TO: Environmental Policy Innovation Center
FROM: Phillip Cork
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SUBJECT: New Orleans Rain Gardens

Executive Summary

This project considers the impact of forty proposed rain gardens to be cultivated across New Orleans, LA. This report first outlines the methodology used to gather, clean, and process the necessary datasets. It then provides a socio-economic overview of the neighborhoods that would benefit from these gardens, finding most are diverse communities in which roughly one-forth of residents live below the poverty line. Next, it presents findings on the rain gardens' capture capacity, estimating that more than six million gallons of rain water could be captured annually. Finally, it provides an interactive map for exploring the intersection of these considerations in more detail.

Methodology

Data Collection

With the geospatial and dimensional data for the proposed gardens provided, the data collection tasks focussed on accessing census data to create a snapshot of the present communities and acquiring precipitation data for calculating average rainfall and capture capacity.

Tidycensus, an R package that wraps around the Census Bureau's API, was used to query Louisiana block groups from the 2019 American Community Survey. The results included both the geospatial outlines of the block groups and estimated population counts. The variables of most relevance included each block group's population by race and the count of individuals living below the national poverty level.

Daily precipitation observations recorded by NOAA were accessed through the Environmental Impact Data Collaborative platform on Redivis. Minor transformations were conducted in the tool's interface to create a subset of the two available datasets. The first consisted of the weather stations and their locations, while the second contained each station's daily observations of precipitation.

Data Cleaning & Transformation

The data cleaning and transformation steps were carried out in Python given the variety of text features within each dataset. In working with the rain gardens data, this stage included standardizing street address labels, correcting instances where the garden's area was stored inconsistently (e.g. '120x30' instead of 3600), and other minor adjustments to streamline analysis.

The Census data required little cleaning beyond renaming variables for easier interpretation and filtering to the relevant block groups for the scope of this project. The population estimates were used to calculate the non-white population percentage of each block group as well as the percentage of community members living below the national poverty line.

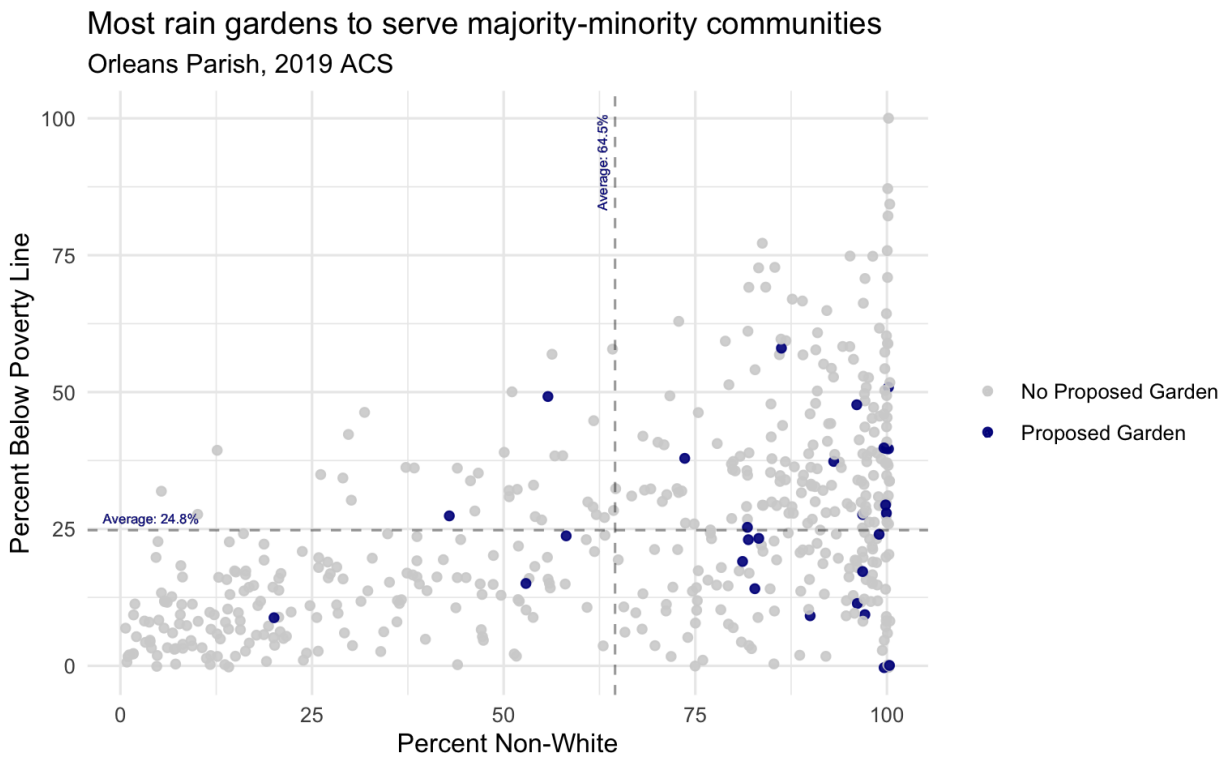
The NOAA precipitation data also required little cleaning, but needed to undergo more transformations for further analysis. To find the weather stations closest to each rain garden, the geospatial points for both stations and gardens were compared to find the minimum distance between each. The nearest weather station was then assigned to each garden to provide a more accurate source of rainfall in the given area. The daily precipitation observations were also filtered to include only the nine stations closest to the proposed rain gardens.

Rainfall measures were aggregated at the average daily, monthly, and yearly rate for each station and converted from a tenth of a millimeter to inches. Finally, using the area of each garden and the aggregated rainfall statistics for each weather station, a rainfall capture capacity measure was calculated for each rain garden. These statistics, presented in the next section, provide an initial estimate for how many gallons could be captured on a monthly and annual basis.

Analysis

New Orleans Neighborhoods

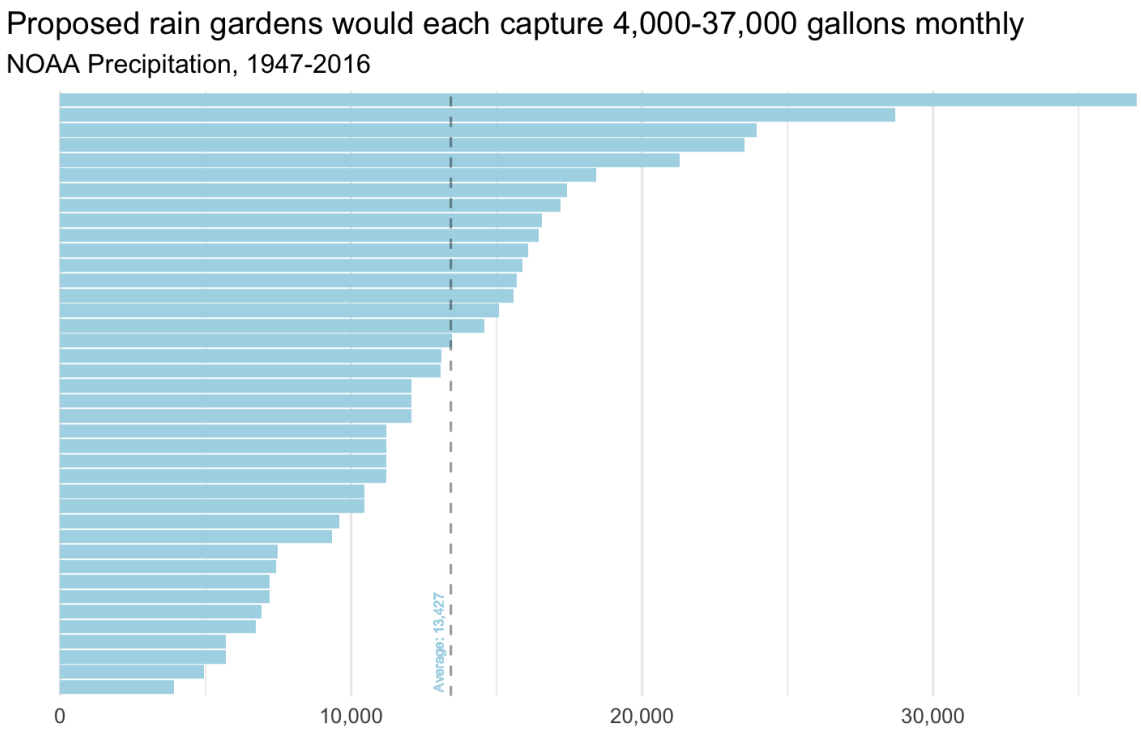
Broadly speaking, the aggregated census data suggests that most New Orleans neighborhoods are home to diverse communities where on average, one-fourth of residents live below the poverty line. There is, of course, substantial variance in these measures, which the figure below helps illuminate.



As the scatter plot shows, all but three of the forty proposed rain gardens would serve a community that is either above average (24.8%) in the percent of individuals living below the poverty line, above average (64.5%) in non-white residents, or both, when considering all block groups in Orleans Parish.

Rain Capture Capacity

The second critical consideration for this project is the effectiveness of gardens to capture excess rainwater. As this second figure depicts, because the average monthly precipitation measures only vary by a few inches between block groups, the total gallons captured by each garden depends greatly on the size of its collection area. In all, it is estimated that the forty rain gardens across New Orleans would capture 537,109 gallons per month, or approximately six million gallons annually.



Interactive Map

To plot and examine the intersection of these two considerations, this report includes an interactive map in which users can view the locations and estimated capture capacity of each rain garden in the context of the communities they would serve. Note that within the map, each census block group can be clicked on to see a pop-up display of the aforementioned statistics. Similarly, hovering over a rain garden will display a tooltip with the relevant monthly and annual metrics for rainfall and capture capacity.

Future Improvements

To further refine the precision of the capacity estimates, next steps would include increasing the granularity of the precipitation data, as well as taking into account the elevation and impervious surface area of the rainfall gardens locations. Neighborhood observations could be improved by including the margin of error for each variable provided by the ACS to create a more representative range of outcomes for the socio-economic variables of interest. These additional features would provide more precise estimates for both community representation and rainfall capture capacity, ultimately painting a clearer picture of the extent of the benefits and who would experience them most.

Conclusion

This report presents the methodology and tools used to evaluate the estimated effectiveness of forty proposed rain gardens. These rain gardens would not only mitigate flooding, a constant threat across southeast Louisiana, but also filter out pollutants from storm runoff and provide habitats for birds and butterflies. As such, it is crucial to make the most of this opportunity by cultivating the gardens in strategic locations, both in terms of their environmental impact as well as the benefits they would provide to numerous marginalized and impoverished communities.