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2021 I-Tree Academy – Capstone Project

What's Going On: Using trees to reduce stormwater runoff along Marvin Gaye Park

INTRODUCTION

The District of Columbia is addressing climate change through its citywide plan, Climate Ready DC, which evaluates risks and impacts of climate change and makes recommendations for mitigation and adaptation. Impacts of climate change include warmer average temperatures, more extreme heat days, high intensity rain events that occur more frequently, and higher tidal inundation with rising sea level.[i] These impacts will vary across the city due to urban warming, topography, infrastructure, and watersheds. In addition, communities themselves vary in their vulnerability to climate impacts, due to socioeconomic factors that heighten an individual's sensitivity to higher temperatures and reduce their ability for adaptation (limited incomes, unemployment, age). [ii] One such area with highly vulnerable communities, is along Watts Branch, encompassed by Marvin Gaye Park. Watts Branch was identified as at high risk of flooding, while also having the highest number of community resources at risk to flooding. This area and natural resources are managed by District of Energy & Environment, Department of Parks and Recreation, Department of General Services, and the District Department of Transportation (DDOT). The latter agency, DDOT, includes Urban Forestry Division, which manages trees on all public property and indirectly manages trees on private property.

Urban trees can mitigate flooding through the interception of stormwater and in helping to retain soil, allowing for improved infiltration during storm events. Individual trees may vary in their ability to reduce stormwater runoff, depending on the species as well as the size and health of individual trees. The objectives of this project are to evaluate stormwater reduction benefits of existing trees in and adjacent to an urban creek at high risk of flooding and to make recommendations for new tree plantings to maximize stormwater mitigation.

METHODS

Area studied

This project encompasses both park and street trees along a creek in Ward 7. Marvin Gaye Park is approximately 1.6 miles long and includes an urban creek, Watts Branch, which is part of the Anacostia River watershed. Marvin Gaye Park is located in Ward 7, in the Northeast Quadrant of Washington, DC.

Data selection

The District of Columbia's Urban Forestry Division (UFD) maintains an inventory of all publicly owned trees, located in the right-of-way, and on District school and park property. The inventory of street trees is complete and updated on a daily basis, while the inventory of trees on schools and park properties is currently being developed and updated through a combination of inventories conducted by UFD Urban Foresters and in cooperation with Casey Trees Community Science Park Tree Inventories. Tree Inventory data was accessed from the District of Columbia Open Data DC: https://opendata.dc.gov/datasets/urban-forestry-street-trees)

For this investigation, trees within the 100-year floodplain were selected for iTree Eco analysis. This selection was made in ArcPro using *Intersect* to identify trees located within the 100-year floodplain surrounding Watts Branch within Marvin Gaye Park. This new selection was saved as a CSV file and uploaded into iTree Eco.

Key i-Tree Tools and Parameters

iTree EcoV6 was used to estimate ecosystem services of inventoried trees, specifically avoided runoff by tree species. Chosen parameters included in the analysis:

Location: Study area=Urban, Population (1530)[iii], Weather year 2018, weather station 724050-13743

Data Collection Options: Species, DBH, Tree address, Crown health (condition) defined as Excellent (90%), Good (70%), Fair (50%, Poor (30%), Dead 10%).

Project and Strata: Urban, 107 acres, 1178 trees

Inventory values: iTree default benefit prices were used, such as runoff valuation of $0.07 per ft^3

iTree Species was used to determine tree species best suited to the Mid-Atlantic, with an emphasis on stream flow reduction. Chosen parameters included in the analysis: Location: Washington DC, no height constraints, Functions: Overall Pollution rate removal of 7/10 and streamflow reduction of 10/10.

PRELIMINARY RESULTS and DISCUSSION

Tree species composition

The forested area within the floodplain of Watts Branch is comprised of a diverse array of species with no species accounting for more than 10% of all trees. The most common species reported, are red maple, American elm, Eastern redbud, pin oak, goldenrain tree, willow oak, river birch, Chinese pistache, American sycamore, and crape myrtle (Figure 1).

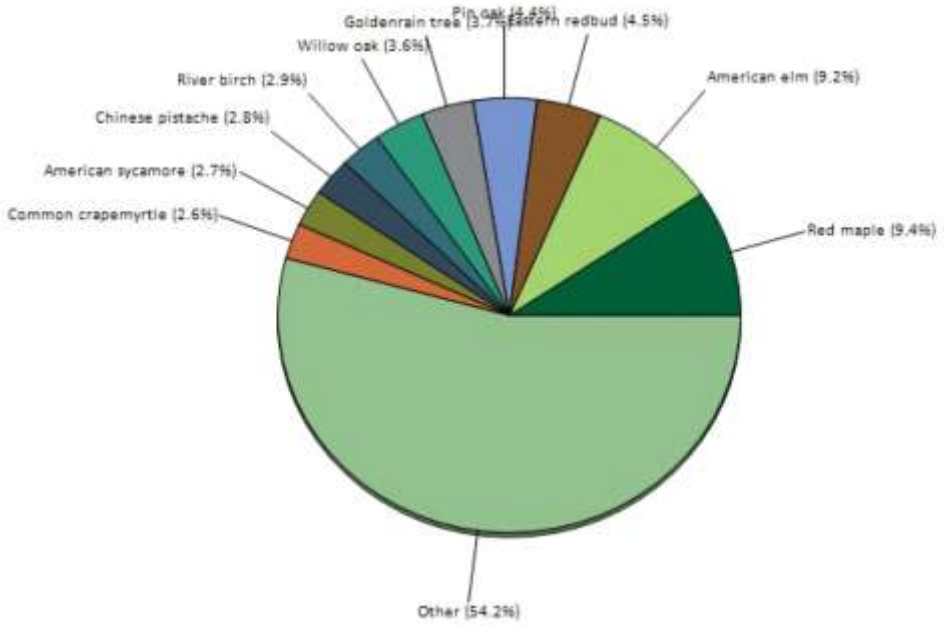

Figure 1. Tree species composition along Watts Branch in Marvin Gaye Park

The top ten most common tree species can be contrasted with the most important tree species, as defined in iTree, dependent on the relative proportion of a tree species in the forest and percent leaf area (Table 1). Willow oaks are reported as the most important species, likely due their relatively large sizes, reaching up to 48” DBH (Appendix A) and high percent leaf area.

Table 1. Most important species along Watts Branch in Marvin Gaye Park

Species Name	*Percent Population*	*Percent Leaf Area*	*IV*
Willow oak	3.6	19.2	22.7
American elm	9.2	12.3	21.5
Red maple	9.4	10.2	19.7
Pin oak	4.4	10.0	14.4
Sweetgum	2.5	5.8	8.3
Northern red oak	2.1	5.5	7.7
American sycamore	2.7	4.7	7.4
Eastern redbud	4.5	1.1	5.6
River birch	2.9	2.4	5.2
Tulip tree	1.6	3.2	4.8

Tree benefits analysis

The iTree Eco calculates a variety of ecosystem services by species, these have been summarized in Appendix B (Benefits Summary by Species). Pollution is not included here as those data were not available for the study year in iTree, 2018. To summarize, inventoried trees within the 100-year floodplain surrounding Watts Branch account for 449.3 tons of carbon storage, 6.1 tons of carbon sequestration, and 15.3 thousand cubic feet of avoided runoff (Box 1).

Box 1. Ecosystem services summary
- Number of trees: 1,178
- Most common species of trees: Red maple, American elm, Eastern redbud
- Percentage of trees less than 6" (15.2 cm) diameter: 55.3%
- Carbon Storage: 449.3 tons ($76.6 thousand)
- Carbon Sequestration: 6.138 tons ($1.05 thousand/year)
- Oxygen Production: 16.37 tons/year
- Avoided Runoff: 15.28 thousand cubic feet/year ($1.02 thousand/year)

The impetus for this study was to conduct an analysis of stormwater benefits of trees surrounding Watts Branch, located within and adjacent to Marvin Gaye Park. This was accomplished by including trees within the 100-year floodplain of Watts Branch. The combined benefit of inventoried trees located in the 100-year floodplain allows for 15.5 cubic feet of avoided runoff, based on precipitation data from 2018 (Box 1). The best performing trees for avoiding stormwater runoff were willow oak, American elm, red maple, pin oak, and sweetgum (Figure 2). This mostly matches the most important species reported for the park, with a few exceptions (Table 1).

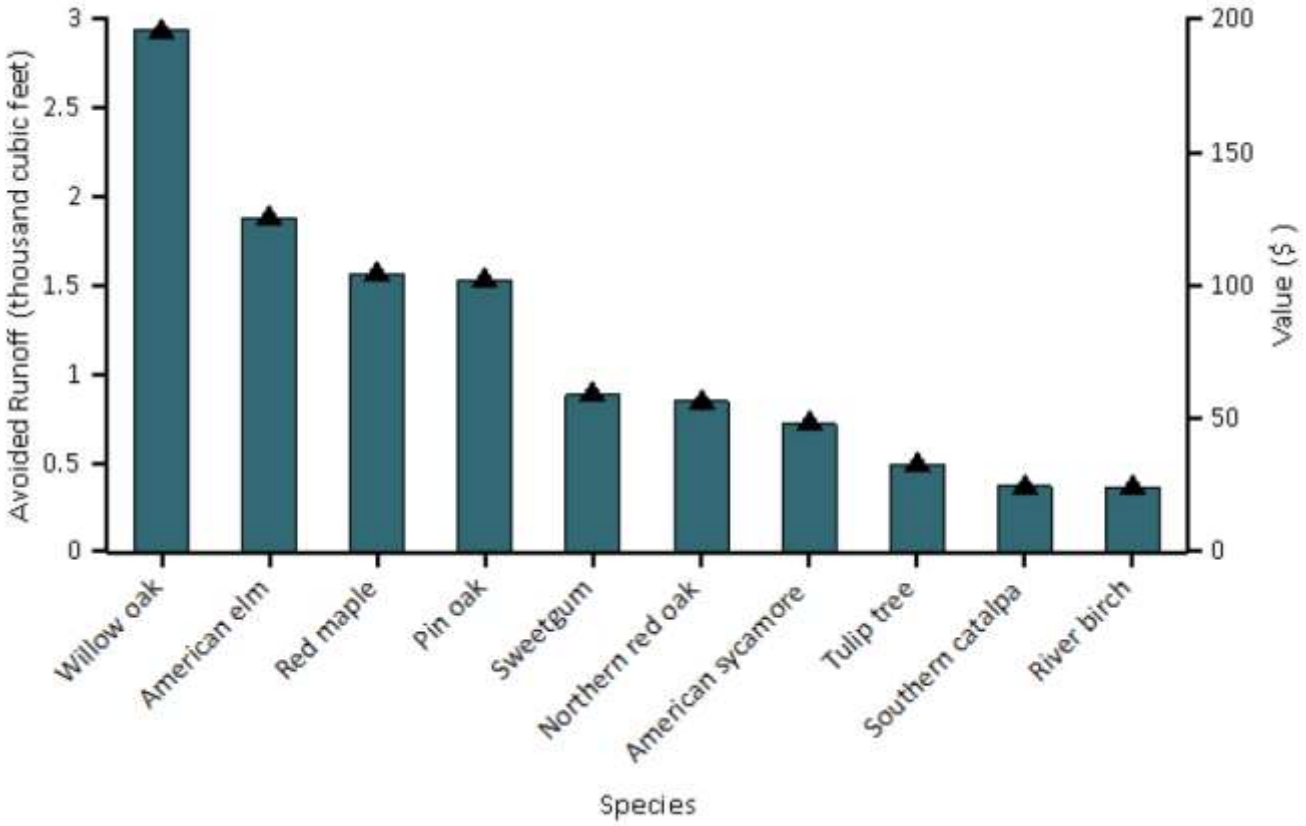

Figure 2. Avoided runoff for species with the greatest impact on runoff.

Southern catalpa provides greater benefits than would be expected, solely based on its importance value and Eastern redbud provides relatively fewer benefits, given its reported importance value. Willow oaks are providing the greatest benefits, in terms of avoided runoff, while only making up 3.6 % of the population of trees included in this analysis (Table 1, Figure 2).

Recommended tree species for maximizing stormwater runoff avoidance

iTree Species calculated a total of 90 tree species that could maximize reduction of stormwater runoff. However, this list presents some tree species that are ill-suited due to their hardiness zones, which would match currently, but not in the future when the District's hardiness zone shifts to 8 or 9[i]. When this list is filtered to exclude trees that are hardy only up to zone 7 or 8, the list is reduced to 68 or 40 tree species, respectively. In addition, some species may not be appropriate as they are not native to the Mid-Atlantic, or are considered nuisance species, such as the Norway maple. The following trees species are recommended by the iTree Species analysis to maximize avoided runoff and also have good suitability for future climates: American elm, Northern hackberry, bald cypress, American basswood, tulip tree, American sycamore, pond cypress, hop hornbeam, sweetgum, swamp tupelo, southern magnolia, southern red oak, cucumber magnolia, ginkgo, and Japanese zelkova (Appendix C: iTree Species). Additional trees were identified, such as *Acer* spp, but excluded given their already high proportion among the street tree population and vulnerability to pests such as the Asian longhorned beetle.

Limitations

There were clear limitations to this analysis as the estimated tree cover was 7.3% and the average tree cover of the area around Watts Branch is 32-33%[iv]. This inconsistency may be due to the data collection methods. Only street, park, and school trees overlapping with the Watts Branch floodplain were considered. This is

problematic for two reasons. First, Marvin Gaye Park trees are not fully inventoried, particularly those trees directly adjacent to the creek. Second, this does not include private trees and trees on federal land, some of which lies adjacent to Marvin Gaye Park (Ft. Circle Hiker Biker Trail, https://www.nps.gov/cwdw/index.htm). In addition, the floodplain polygon excludes some areas directly adjacent to Watts Branch, therefore excluding some potential trees.

Future work

Future analyses of stormwater benefits provided by trees along Watts Branch should include a complete inventory of park trees along Watts Branch. In addition, iTree parameters should be reconsidered and verified to ensure tree inventory data are interpreted as intended. More comprehensive analyses could be considered using iTree Hydro.

To summarize, tree species in the Watts Branch floodplain (along Marvin Gaye Park) vary in their capabilities to reduce stormwater runoff, due their size and individual differences in relative leaf area. Willow oaks were the top performing tree, though they only accounted for 3.6% of the tree population. iTree Species analysis recommends 90 different tree species, though that count is reduced to 40 or 68 trees, when considering some tree species may not fare well in projected climates and hardiness zones.

[i] Climate Ready DC, 2016, https://doee.dc.gov/sites/default/files/dc/sites/ddoe/service_content/attachments/CRDC-Report-FINAL-Web.pdf

[ii] Vulnerability & Risk Assessment: Climate adaptation plan for the District of Columbia, 2016, https://doee.dc.gov/sites/default/files/dc/sites/ddoe/publication/attachments/AREA_Vulnerability_Assessment_DRAFT_2016-06-21lowres_.pdf

[iii] This was estimated using the population (80,669) and area (8.81 sq miles) of Ward 7, https://opendata.dc.gov/ and https://www.dchealthmatters.org/demographicdata

[iv] Treeplotter Canopy, Planit Geo, https://pg-cloud.com/DDOTUFA/