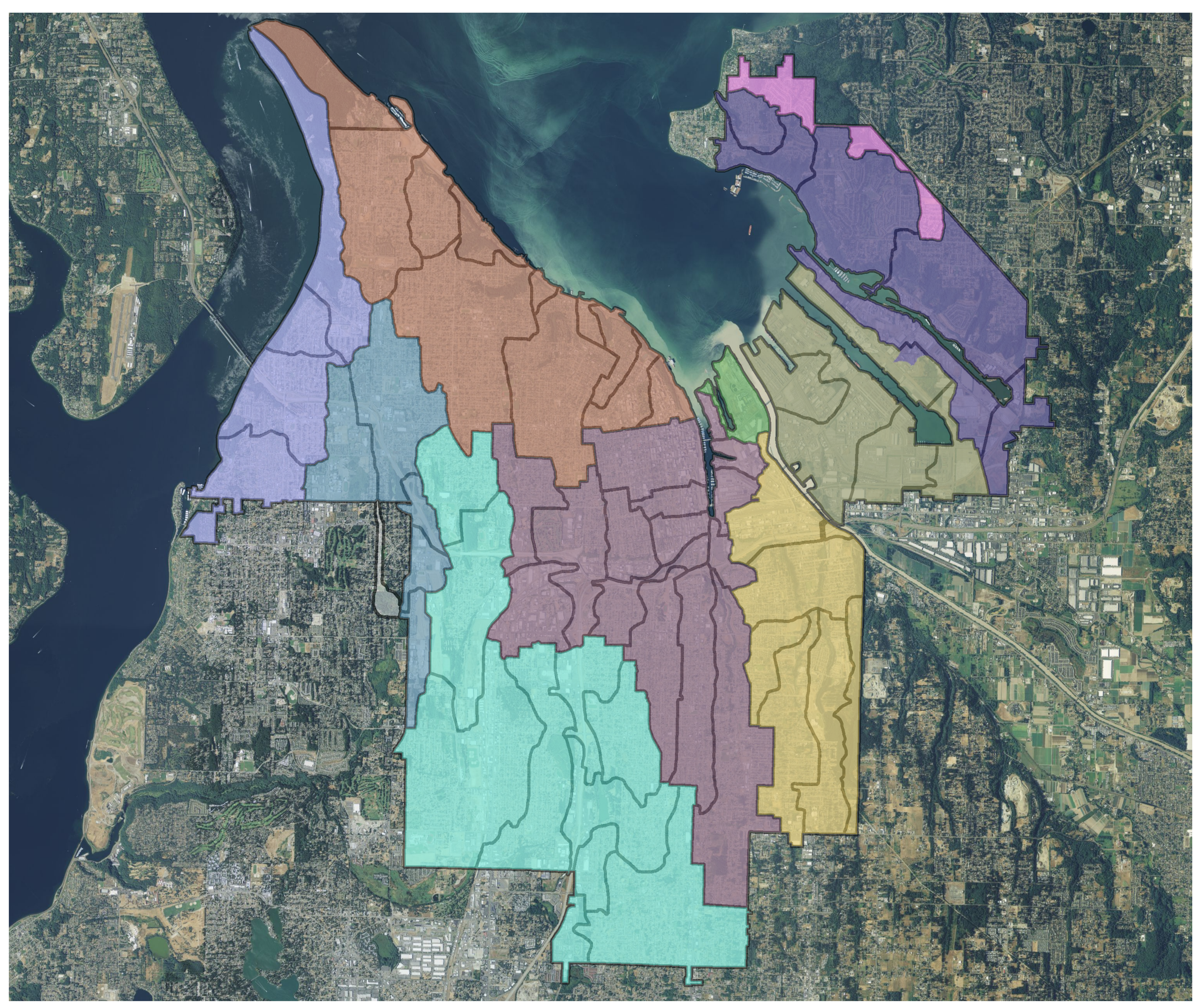
Method for Placement of Rain Gardens

Purpose

The purpose of my project is to contribute to the sustainability goals of Tacoma through implementation of a rain garden placement strategy. Finding advantageous locations where rain gardens can be placed was the primary objective. The Pacific Northwest is well known for its wet climate. Further, Tacoma is an industrious city that especially needs to monitor its pollutants. Rain gardens have two primary objectives which is to provide additional support for our storm water drainage system by collecting, retaining, and filtering pollutants out of the water through the soil and to mitigate flooding.



Tacoma is broken down into 9 seperate water sheds and each of those are broken down into sub watersheds totaling 67.

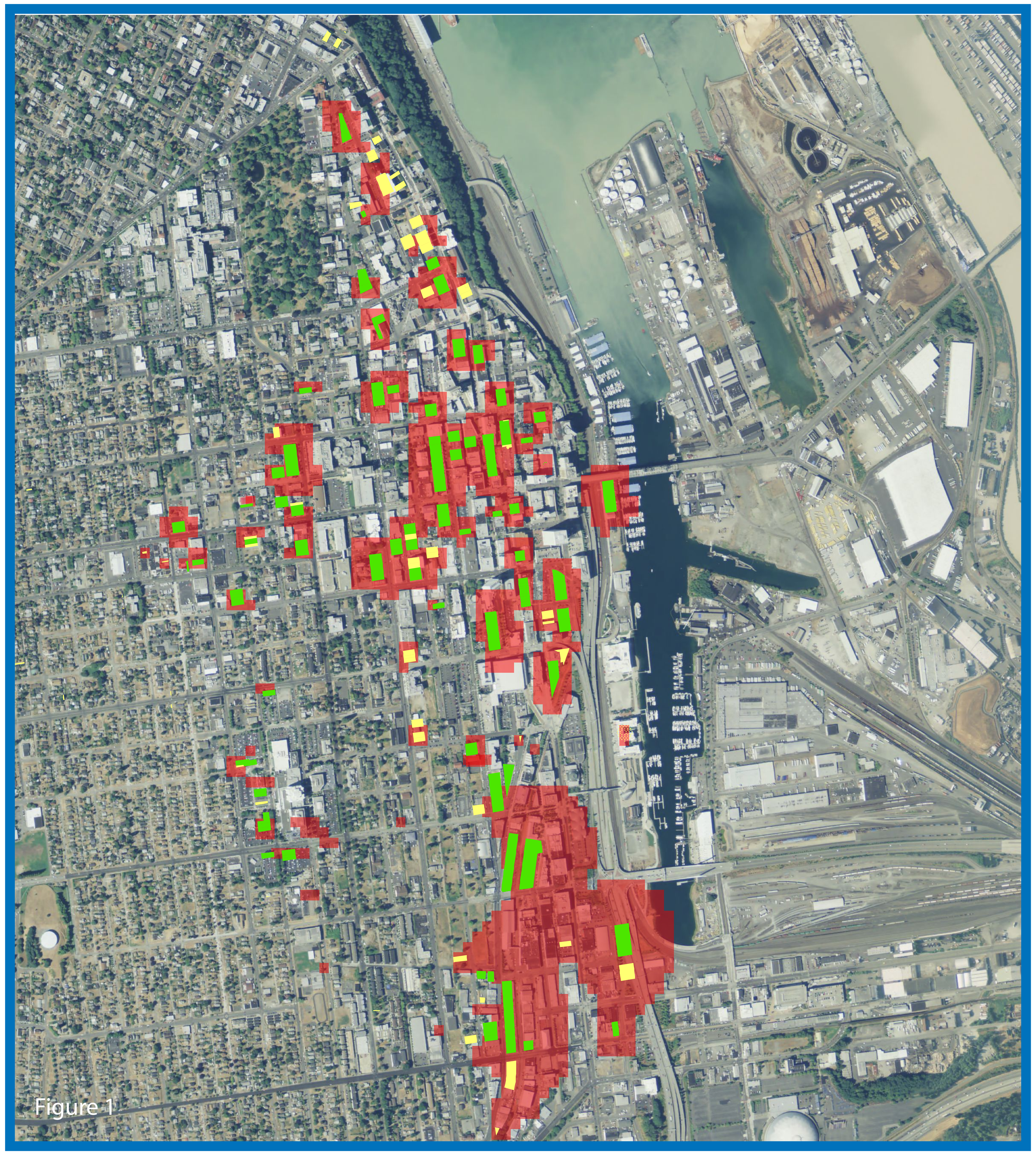


Figure 1

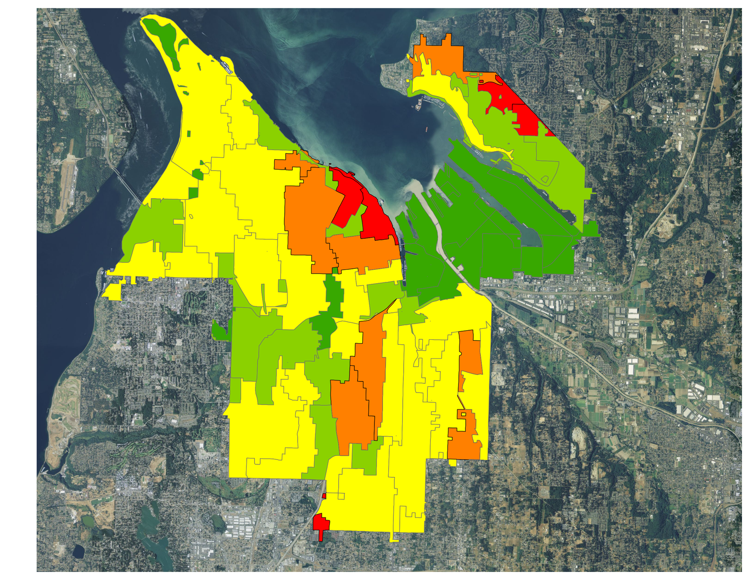
Method

The analysis looks at 3 factors that contribute to surface water pollution. Impermeable surface coverage, population density, and road length data were joined according to the sub basin they were contained in. The 3 data sets were given an index score by sub basin if x = the attribute then ([x] – (Mean of[x] /StdDev.)= the index score. Each category were attached to sub basins then symbolized according to index score(Fig 2). The highest score being a 3 and the lowest being a -4. The sub basins with the highest index score were the areas that I focused on for my analysis (Fig 1). Within each basin I attached parcel data and filtered that down to parcels with land use type: Commercial vacant, residential vacant, vacant land with problems, and parking. Rain gardens must be 20% of the supporting area's size in order to be optimally effective. These vacant or parking parcels were buffered individually to extend out to 80% of the parcel's land area coverage (SqrRoot[Parcel Area · 4]). Next, in order to find the parcels where rain gardens could be most advantageous I conducted a zonal statistics to find the areas that have at least 80% of its containment area to be impermeable surface. Because of the surrounding impermeable surface coverage these parcels were selected to be the msot advantageous areas to place a rain garden(Fig1). Measuring storm water runoff and polluted runoff is not an exact science. Several studies have been conducted to measure these effects. These studies included pollution data that has been collected. Because of the unexisting data I used my own analysis model to predict the most polluted water runoff in Tacoma.

Result

Downtown Tacoma has the highest amount of overall impermeable surface coverage, population density, and road networks. Further, this is a highly commercialized zone allowing the rain gardens to have a better chance at a positive aesthetic impact. The bottom image in figure 2 shows the most concentrated areas of stress(in red)are located in downtown but to the south (symbolized in yellow) are still considered downtown. I decided to extend my analysis to two sub basins below to include all of downtown. The reason the sub basins in yellow were not in the top of the index scores were because of the lack of roads and population density but downtown is a high end commercial area with high traffic and street activity making it suitable for a rain garden's purpose and aesthetic appeal.

Block groups were spatially joined with block group population data then attached to each sub basin. The total populatino was divided by the area of the basin resulting in a density statistic.



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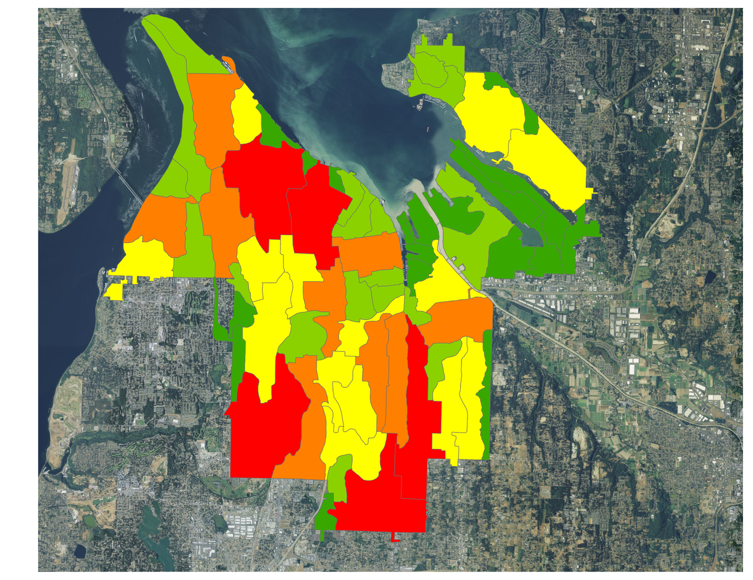
TThe road data was inputed and joined to each subb basin. The total length of roads is respresented by sub basin.



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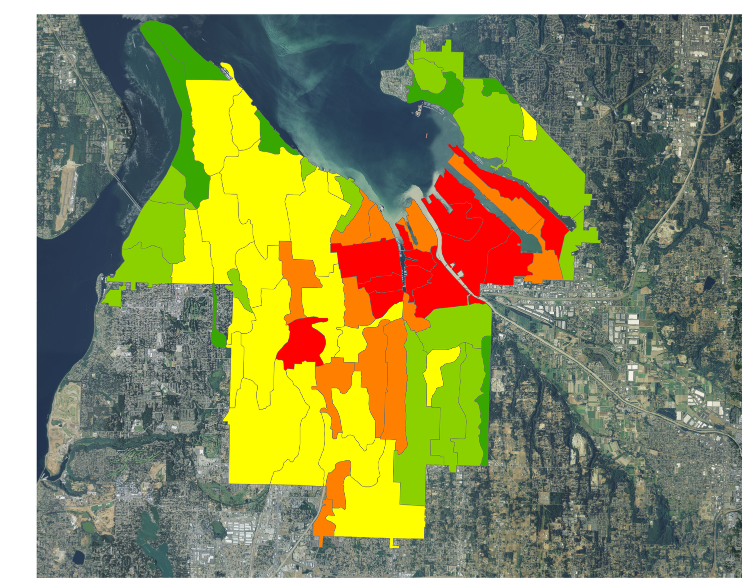
Impermeable surface coverage came in the form of a raster and calculated with a zonal statistics with the sub basins as a target.



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This represents the combined index score of all 3 variables. The blue rectangle surrounds the downtown Tacoma area, the extent of my analysis.

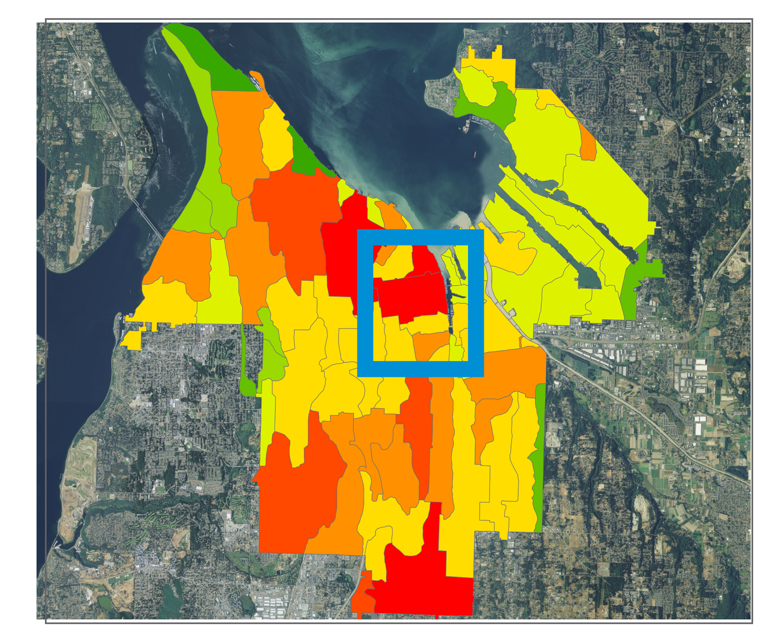

Figure 2

Key Literature:

Palhegyi, G. (2010). Modeling and sizing bioretention using flow duration control. Journal of Hydrologic Engineering, 15(6), 417-425.

Roy-Porier, A, Champagne, P, & Filion, Y. (2010). Review of bioretention system research and design: past, present, and future. Journal of Environmental Engineering, 136(9), 878-889.

Data Sources:

Census Burea, Wagda, & City of Tacoma

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Data collection and presentation by Takumi Ledbetter.
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