Hydrologic Modeling of the Effects of Stormwater Runoff in Plaster Creek Watershed

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Introduction

A major detriment to the health of Plaster Creek is stormwater that brings a large volume of warm, polluted water into the creek. Stormwater is water that runs off of impervious surfaces like pavement and rooftops. A significant amount of the Plaster Creek Watershed is urban with a lot of roads and parking lots which results in too much stormwater entering the creek at an unnatural speed. A common way to decrease the impact of stormwater is to install best management practices (BMPs) that capture the stormwater and give it a chance to percolate into the ground. A few examples of BMPs are:

- Rain gardens
- Detention basins
- Planter boxes

To understand where and what types of BMPs are most needed, a hydrologic model is necessary. The model is also able to measure BMP effectiveness which aids in future BMP implementation.
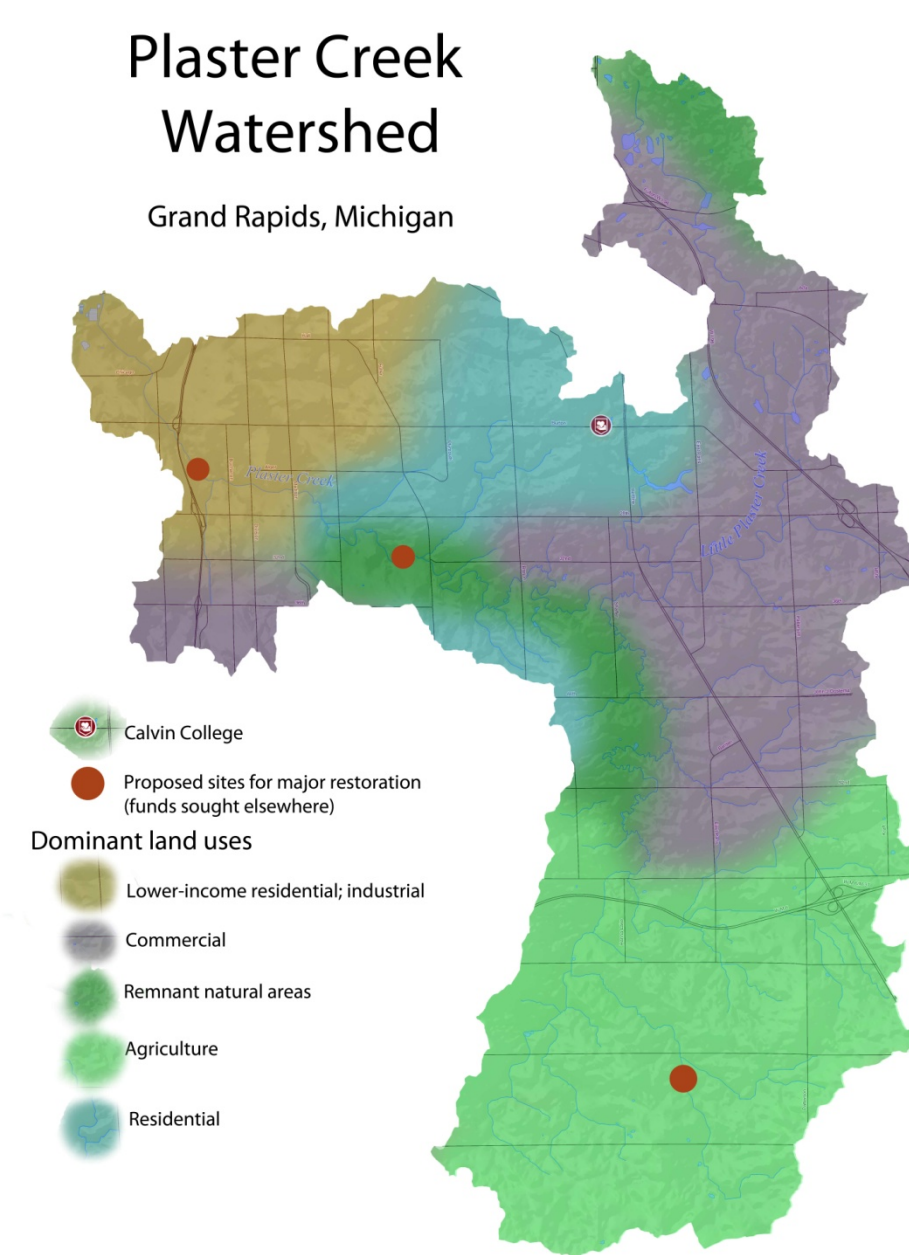

Curb cut rain garden installation

Stormwater catchbasin

Stream bank erosion

Methods

The model was developed in HEC-HMS, a program designed by the Army Corps of Engineers to simulate how watersheds react to storms. To gather the information needed for HEC-HMS, we worked with other programs including GIS (a mapping software) and HY-8 (a culvert analysis software).
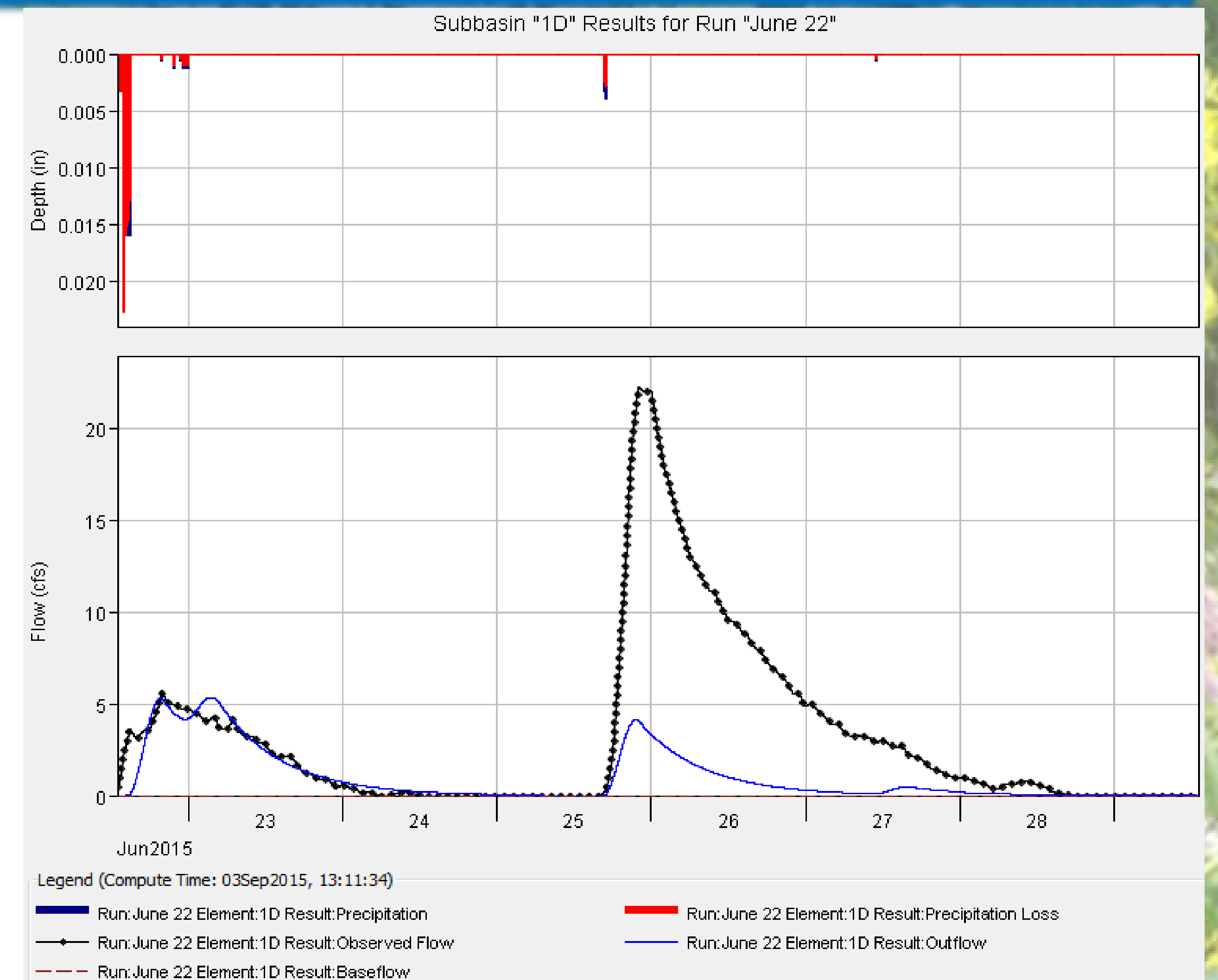

Plaster Creek Watershed

Grand Rapids, Michigan

- Calvin College
- Proposed sites for major restoration (funds sought elsewhere)

Dominant land uses
- Lower-income residential; industrial
- Commercial
- Remnant natural areas
- Agriculture
- Residential

Plaster Creek Watershed Land Use   Cartographer: Seth Kenbeek Image prepared by Nathan Haan

We also strategically installed 16 leveloggers in streams throughout the watershed. Leveloggers show us how much water is flowing at a particular location which allows us to calibrate the HEC-HMS model, improving its accuracy. The calibration process involves choosing an actual rain event and comparing how the real watershed and model watershed respond to the rain event.

Installing leveloggers

Subbasin "1D" Results for Run "June 22"

Legend (Compute Time: 03Sep2015, 13:11:34)
- Run:June 22 Element:1D Result:Precipitation
- Run:June 22 Element:1D Result:Observed Flow
- Run:June 22 Element:1D Result:Baseflow
- Run:June 22 Element:1D Result:Precipitation Loss
- Run:June 22 Element:1D Result:Outflow

Hydrograph comparing observed (levelogger) and simulated discharge

Plaster Creek after a rain event

Results & Conclusion

This research was a part of an ongoing effort to make an accurate model of the watershed. We created a model this summer and have calibrated it using a rain event in June. Future calibrations will help improve the model's accuracy, making it a useful tool for quantifying BMP effectiveness to improve the health of Plaster Creek.