Downtown Concord, NH Stormwater Improvement

Kyle Ruprecht, Adam Minkema, Matthew Carter & Leland Qua

Department of Civil and Environmental Engineering, University of New Hampshire, Durham, NH

Introduction

Concord, NH is a small city in central NH with approximately 43,000 residents (2018). During high intensity storms, it's aging stormwater network is unable to handle the runoff from even 1-5 year storm events, which causes system surcharge and flooding issues on Federal and Lincoln St.

All pipes analyzed exceeded their available headwater, meaning that water would overwhelm their inlet structures, resulting in roadway flooding. It was also found that all structures were under outlet control, indicating a bottleneck further downstream. Furthermore, each pipe's capacity, found using the Manning's Equation was found to be deficient by comparing it to the calculated peak discharge

Methods

The 43 acre stormwater system watershed surrounding the Lincoln/Federal St area was subdivided into 10 smaller subcatchments. Then, using the Rational Method, which is useful for analyzing small urban watersheds, the peak discharge was calculated for each subcatchment. Using the peak discharge, hydrographs were created for 5, 10, and 25 year storm intensities

Using the hydrographs for each subcatchment, the peak discharge of each pipe was found. Then, using the velocity head of each pipe, the inlet and outlet controlling headwater was found for each pipe. The controlling headwater was then compared to the available headwater, or the invert elevation of the inlet structure of the pipe to see if surcharging would occur.

Rational Equation

$$q_p = CiA$$

Where:

q_p = Discharge (cfs)

C = Runoff coefficient

I = rainfall intensity, (in/hr)

A = Area of watershed (ac.)

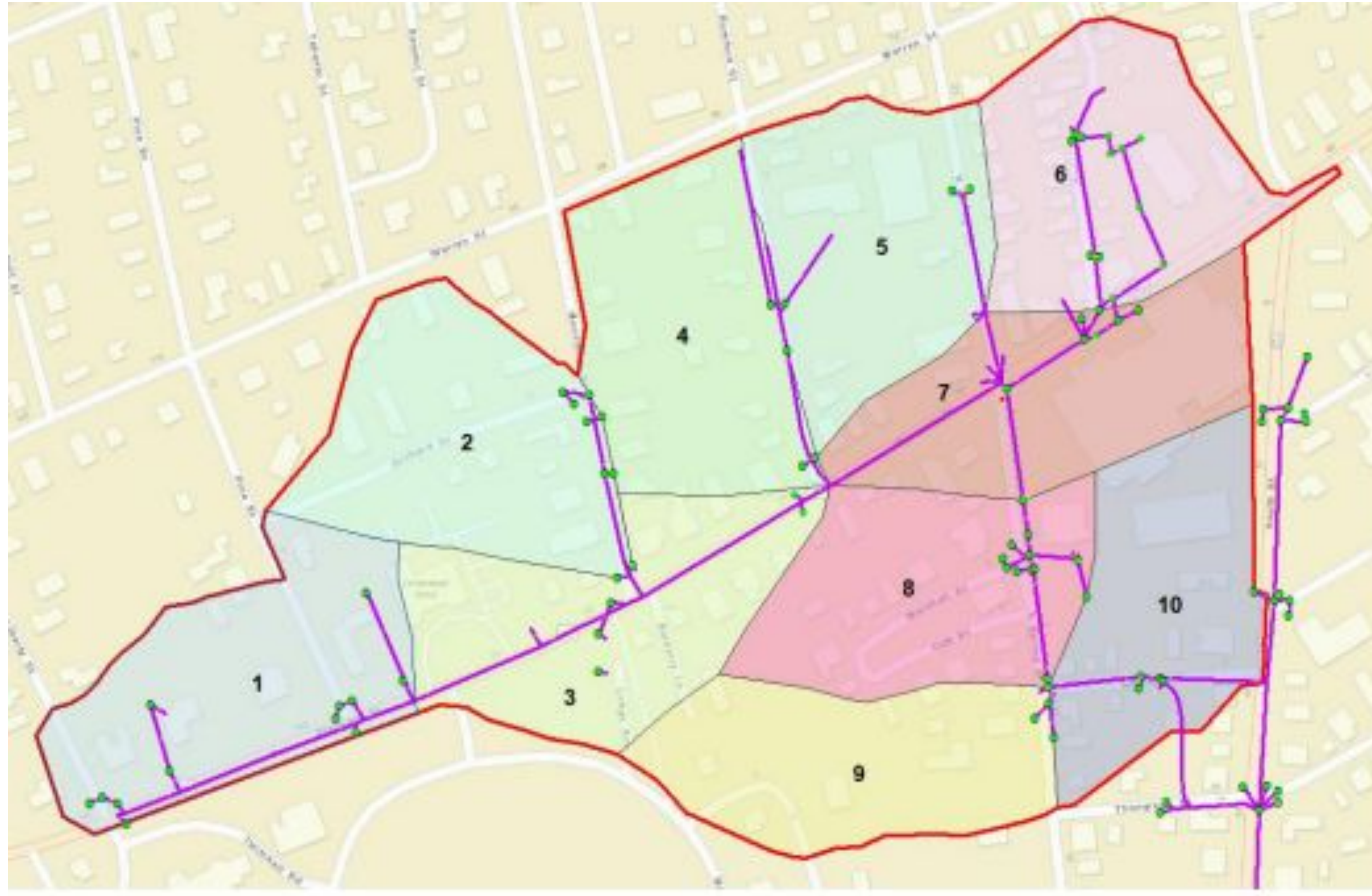

Figure 1: Subwatersheds

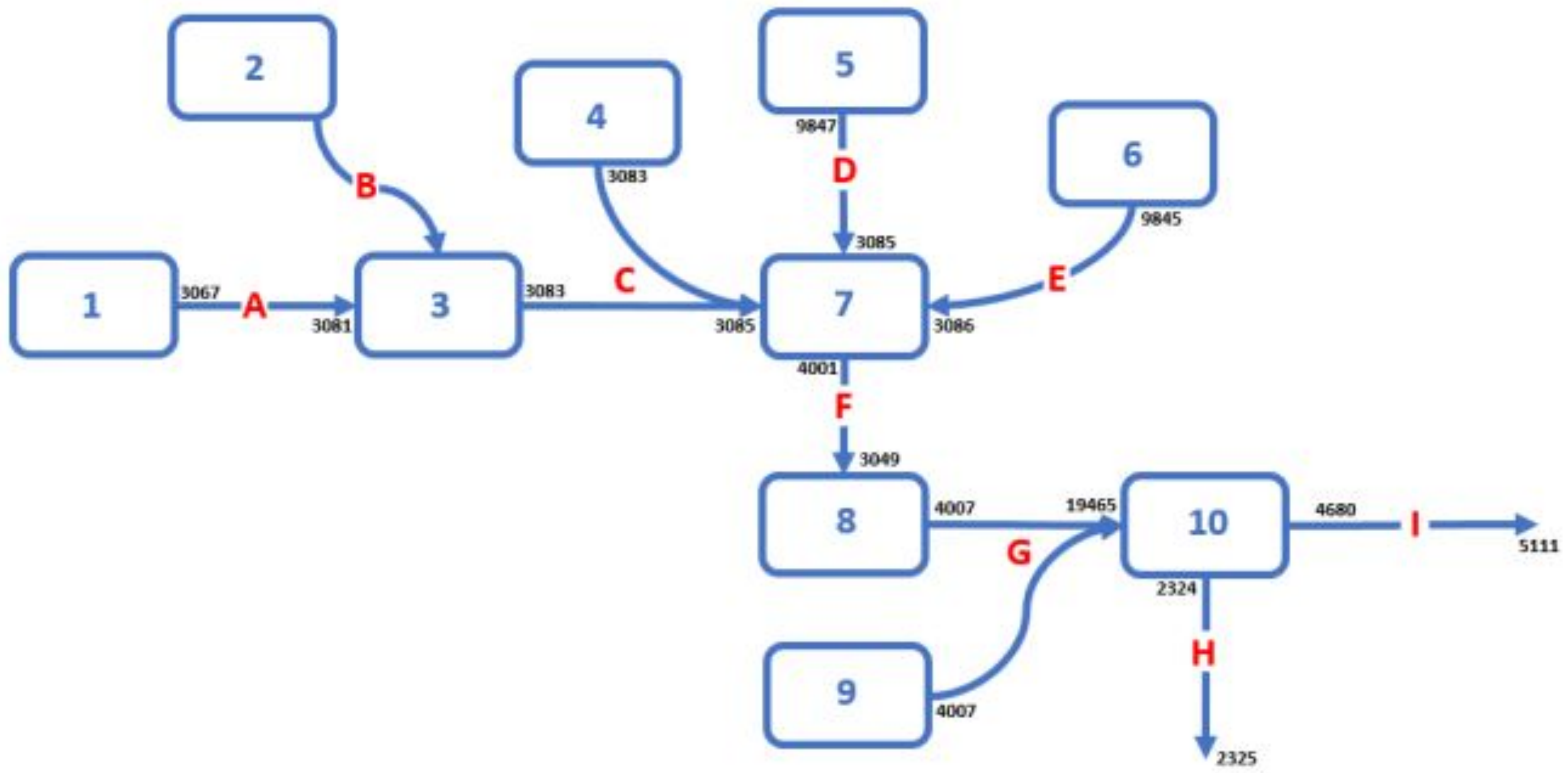

Figure 2: Drainage System Flow Diagram

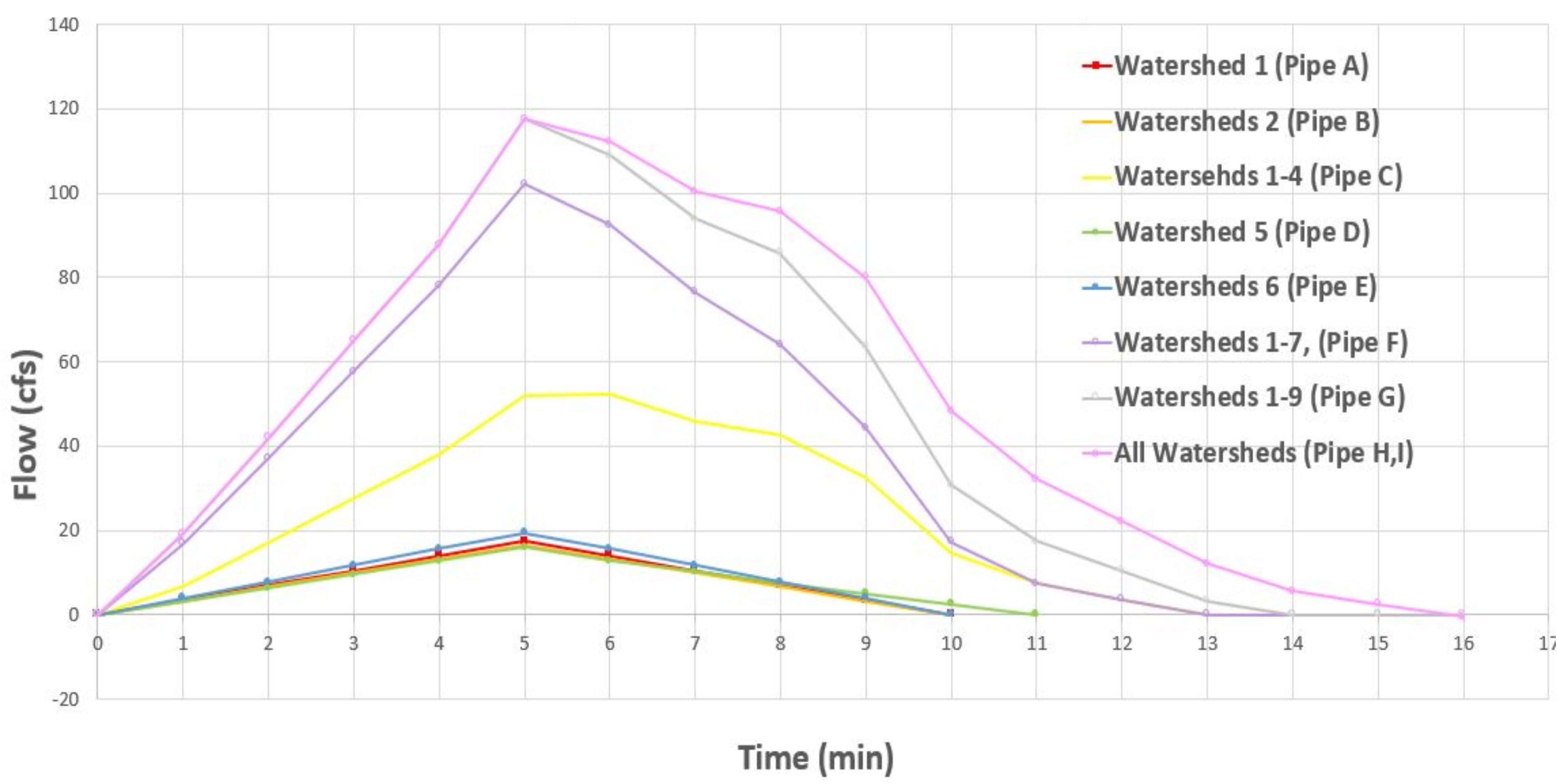

Figure 3: Hydrograph for 25 year Storm

Design Objectives

The goal of this project is to analyze the current stormwater network and present system redesigns that will reduce localized flooding while meeting triple-bottom line considerations.

Three solutions to current capacity issues were explored:

Additional Pipes: New pipes could be added to the system redirecting flow away from flood-prone areas with a larger capacity

Green infrastructure with Infiltration: Reduces peak runoff and provides beauty, pollution reduction, and animal habitation

Retention Systems: Provide storage for stormwater that slowly drains back into existing system, thereby flattening hydrograph curve

Conclusions

An underground retention system was selected as the recommended option to reduce neighborhood flooding. The storage systems can be placed under existing lots, holding onto stormwater during high intensity events and releasing it back into the existing system at a rate the pipes can handle

Three sites were noted as optimal areas for retention systems for their available size and proximity to flooding locations. To handle a 25 year storm event, construction costs range from $377,000 to $2.3 million (2020)

References

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