

Evaluating the effectiveness of curb cut rain gardens in terms of storage volume and sediment removal

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Objectives

The objective of this research project is to analyze the effectiveness of curb cut rain gardens in two specific aspects:

- Storage volume- evaluated using pressure transducers and the geometry of the Curb cut rain gardens;
- Sediment removal- analyzed by collecting and weighing sediment from the curb cut rain gardens' sediment traps following rainstorms.

What is a rain garden?

Rain gardens are landscaped gardens in a shallow depression that receive rainwater runoff from nearby impervious surfaces such as rooftops driveways, sidewalks, parking lots and streets. They mimic natural meadows, but are located in urban environments. Curb Cut Rain Gardens differ from regular rain gardens in the way they are built. They are located between the sidewalk and street curb where a depression is made and a cut is created in the curb to allow water to enter the garden, allowing water that is flowing in the curb and gutter to go into the garden instead.



Methodology

Four Curb cut rain gardens sites were selected for monitoring and research, and the selection was based on location, geometry and street slope.

Three of the gardens were located in flat slopes with "typical" gardens shapes, which means they did not have any large trees or utilities to alter the shape of the garden. The forth one was located in a street with steeper slope and more complicated geometry, which ended up giving inaccurate data.

Storage Volume

- Install a 6ft long perforated PVC tube containing a pressure transducer at each site leaving 2ft above the ground. The perforations allow water to enter the tube so that the pressure in the tube is the same as that in the rain garden;
- Remove the pressure transducers and download all data using a software specifically for this type of pressure transducers.

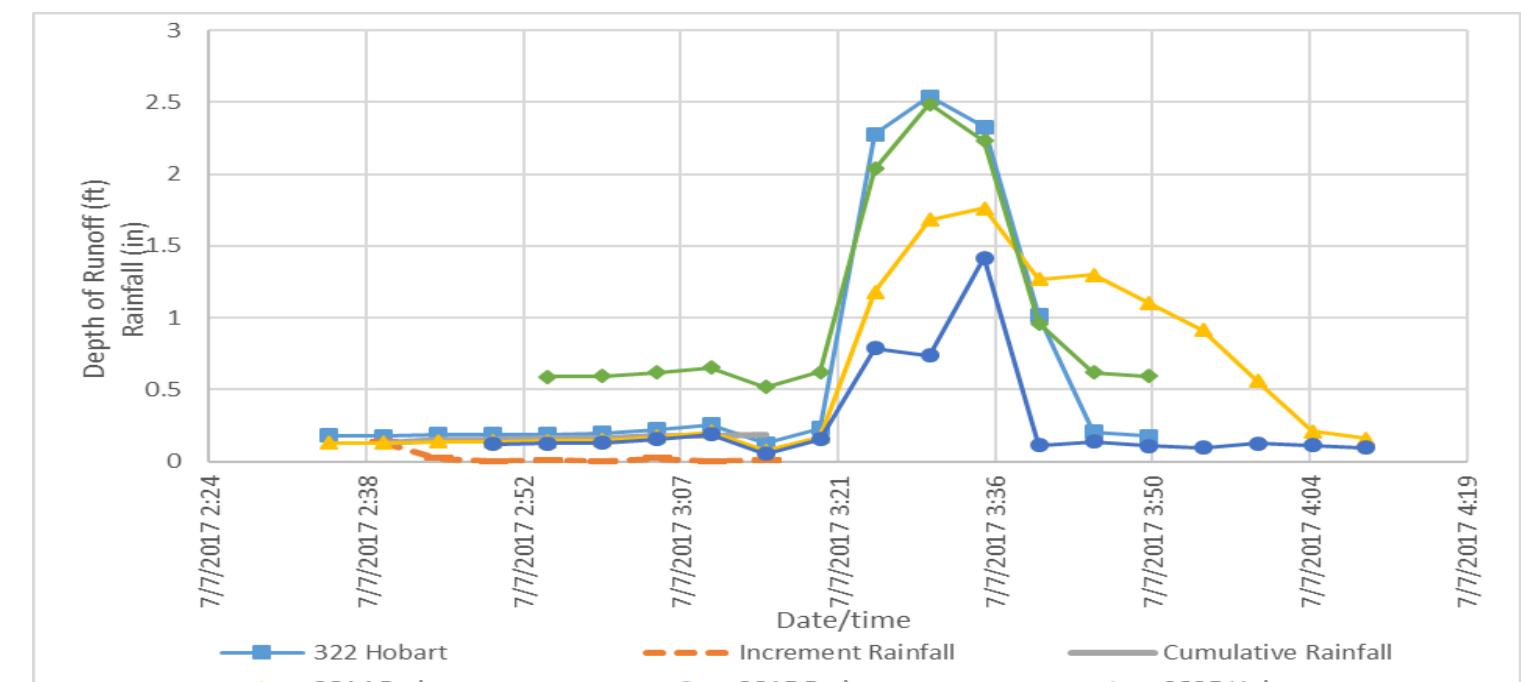
Sediment removal

- After each rain event, collect sediment from the sediment traps at each site;
- Weight it and place in aluminum pans;
- Dry the sediment at approximately 110°C, for at least 48 hours;
- Weight the sediment every 24 hours and once the weight was consistent, it was considered fully dry.

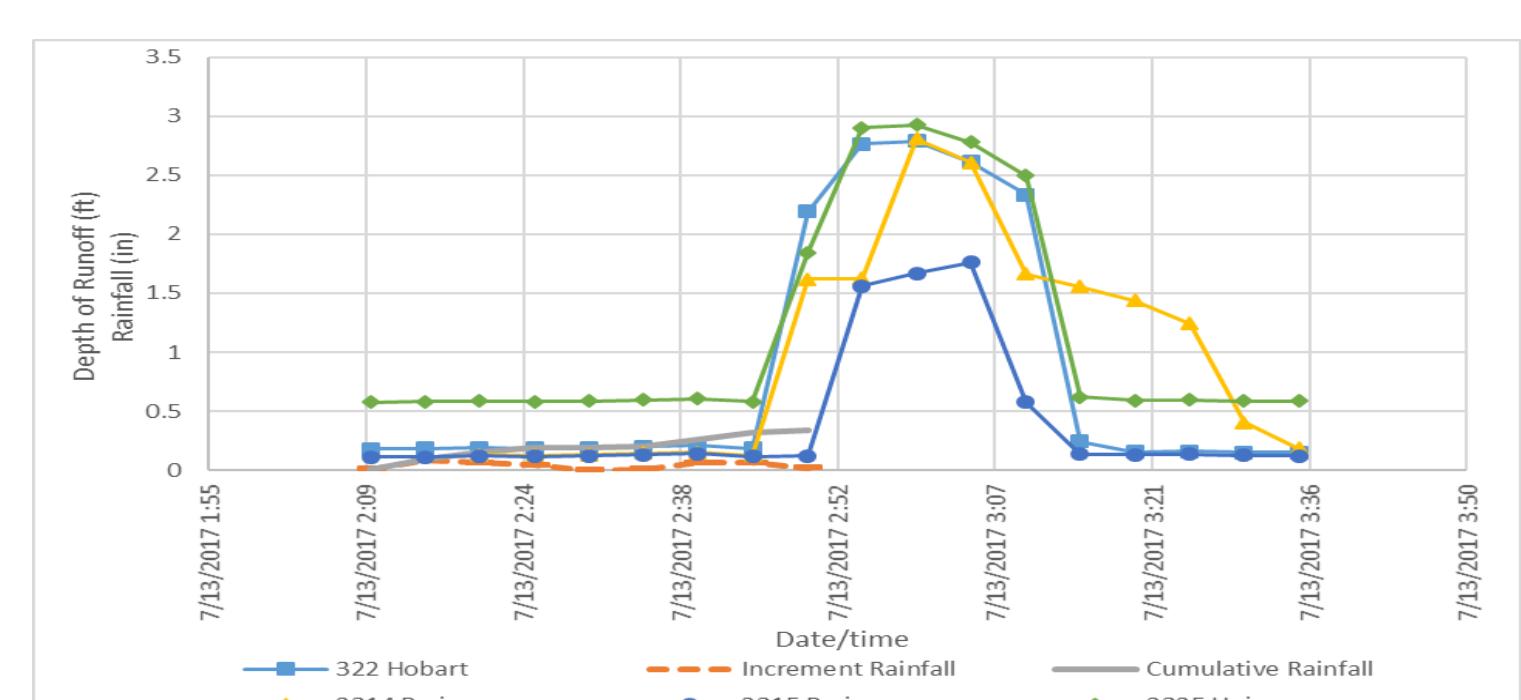
Results

By the end of summer there were three rain events for analyzing the effectiveness of rain gardens.

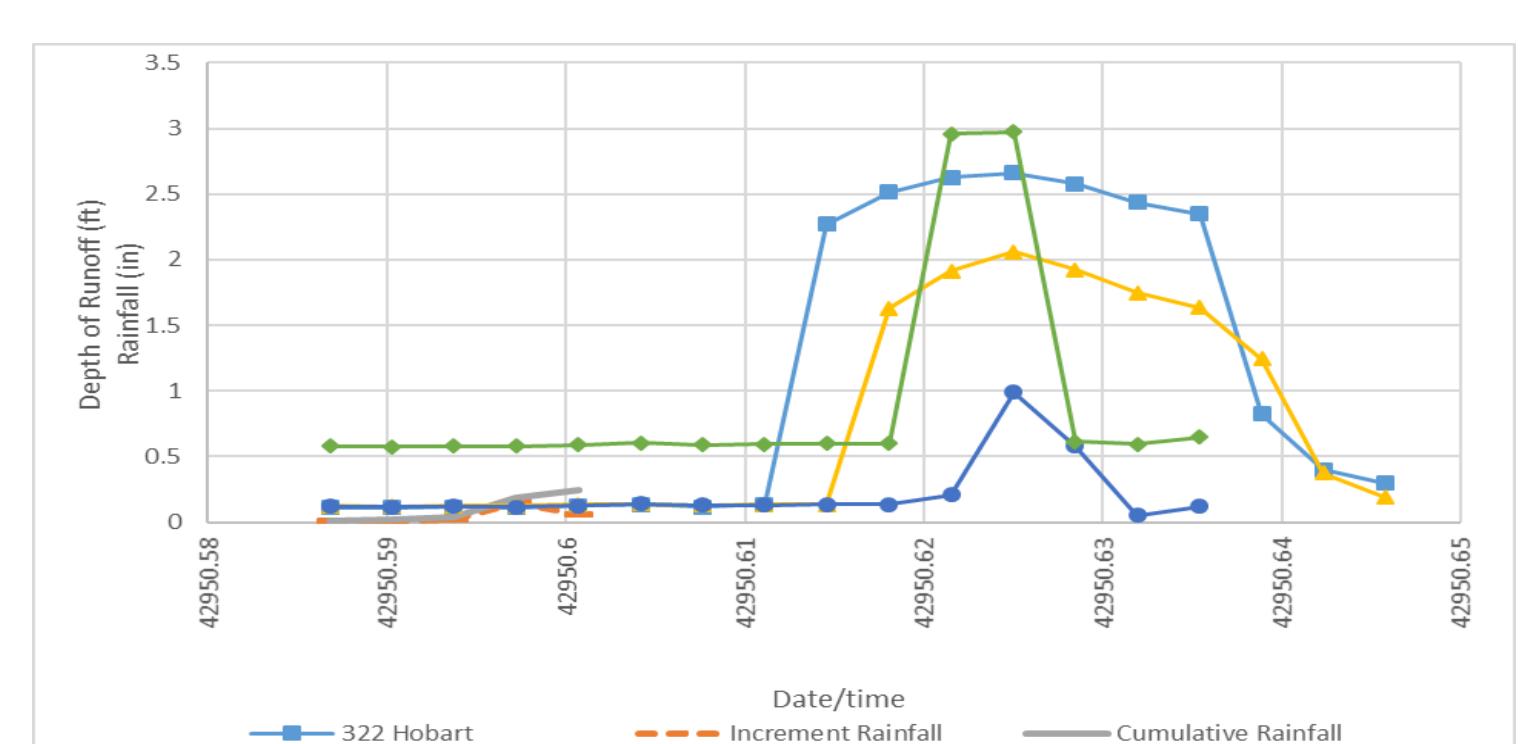
The level logger data is easily converted to depth of runoff. Furthermore, rainfall data from a database, Mesowest, was collected. This data was used to compare the amount of rainfall and expected runoff and calculate volume of runoff in the garden based on the level logger results.



Hydrograph and CCRG response for July 7, 2017 rain event



Hydrograph and CCRG response for July 13, 2017 rain event



Hydrograph and CCRG response for Aug 3, 2017 rain event

Conclusions

Sediment removal

The four Curb Cut Rain gardens chosen for this project collected this summer an average of 1.40×10^{-3} lb of sediment per square-foot of tributary area. There were 5 rain gardens currently installed by Plaster creek Stewards, and assuming 4,000 SF Tributary area for each rain garden we projected 315 lbs of sediment was removed in about a month during the summer of 2017.

Storage Volume

When comparing the data collected, it can be seen that, in most cases, the CCRG are storing less water than they were expected to receive. However, these calculations also contain some amount of error. Aside from flaws in monitoring, it is possible that the rain gardens are not constructed per the design plans.

References

- City of Portland. *Flow Test Report: Siskiyou curb Extension*, 4 Aug. 2004, www.portlandonline.com. Accessed 4 Sept. 2017
- MesoWest Data, University of Utah, 2002, mesowest.utah.edu/. Accessed 4 Sept. 2017.
- Plaster Creek Stewards. *Calvin College Plaster Creek Stewards*, www.calvin.edu/admin/provost/pcw/learn/status. Accessed 4 Sept. 2017.
- Solinst Levelogger Edge, Solinst, https://www.solinst.com/products/dataloggers-and-telemetry/3001-levelogger-series/levelogger-edge/datasheet/. Accessed 4 Sept. 2017.