Enhancing Urban Flood Resilience through 1D-2D PCSWMM Modeling: A Case Study of Air Combat Command Campus, Joint Base Langley Eustis (JBLE)-Langley

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1. Introduction

Urban flooding is increasingly exacerbated by the combined effects of rapid urbanization, climate change, and aging drainage infrastructure. This study leverages the Personal Computer Storm Water Management Model (PCSWMM) for 1D-2D flood modeling to assess and mitigate flood risks within the Air Combat Command (ACC) Campus at Joint Base Langley Eustis (JBLE)-Langley. JBLE-Langley is established on the coast of VA surrounded by marshland and bottomland hardwoods.

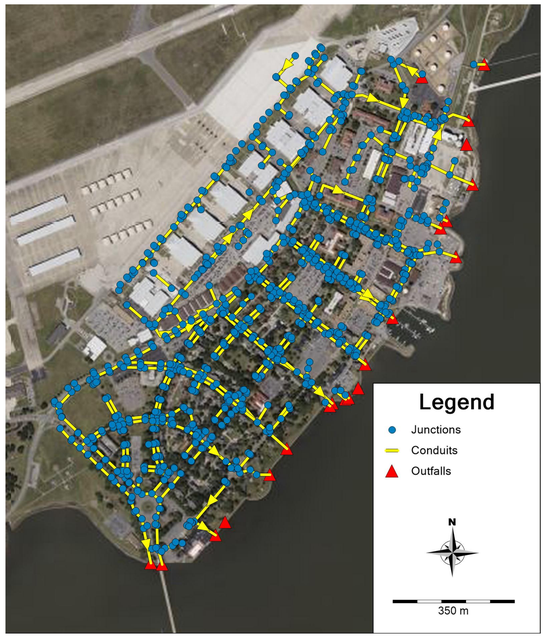


Figure 1: The map showing the location of manholes, conduits and outfalls within the JBLE-Langley ACC campus.

3. Method

Baseline Model (BM): These scenarios included all existing BMPs on the base, i.e., surface drains, culverts, outfall devices (accounting for present functionality such as submerged, obstructions or free flowing)

Proposed Mitigation

i. Conduits cleared of obstruction and duckbills on all outfalls **(PM 1)**.

ii. Conduits cleared of obstruction, duckbills on all outfalls and adjust line gradient **(PM 2).**

Scenarios

i. Tidal SLR + 2 YRP rainfall

ii. Tidal SLR + 5 YRP rainfall

iii. Tidal SLR + 10 YRP rainfall

iv. Tidal SLR + 25 YRP rainfall

2. Datasets

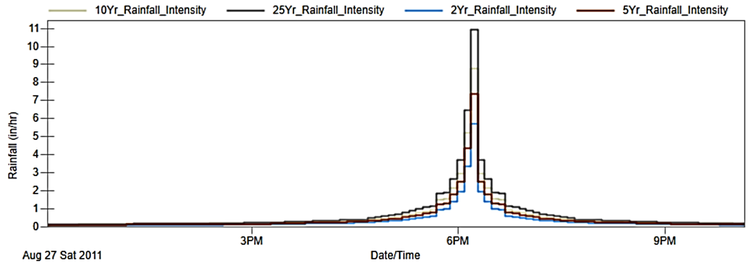


Figure 2: 24 hours duration rainfall events for the 2-year, 5-year, 10-year and 25-year return period

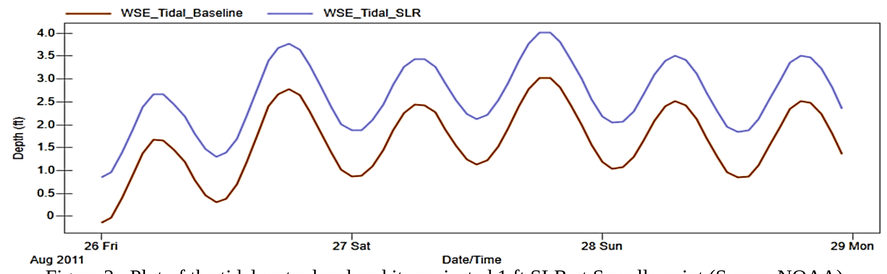


Figure 3: Plot of the tidal water level and its projected 1 ft SLR at Sewells point (Source NOAA)

4. Results

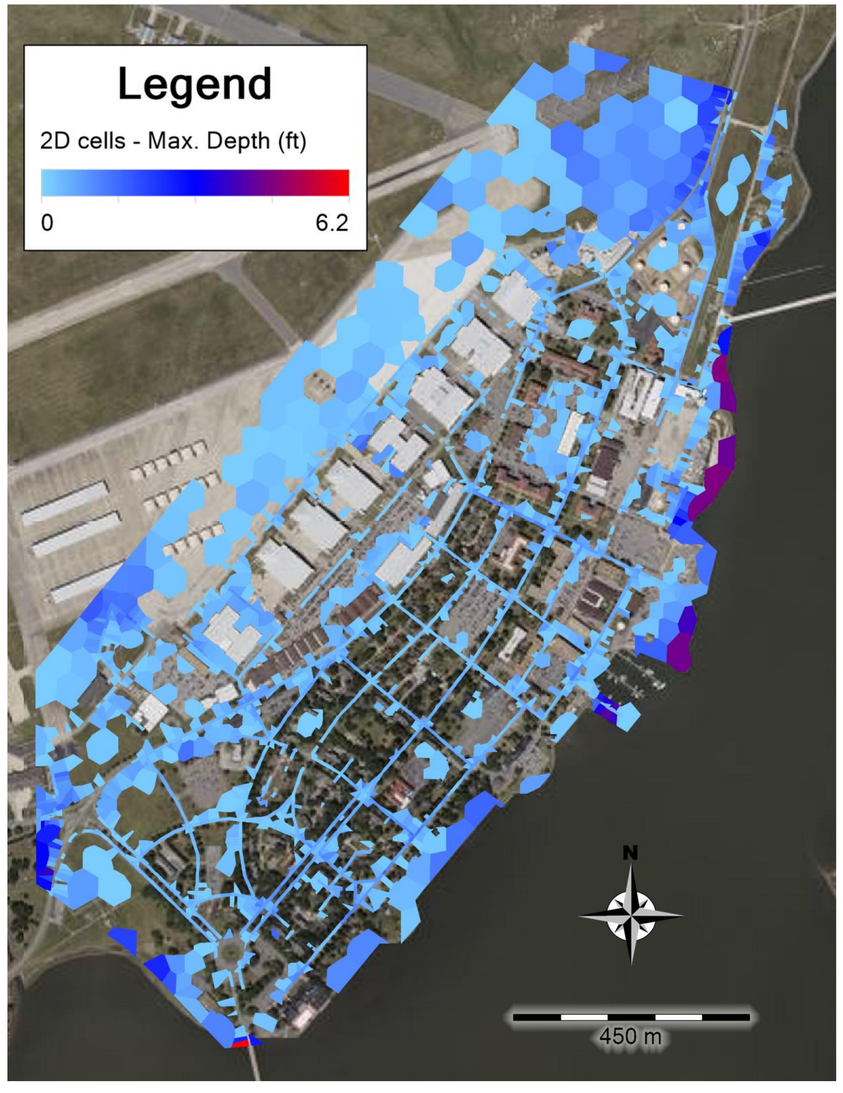


Figure 4: Map of the maximum depth of the baseline model (< 0.1ft depth is excluded from the map)

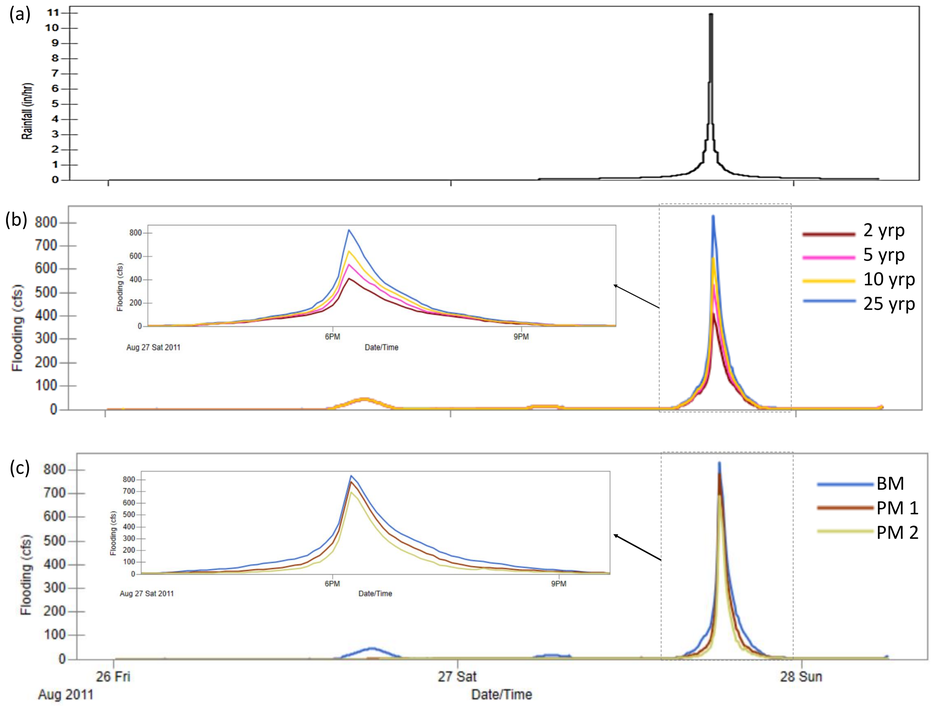


Figure 5: (a) Plot showing the 25 year return period rainfall (b) Plot showing the flooding peaks under different scenarios for the baseline model (c) Plot showing the flooding peaks under 25 yrp rainfall scenarios for the baseline model (BM), proposed mitigation 1 (PM 1) and proposed mitigation 2 (PM 2) indicating reduction in the flood peaks with proposed mitigation.

5. Conclusion

The results demonstrate that these interventions significantly enhance the system's resilience, offering a robust approach to flood hazard mitigation. This case study underscores the importance of integrating advanced modeling techniques with targeted infrastructure improvements to build urban flood resilience.

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