Figure 4: Rainfall intensity and sewer loading

Expected Outcomes

- An evaluation of the enhanced resilience of implementing biofilm technologies.
- We expect to see a resiliency curve like figure 5
- A better understanding on where improvements can be made to get the best "bang for your buck".

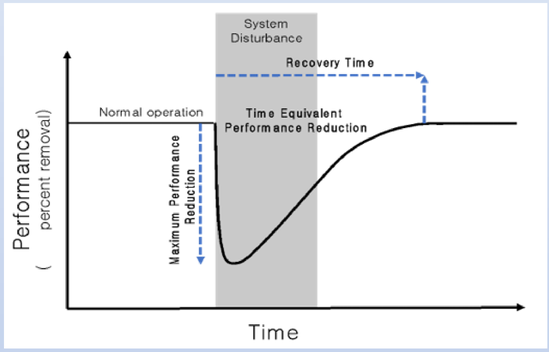

Figure 5: Resiliency curve

Future Work and Timeline

- We are currently in the first year of task 3
- Data collection and compiling will be achieved by the end of Fall Semester
- SWMM Modelling will being in the Spring semester
- Analysis will be done during the summer of 2022

Table 1. Research timeline.

Objectives	Summer 2021	Fall 2021	Spring 2022	Summer 2022	Fall 2022
Objective 1	Literature review and data collection				
		Model development and scenario design			
Objective 2				Resilience assessment under predefined scenarios that differ in system configuration and external weather forcing	
					Begin manuscript writing

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