SEAL OF TUKWILA WASHINGTON
1908

GREEN INFRASTRUCTURE ASSESSMENT

MARCH 2026

ACKNOWLEDGEMENTS

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EXECUTIVE SUMMARY

VALUING TUKWILA'S GREEN INFRASTUCTURE

CITY OF TUKWILA GREEN INFRASTRUCTURE ASSESSMENT

The City of Tukwila Green Infrastructure Assessment (Assessment) provides a comprehensive ecosystem service valuation of citywide (both public & private) green infrastructure (including the urban forest, parks and open space). In this assessment, the value of the ecosystem services highlights the benefits of city program investments in green infrastructure preservation and restoration that ultimately enhance the quality of life for all Tukwila residents. At the conclusion of the Assessment, city leadership is provided with an analysis of opportunities for investing in and sustaining the valued green infrastructure of the city – aligning with leadership's vision for Tukwila: The City of Opportunity, The Community of Choice.

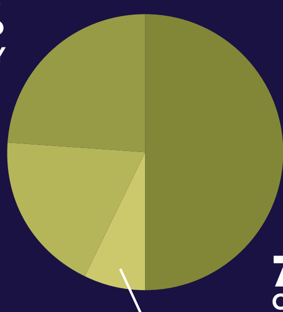
GREEN INFRASTRUCTURE & LAND COVER CONTEXT

Green Infrastructure consists of ecosystems (vegetation, water, and biological systems) that provide essential goods and services, including:

- **Stormwater Retention**
- **Flood Reduction**
- **Water Infiltration**

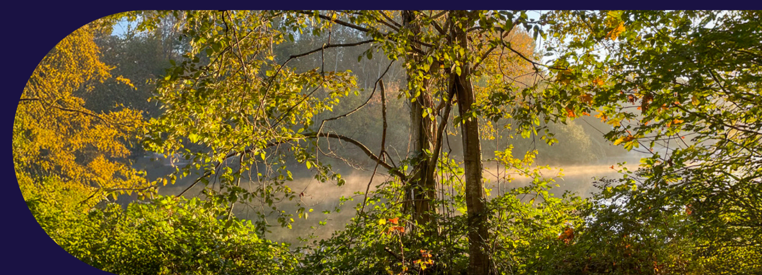
Tukwila Land Cover provides a baseline understanding of current assets and opportunity for tree planting to enhance ecosystem service value citywide.

TUKWILA LAND COVER



TUKWILA CANOPY COVERAGE GOAL

24% CURRENT COVERAGE → **29%** COVERAGE IN 2034



ANNUAL ECOSYSTEM SERVICE VALUE

The Assessment quantifies six primary ecosystem services provided by Tukwila's forests and tree canopy. Estimated annual values are shown below: On average, Tukwila's forests generate approximately **$34 million** in ecosystem services each year, representing a recurring natural asset comparable in scale to major capital investments.

ECOSYSTEM SERVICE	AVERAGE VALUE
STORMWATER	$8,479,821
WATER QUALITY	$8,210,080
AIR QUALITY	$452,411
COOL AIR (HEAT MITIGATION)	$869,360
GROUND STABILITY	$5,583,513
ACCESS TO NATURE	$10,502,142

"Green infrastructure" means a wide array of natural assets and built structures within an urban growth area boundary, including parks and other areas with protected tree canopy, and management practices at multiple scales that manage wet weather and that maintain and restore natural hydrology by storing, infiltrating, evapotranspiring, and harvesting and using stormwater.

GREEN INFRASTRUCTURE AS A CAPITAL ASSET

Unlike built infrastructure, trees do not depreciate when maintained; they appreciate as biomass and ecological function increase. When annual ecosystem service flows are treated as capital assets and discounted at **2.75%** (the discount represents the present value of future benefits, consistent with federal water infrastructure analysis), this green asset is valued at $659M to $1.03B over 50 years.

CITY OF TUKWILA
ECOSYSTEM SERVICES VALUE

CURRENT VALUE
$26.5 M - $41.7 M

50-YEAR VALUE
$659 M - $1.03 B

GREEN INFRASTRUCTURE IN ECONOMIC CONTEXT

Tukwila's tree canopy generates ecosystem service value annually comparable to large-scale municipal capital projects and represents a **billion-dollar long-term natural asset** if preserved and managed sustainably.

EXECUTIVE CONCLUSION

The City of Tukwila's Green Infrastructure Assessment shows that the urban tree canopy functions as essential infrastructure, delivering millions of dollars in annual benefits—from stormwater and water quality improvements to public health, cooling, slope stability, and community well-being. **By converting these benefits into economic terms aligned with policy frameworks, the Assessment provides a clear foundation for protecting existing canopy, guiding strategic expansion, and integrating green infrastructure into capital planning and long-term budgeting.**

- Adopt a Citywide Urban Forest Management Plan that updates tree regulations, aligns buffers and LID practices with best available science, coordinates across departments, and phases funding toward canopy and equity goals.
- Modernize regulations to strengthen large-tree protections, apply science-based buffer standards, and integrate tree-retention and canopy credits into development review.
- Secure stable funding through stormwater-linked canopy investments, expanded capital improvements or staffing, targeted grants, and evaluation of long-term revenue tools.
- Formalize governance and data systems via an interdepartmental team, a unified canopy dataset, and standardized review processes.
- Use ecosystem valuation data to target high-need areas, strengthen benefit-cost analysis for policy and grant decisions, and track progress through clear canopy, equity, and stormwater metrics.

This Exec Summary accompanies the full City of Tukwila Green Infrastructure Technical Report, accessible at this link:

Tukwila Green Infrastructure Assessment

Table of Contents

City of Tukwila Green Infrastructure Assessment

The City of Tukwila Green Infrastructure Assessment (Assessment) provides a comprehensive tree canopy ecosystem service valuation within the city's boundary.

The collaborative approach of the Project Team, in partnership with King Conservation District (KCD) and the City of Tukwila, ensures the use of proven scientific ecosystem service valuation methods to develop this assessment, tools, and recommendations that will benefit the city's programs and green infrastructure for years to come.

The Assessment draws on priorities identified in city policy and planning documents including Tukwila's urban forestry efforts, Tree Regulations (TMC 18.54), Shoreline Overlay (TMC 18.44), and Environmentally Critical Areas Code (TMC 18.45), as well as the city's stormwater and Low Impact Development (LID) standards. Together, these frameworks outline Tukwila's commitment to maintaining and expanding its green infrastructure through investments in urban tree canopy (UTC) preservation and growth, protecting riparian and shoreline vegetation, and managing stormwater through nature-based solutions.

The Assessment provides an in-depth analysis of a targeted set of tree canopy ecosystem services that are most relevant to Tukwila's policy objectives, regulatory framework, and investment decisions, leveraging local data and practitioner expertise to maximize the value of the analysis. The results are designed to directly support adopted City goals, advance Comprehensive Plan implementation strategies, and inform updates to related programs such as urban forestry, stormwater management, and natural-area stewardship. By translating ecosystem service performance into decision-relevant metrics, the Assessment helps the City prioritize actions, justify funding mechanisms, and align capital, regulatory, and partnership efforts to reduce long-term infrastructure costs while sustaining Tukwila's tree canopy and quality of life.

What is Green Infrastructure?

Green infrastructure [1] consists of minerals, energy, plants, animals, and ecosystems that provide a flow of natural goods and services. Green infrastructure performs essential functions such as intercepting rainfall and preventing soil erosion, while also supplying

[1] According to Washington State RCW 36.70A.035, the definition of green infrastructure: "…wide array of natural assets and built structures within an urban growth area boundary, including parks and other areas with protected tree canopy, and management practices at multiple scales that manage wet weather and that maintain and restore natural hydrology by storing, infiltrating, evapotranspiring, and harvesting and using stormwater."

critical benefits like clean water and reduced flooding. These benefits, often taken for granted, are known as ecosystem goods and services.

For Tukwila, green infrastructure is initially defined by land cover—the vegetation, built environment (roads, buildings, sidewalks), rock, or water present in an area. Land cover for this project was mapped using Geographic Information Systems (GIS) data provided by city staff. Tukwila's land cover types are summarized by acreage in Table 1. Impervious surface makes up the greatest percentage (50%) of land cover within the city, approximately 3,077 acres. The rest is made up of various vegetation, open water, and canopy over impervious surfaces. Tree canopy is the most abundant type at 24%, encompassing 1,491 acres. About 19% of the city's land, or 1,146 acres, is plantable space [2] for potential tree canopy expansion. [1] In later sections of this report, prioritized tree canopy needs are identified using this information.

Table 1. Land Cover Acreage.

Land Cover	Acres	Percentage
Impervious	3077.55	50%
Non-Canopy Vegetation	1187.66	19%
Shrub	102.97	2%
Soil and Dry Vegetation	66.50	1%
Tree Canopy	1355.65	22%
Tree Canopy over Impervious	135.30	2%
Water	229.98	4%
Grand Total	**6155.61**	**100%**

[2] Plantable space is land where tree planting is biophysically feasible—pervious areas not already covered by tree canopy, water, impervious surfaces, or other non-plantable pervious uses.

Ecosystem Service Valuation Framework

Clean air, clean water, shading hot surfaces, flood risk reduction, waste treatment, and reduced stormwater are examples of ecosystem services. Without green infrastructure, these benefits would not exist—they are the foundation of livability and economic activity, supported by nature.

The health of Tukwila's urban canopy influences riverbank stability, slope integrity, and water quality and provide a broad range of ecosystem services. Both individual trees and tree canopy act as critical infrastructure city wide, whether downtown or along the outskirts. While this assessment emphasizes tree canopy benefits, other land covers—such as grasslands, shrubs, and soils—also sequester carbon, retain stormwater, and filter pollutants.

Tree canopy ecosystem services generate direct economic value for the city by reducing stormwater collection, conveyance and treatment costs, lowering flood damage risks, and supporting recreation and tourism. Recognizing these savings highlights the importance of preserving and enhancing the tree canopy. The framework for ecosystem services used in this assessment was adapted from the United Nations' System of Environmental-Economic Accounting Framework (SEEA Framework).[2] Appendix A provides detail on this framework and the list of ecosystem services outlined within.

Ecosystem Service Valuation (ESV) assigns dollar values to goods and services provided by ecosystems. Like a real estate or business appraisal, ESV aggregates comparable values from existing studies to estimate the worth of ecological functions in a specific location. While all valuations carry uncertainty, ESV is widely applied and accepted by academics, industry, and all levels of government. The US Federal Emergency Management Agency (FEMA), for example, formally incorporated ESV methods into disaster mitigation policy in 2013, influencing millions of dollars of disaster mitigation funding since.[3] The City of Snoqualmie used ESV estimates to help pass a 2020 council approved ordinance that funded local tree canopy maintenance permanently.[4] King County demonstrated the value of biosolids and compost applications by showing the ESV benefits of biosolid and compost application on their property.[5]

Ecosystem Service Modules

This assessment of the City of Tukwila's green infrastructure estimates ESV benefits in six select modules, chosen by the Project Team as those most relevant to the City of Tukwila. Each module corresponds to a single ecosystem service taken from the SEEA Framework, and has a unique methodology embedded using local economic, scientific, and spatial datasets to estimate green infrastructure benefits. While each module is summarized below, Appendix B of this assessment provides details on all calculations and sources. The six selected modules are:

Stormwater	Water Quality	Air Quality
Cool Air	Ground Stability	Access to Nature

Stormwater Module

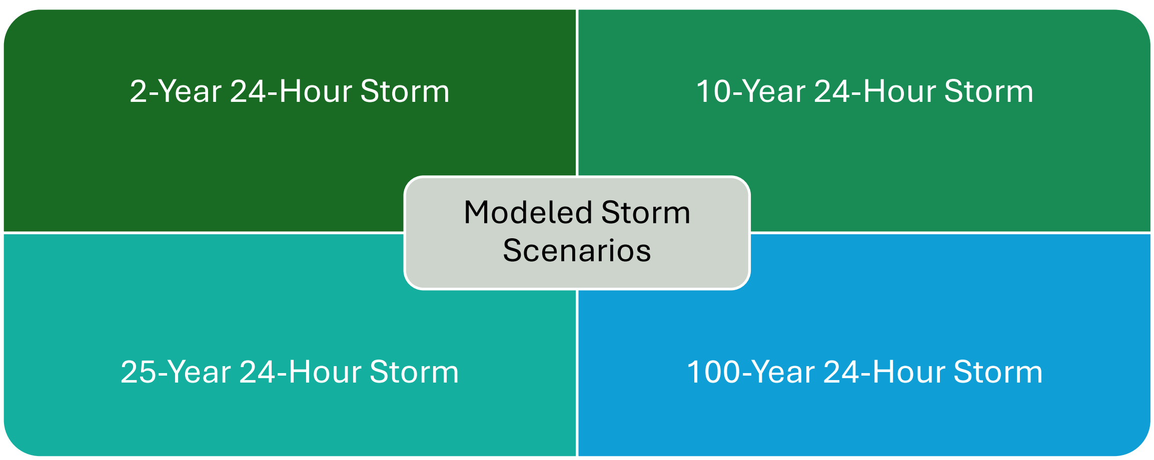
The Green-Duwamish River forms the backbone of Tukwila's surface water system, influencing both stormwater management and flood risk across the city while simultaneously providing critical habitat, including to ESA-listed threatened species such as Chinook Salmon and steelhead which in turn feed endangered orca whales. Past flood events, particularly in low-lying industrial and residential areas, have underscored the need for resilient and adaptive infrastructure. New state requirements for the National Pollution Discharge Elimination System (NPDES) permits outlines the importance of urban canopy for managing stormwater, with requirements to identify and map tree canopy for stormwater management purposes. [3] Tukwila's municipal stormwater system includes a network of pipes, pumps, vaults, detention facilities, and green infrastructure designed to reduce peak flows and improve water quality. Recent City investments have focused on upgrading conveyance capacity (such as the installation of the Strander Street Pump Station) and integrating green infrastructure to manage runoff (such as the E. Marginal Way Stormwater Outfalls Project) to more effectively handle stormwater and flood events and reduce long-term maintenance and capital costs. This module estimates the amount of stormwater captured by each acre of tree canopy and calculates the monetary benefits

[3] 2025 Stormwater Management Program Plan, Appendix A, 2024-29 NPDES New Permit Requirement Summary, MS4 Mapping and Documentation, S5.C.4.b.i

provided by way of capturing, storing, and slowing the release of stormwater. In the absence of tree cover in urban areas, precipitation otherwise hits "developed surfaces", which are typically impervious, and rather than be intercepted or infiltrate, becomes surface runoff that requires built infrastructure to capture, store, convey, treat and release.

This module is designed to value the stormwater capture ecosystem services provided by trees by modelling a range of storm events. Figure 1 shows the storm events included in the analysis. Storm events are defined by the probability of any rainfall event occurring in a given year. A 2-year storm is a rainfall event with the probability of occurring every two years, which implies there is a 50% chance of a 2-year storm event occurring in a single year. Whereas a 100-year storm is a rainfall event with the probability of occurring once every 100 years, which has a 1% chance of occurring in any single year. To arrive at an annual dollar value per acre stormwater capture, the volume of stormwater retained by tree canopy in each storm scenario was combined with a marginal cost of stormwater infrastructure. For more information on the detailed economic approach, see Appendix B.

Figure 1. Overview Storm Scenario



Using rainfall estimates, storm occurrence rates, and infrastructure data outlined in Appendix B, the ecosystem service value of stormwater capture was calculated. The total value of stormwater capture provided by Tukwila tree canopy is approximately $5.6M to $11.2M annually across all four storm scenarios (all values in this report converted to 2026 USD).

Value of Stormwater Capture

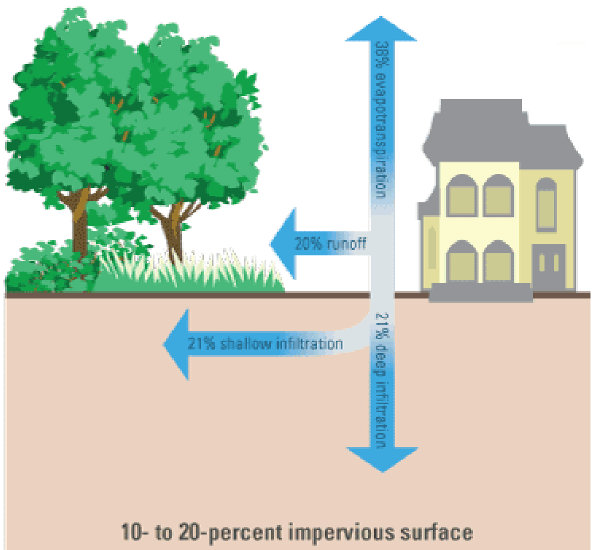
- $5.6 million to $11.2 million per year

Call Out

Around 20% of Tukwila's existing tree canopy overhangs impervious surfaces like streets and parking lots, where it provides high functional value by cooling heat-absorbing pavements, intercepting stormwater, and reducing heat buildup.[6]

In contrast, canopy over pervious surfaces such as lawns and natural vegetation supports infiltration, evapotranspiration, and soil health.

The analysis for the stormwater module accounts for the difference in stormwater capture provided by both tree canopy types. Appendix B provides these details.



Water Quality Module

The Green-Duwamish River serves as a critical receiving water for Tukwila's stormwater system, yet historical water quality issues have been driven by decades of industrial activity and urban runoff. The Duwamish River and the Green River both have Category 5 pollutants, which characterize the waters as being "impaired" for their designated use and requiring planned reduction in those pollutants, per Section 303(d) of the Clean Water Act[4]. Pollution generating surfaces, such as roadways, driveways, parking areas, and some roof systems accumulate pollutants such as heavy metals, hydrocarbons, and excess nutrients. Rainfall causes these pollutants to enter waterways, underscoring the need for effective stormwater treatment. The city continues to implement best management practices to reduce contaminant loads and meet regulatory standards. Expanding tree canopy and vegetated infrastructure, including riparian buffers, supports these goals by filtering pollutants, improving infiltration, and enhancing overall water quality in the Green-Duwamish watershed.

The water quality module estimates the amount of stormwater captured by each acre of combined tree canopy and calculates the monetary benefits of filtering stormwater. In the absence of tree cover, stormwater becomes surface runoff and requires built infrastructure to treat. Like the stormwater module, the water quality module is designed to value stormwater treatment following a range of large storm events, as summarized in Figure 1 above. To arrive at an annual dollar value per acre of water quality, the volume of stormwater filtered by trees in each storm scenario was combined with a marginal cost of water treatment infrastructure. For more information on the detailed economic approach, see Appendix B.

Using rainfall estimates, storm occurrence rates, and infrastructure data, the ESV of water quality was calculated. The total value of water filtration provided by Tukwila tree canopy is approximately $5.96M to $10.46M across all four storm scenarios.

Value of Water Filtration
• $5.96 to $10.46 million per year

[4] Assessment & 303d List - Washington State Department of Ecology

Call out

6PPD-Quinone is a chemical compound formed when 6PPD, a preservative used in vehicle tires, reacts with ozone in the air. As tires wear down, small particles containing this compound are washed from roads into storm drains and eventually reach local waterways. Even at very low concentrations, 6PPD-Quinone is highly toxic to salmon and other aquatic species, posing a significant regional water quality concern. One study shows that riparian vegetation filters 95% of the 6PPD-Quinone compounds from roadside water runoff.[7] Increasing tree canopy and vegetated buffers along roads and streams may provide crucial filtration of these pollutants before they enter the stormwater system, reducing their movement into the Green-Duwamish River.

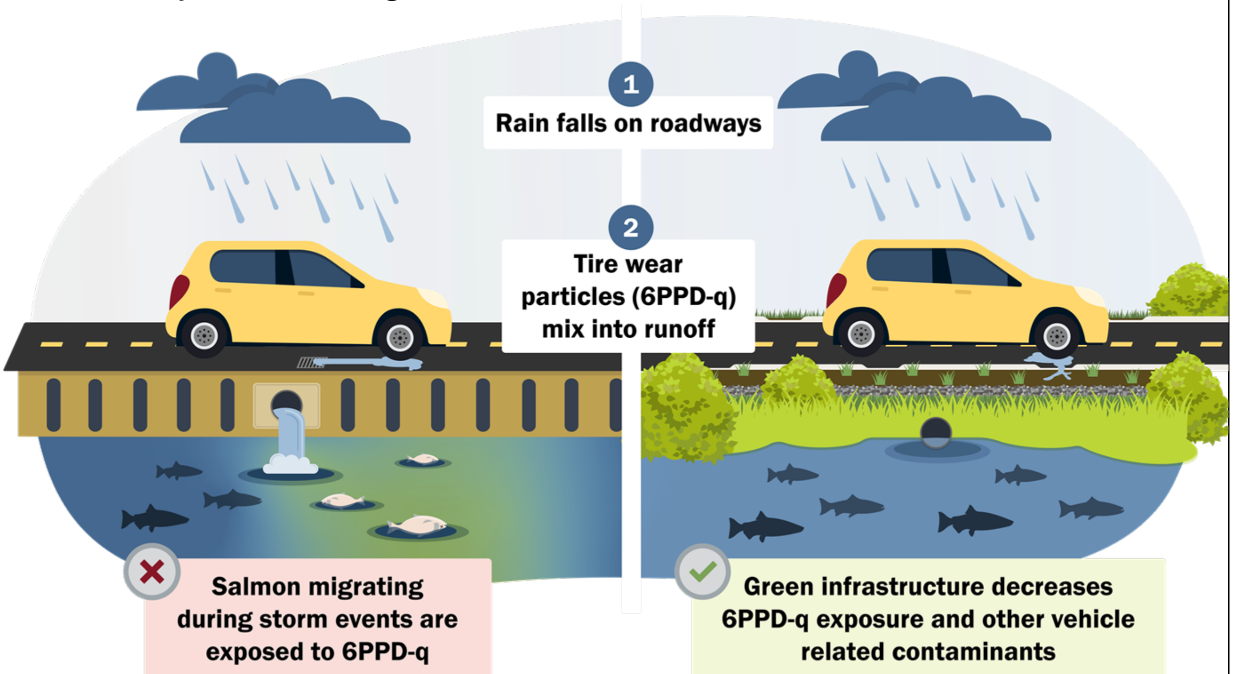


Figure 2. Impact of 6PPD-Q Runoff[8]

Air Quality Module

Air quality in Tukwila is influenced by its proximity to major transportation corridors, industrial operations, and regional freight activity along the Green-Duwamish River valley. Vehicle emissions, diesel exhaust, and particulate matter from nearby industrial areas and highways contribute to elevated pollutant levels in certain areas. These pollutants disproportionately impact on residents living near industrial zones and high-traffic corridors, where many lower-income and historically underrepresented communities are located. The city's ongoing efforts to expand tree canopy and green buffers aim to reduce particulate concentrations, improve local air quality, and support healthier conditions for residents most affected by pollution exposure.

The air quality module estimates the quantity of pollutants, including particulate matter and carbon dioxide, intercepted and absorbed by each acre of tree canopy and calculates the monetary benefits of air filtration. In the absence of tree cover, pollution exposes the community to higher levels. Unlike the two previous modules, the air quality module is designed to value air filtration using estimated health costs to people over time. To arrive at an annual dollar value per acre of air quality benefits provided by trees, pollution absorption rates from trees were combined with the marginal health cost of respiratory and other diseases related to long-term pollution exposure. For more information on the detailed economic approach, see Appendix B.

Using tree canopy, population density, and other supporting datasets, ecosystem service values for air quality were estimated by running multiple i-Tree scenarios. These scenarios isolate changes in pollutant removal and associated benefits under different canopy conditions, allowing air-quality outcomes to be compared across alternative land-use and management assumptions. The total annual value of air filtration provided by Tukwila tree canopy is approximately $450,000 across the city. Given the economic values were derived from implementation of the iTree software,[9] a single value was provided rather than a range of values. These details are provided in Appendix B.

Value of Air Purification
• $452,411 per year • $303 per acre per year

Call Out

Living near airports exposes residents to higher levels of air pollutants such as nitrogen oxides, carbon monoxide, and fine particulate matter generated by vehicle exhaust, aircraft operations, and related traffic. These pollutants contribute to respiratory and cardiovascular health risks. Included in the Air Quality Module was the estimated impact to residents exposed to jet fuel exhaust, which was estimated to be between $34,332 and $264,431 in health costs per year. Health costs include impacts of premature mortality and morbidity due to PM2.5 exposure. Refer to Appendix B to learn more as to why the gap between the low and high value is approximately $230,000. Expanding tree canopy along roadways and safe proximity to flight paths helps capture airborne particles, buffer noise, and improve overall air quality for communities most affected by transportation emissions.

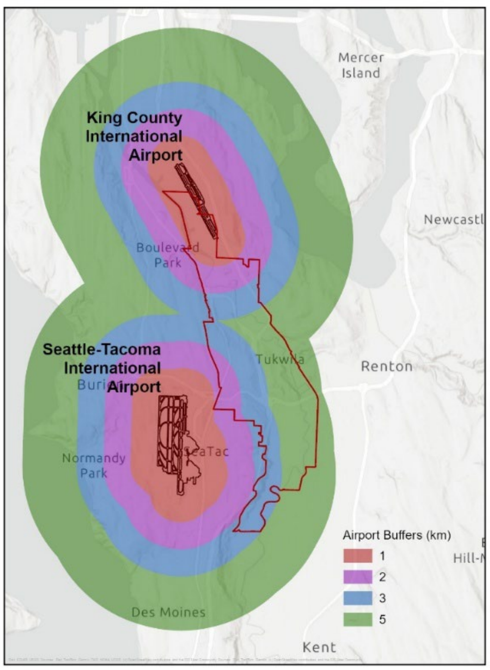


Figure 3. Distance Buffer Around SeaTac and King County International Airports. Source: Direct calculation of straight-line buffers from runway center points.

Cool Air Module

Tukwila has experienced a growing number of extremely hot days (90F+) in recent years, reflecting broader regional warming trends. The 2021 heat dome highlighted the city's vulnerability, with record-breaking temperatures intensifying heat exposure in urbanized and paved areas. Industrial zones, large parking areas, and limited vegetation contribute to higher local temperatures, a pattern known as the urban heat island effect. These conditions pose greater health risks for residents without adequate cooling or shade. Expanding tree canopy across streets, neighborhoods, and public spaces helps lower surface and air temperatures, providing critical relief and resilience during extreme heat events.

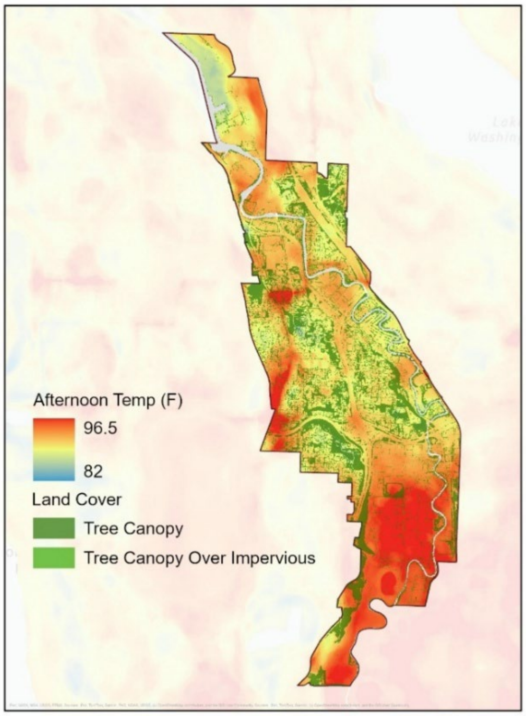
The cool air module estimates the impact tree canopy has on blocking, reflecting, and absorbing solar radiation and calculates the monetary benefits of the cooling effect. In the absence of tree cover, communities are exposed to more direct sunlight and higher temperatures. The cool air module uses multiple approaches to value the cooling effect of tree canopy, first using estimated health costs of heat exposure to people over time, and second using utility cost savings of avoided air conditioning in peak temperature conditions. To arrive at an annual dollar value per acre of cool air benefits provided by tree canopy, data from the temperature reduction under multiple tree canopy scenarios is combined with 1) the marginal health cost of heat related illnesses, and 2) reduced number of days requiring air conditioning. For more information on the detailed economic approach, see Appendix B.

Using tree canopy, temperature sampling, healthcare costs and utility savings data, the ESV of cool air was calculated. Summing together the energy savings and health cost savings, the total annual value of cool air provided by Tukwila tree canopy is approximately $840,199 to $898,521 across the city.

Value of Energy Savings	Health Cost Savings
• $818,523 to $874,019 per year	• $21,675 to $24,502 per year

Call out

King County's Heat & Health Data Explorer Tool quantifies spatial heat exposure and vulnerability by mapping heat islands, tree canopy, social vulnerability, and health indicators at the census-block level across the region. The tool is a valuable resource for planners and decision-makers to visualize and prioritize heat mitigation strategies. In Tukwila, the tool highlights neighborhoods with low canopy cover and elevated heat risk, reinforcing the need for targeted tree planting to cool hot spots and improve resilience.



Ground Stability Module

The soils in Tukwila's upland and sloping areas are mostly shallow glacial deposits and loose hillside material that can become unstable when soaked by heavy rain. During intense storms, saturation creates instable soils, raising the likelihood of small landslides—especially on steep or previously disturbed slopes. A notable slide in 1996 along the Duwamish River's valley slopes showed how development and saturated soils can combine to cause slope failure. Tree roots help hold the soil together, reduce excess moisture, strengthen hillsides whereby tree canopy creates valuable rainwater interception that meaningfully reduces soil saturation severity by slowing and reducing water penetration of slopes. Healthy, sustainable tree canopy offers natural stability that lowers landslide risk across the city.

The ground stability module estimates the reduced risk of shallow[5] landslides due to forest cover on sloped surfaces and monetizes the reduction in risk cost in their presence. In the absence of tree cover, steeper slopes are at risk of failure during heavy rain events, risking damage to downslope infrastructure. To arrive at an annual dollar value per acre of forested slopes, the module compares forested vs non-forested slopes in soils found common west of the Cascade Mountains in the Pacific Northwest. For more information on the detailed risk model and economic approach, see Appendix B.

Using tree cover, storm occurrence rates, landslide risk modeling and parcel data, the ESV of ground stability was calculated. The total annual value of ground stability provided by Tukwila tree canopy is approximately $3.6M to $7.6M across the city.

Value of Land Stability
• $3.6M to $7.6M each year • $6,861 to $14,408 per acre per year

[5] Risk associated with deep seated landslide hazards were not considered in this analysis. Calculations were made in alignment with the SHALSTAB model and related publications. See Appendix B for more details.

Call out

One known area with steep slopes is the northeast section of the McMicken neighborhood and the above Southcenter Parkway, where hillsides exceeding 15% grade rise above homes and local streets. These slopes border residential areas, roads, and essential infrastructure, including stormwater lines and utilities. The combination of steep terrain and developed land increases the risk of slope instability, potentially affecting nearby housing and public infrastructure if erosion or landslide activity occurs. Both FEMA and local surveys have identified the highest slopes of this region as hazard or at higher risk of landslide under heavy rain events.

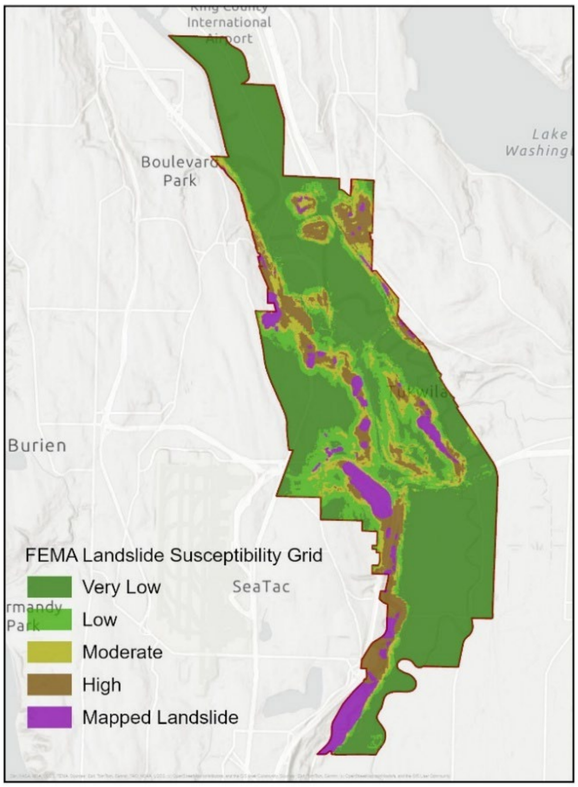


Figure 4. FEMA Landslide Inventory Unstable Areas[10] with Forest Cover

Access to Nature Module

The benefits of accessing nature are well-supported by studies demonstrating positive impacts on mental and physical health, from reducing stress and improving mood to supporting cognitive function and social connection. Proximity to trees, parks, and forested areas encourages outdoor activity and strengthens community ties, offering restorative experiences that built environments often lack. In Tukwila, maintaining and expanding access to nearby green spaces helps residents of all ages and backgrounds experience these benefits first-hand. Ensuring equitable access to nature is essential to promoting overall health, well-being, and quality of life across the city.

This module estimates, in multiple ways, the value of people living near and experiencing nature. The following estimates values of avoided health costs from exercise in parks, avoided mental health costs of experiencing nature, and the "village effect," or the contribution tree cover makes creating robust urban centers. The following also explores several other benefits known to benefit people and their communities.

- *Exercise in Nature:* Regular physical activity in parks and natural areas provides measurable economic benefits through avoided health care costs. Residents who live near accessible green spaces are more likely to walk, jog, or engage in outdoor recreation, which reduces the incidence of chronic health conditions such as heart disease, diabetes, and obesity.[11] These health improvements translate into lower medical expenses and increase productivity at the community level. In Tukwila, expanding access to parks and trails can therefore be viewed not only as an investment in livability but also as a means of reducing long-term public health costs.

  Using medical costs data and other information detailed in Appendix B, the estimated reduced health costs of exercise in nature were $1.96M to $2.89M each year across the city.

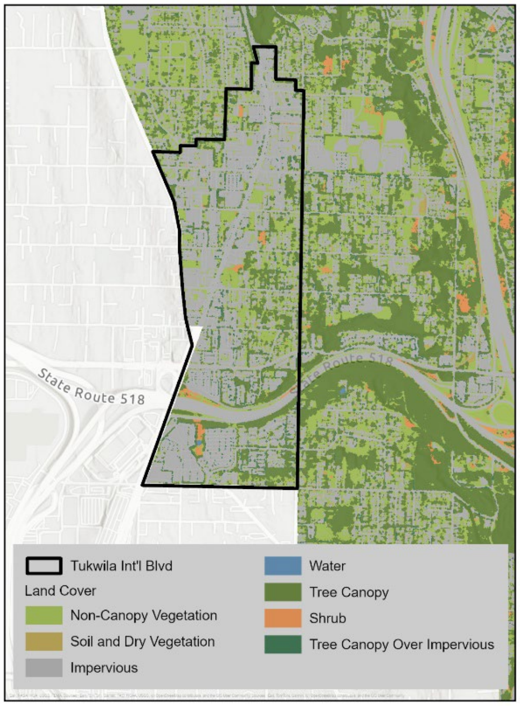
Value of Exercise in Nature
• $1.96M to $2.89M per year

- *Avoided Mental Health Costs:* Access to nature also generates substantial economic value by reducing mental health–related costs. Time spent in parks, under canopy, and other green spaces has been shown to lower rates of depression, anxiety, and stress while improving overall well-being.[12; 13] Residents with *access to nature nearby* experience fewer symptoms and require less clinical intervention, resulting in measurable savings in health care spending and lost productivity. In Tukwila, investments that enhance daily contact with green space can therefore yield long-term benefits by supporting mental health and reducing associated treatment costs.

  Using medical costs data and other information detailed in Appendix B, the estimated reduced mental health costs of experiencing nature was $7.54M to $10.84M each year across Tukwila.

Mental Health Benefits
• $7.54M to $10.84M per year

- *Value of Canopy in Commercial Districts:* Tree canopy supports what was coined by sociologist Ray Oldenburg called "third places" or areas away from home (first place) and work (second place) where social connections and community resilience is strengthened in urban environments. Shaded, walkable streets and green gathering spaces encourage residents to spend more time outdoors, interact in public spaces, and participate in civic life. These social bonds are linked to lower crime rates, improved mental health, and stronger local economies. In turn, this effect enriches urban centers where evidence shows property values increase due to robust and maintained tree canopy.



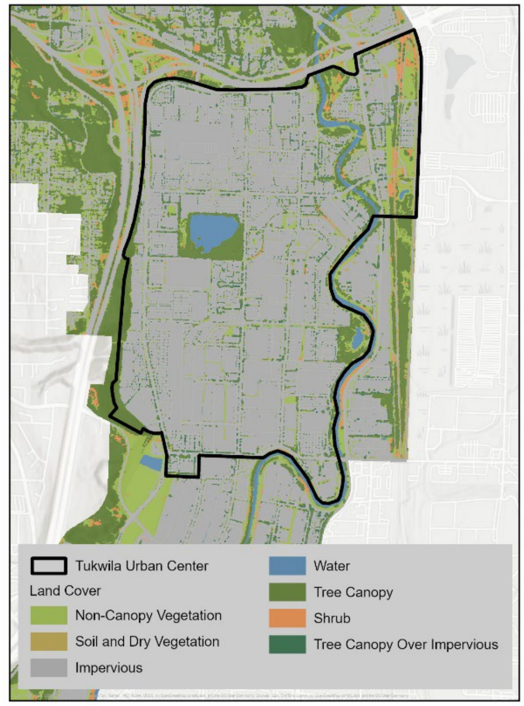


Figure 5. International Boulevard (Left) and Tukwila Urban Center (right)

The City of Tukwila is unique in that it doesn't have a traditional downtown sector. Rather, Tukwila's urban centers are known as the Tukwila International Boulevard (TIB) District, located along the former SR 99 corridor just north of SeaTac International airport, and the Tukwila Urban Center, also commonly known as 'Southcenter' an area that is anchored by the regional Southcenter Mall and comprising much of the city's shopping and commercial areas. This area is transforming into a livable urban center with the new transit-oriented development, more residential buildings and walkable streets.

Using peer-reviewed academic studies and GIS data detailed in Appendix B, the estimated value attributed to existing canopy was $452,293 to $627,557 each year for both urban centers.

Tukwila International Boulevard Canopy Value	Tukwila Urban Center Canopy Value
• $105,748 to $140,477 per year	• $346,545 to $487,080 per year

The total ecosystem service value of access to nature was calculated and summarized in Table 2 below. This shows the total value of access to nature provided by Tukwila forested parks and green spaces is approximately $9.95M to $11.06M, annually.

Call out

- *Child Development:* Exposure to nature plays a vital role in children's cognitive, emotional, and physical development. For example, a longitudinal study found that children whose homes became greener showed greater improvements in attention capacity several months later.[14] Another review isolated 42 studies showing consistent links between increased green space and reduced stress, fewer ADHD symptoms, and improved self-regulation in youth.[15] Access to parks and tree-filled environments encourages active outdoor play, reduces screen time, enhances social skills, and builds a lasting connection to nature. These benefits not only support healthier childhoods but also strengthen community well-being by laying a foundation for lifelong resilience and engagement.

- *Creation of "Third Places":* Parks and green spaces play a foundational role in building social cohesion by offering neutral, inclusive venues where neighbors meet, interact, and organize for collective purposes. Research shows that residents of cities with higher-quality park systems have significantly stronger social connections, more volunteering, and greater civic engagement—one study found 26 % more inter-income group connections and 45 % more civic organizations per capita in top-ranked park cities. In diverse, low-income neighborhoods, high-quality parks and walkable environments were associated with higher levels of social capital among parents with young children.[16; 17] By facilitating everything from casual greetings on shaded benches to coordinated tree-planting events and cultural festivals, green spaces become community "living rooms" where trust, belonging, and civic vitality grow together.

- *Hospital Recovery:* Exposure to nature within hospital settings has been shown to support patient recovery in both subtle and meaningful ways. A recent scoping review of inpatient stays found that elements such as windows overlooking greenery, natural light, and even nature soundscapes were associated with reductions in anxiety, depression, and pain for surgical and medical patients.[18; 19] In one landmark study, patients recovering from surgery in rooms with views of trees had shorter hospital stays, took fewer pain medications, and experienced fewer complications compared to those whose windows faced a brick wall.[20] These findings suggest that integrating access to green space—or even nature imagery—into healthcare environments can create measurable benefits for patient well-being and treatment outcomes.

Asset Value

The ESV in this assessment represents a conservative estimate of the full range of benefits provided by Tukwila's tree canopy. Even so, the value of ecosystem services from Tukwila's forested areas amounts to a multimillion-dollar natural asset.

ESV of Tukwila Canopy Over Time

The analysis presented above quantifies six primary ecosystem services in dollar value per acre per year. When multiplied by the total tree canopy acreage within the city, the estimated total annual ecosystem service value reaches between $23.6M to $35.7M. These figures represent real, ongoing economic benefits that Tukwila's residents receive each year—and will continue to receive, indefinitely, if the City's tree canopy remains healthy and its sustainability is well managed.

Table 2. Annual Value of Ecosystem Services by Module

Module	Low	High
Stormwater	$5,678,451	$11,281,190
Water Quality	$5,956,038	$10,464,122
Air Quality	$452,411	$452,411
Cool Air	$840,199	$898,521
Ground Stability	$3,602,266	$7,564,759
Access to Nature	$9,949,034	$11,055,250
Total	**$26,478,399**	**$41,716,254**

Table 3. Comparable economic values in Tukwila

What is the value of......	
Fire engine	$1,200,000 to $1,800,000
Standard neighborhood park redevelopment or acquisition	$4,000,000 to $8,000,000
Total 2025/26 Biennial budget Tukwila Finance Department	$10,100,000
Water reclamation facility (3M gallons per day capacity)	$30,750,000
Tukwila Ecosystem Service Value on average EACH YEAR	***$34,097,327***
City of Tukwila FY Budget 2026	$176,400,000
Average cost hybrid electric Olympic class ferry	$363,333,333

Asset Value of Forest Ecosystem Services Over 50 Years

Green infrastructure like trees differs from built assets in one crucial way—it does not depreciate over time, if maintained and protected. In fact, tree canopy can increase in value as they grow, increase in biomass, and enhance ecosystem function. However, these benefits are only renewable if the resource base remains intact and resilient against degradation, development, or extractive use. As long as Tukwila's tree canopy is preserved, protected from threats, and managed sustainably, they will continue to provide essential ecosystem services and substantial economic value to the city and its residents well into the future.

Like roads, bridges, or utilities, trees generate a continuous flow of value over time and can therefore be treated as capital assets. In asset management terms, by applying a discount rate[6] to estimate the net present value of the future ecosystem service flows, the long-term asset value of Tukwila's tree canopy can be expressed in today's dollars. This analysis uses a discount rate of 2.75%, consistent with the rate applied to federal water infrastructure projects.[21] Using this approach, Tukwila's tree canopy generate an estimated $659.33M to $1.03B in ecosystem service value over 50 years.

Climate change is expected to intensify precipitation extremes across the Puget Sound region, with significant implications for stormwater infrastructure design. Projections indicate that the yearly maximum 24-hour rainfall will increase by 4% to 30% by the 2050s compared to the 1970-1999 baseline, based on analysis of 10 global climate models under two greenhouse gas concentration pathways: RCP 4.5 (a moderate emissions scenario assuming significant climate policy intervention) and RCP 8.5 (a high emissions scenario representing continued fossil fuel dependence).[22] This projected rainfall is incorporated into the Stormwater Module and asset value calculations above, attributing more water capture benefits to natural capital in years ahead. Moreover, data from climate models on the same emissions scenarios above show projected increased in 90+ F degree days in the Puget Sound, which was incorporated into data used in the Cool Air module. See Appendix B for details on these calculations.

[6] A discount rate is a way to account for the fact that benefits received in the future are generally valued less than benefits received today. In this project, it is used to convert ecosystem service benefits expected over the next 50 years into their equivalent value in today's dollars, so long-term benefits can be compared consistently with near-term costs.

Using Spatial Data to Identify Opportunities for Investment

The value of Tukwila's green infrastructure estimated above demonstrates the substantial economic value to residents; however, we know that this value is not distributed equitably throughout the city. Additionally, areas of high natural capital value are at risk of development, structural encroachment, invasive species, and other threats. This section reviews ecosystem services across the landscape within the City of Tukwila and uses spatial data to determine where there are gaps in ecosystem service value and what underserved populations have little or no access to green infrastructure.

Using Equity Data to Prioritize Canopy Need

Demographic data (i.e. age, income, race, etc.) and health data (vulnerable communities, asthma rates, among others), collectively called equity data provides critical context for understanding where tree canopy and other green infrastructure investments can deliver the greatest community benefit. When combined with ecosystem service valuation, these data help identify neighborhoods where environmental burdens and social vulnerability overlap with limited access to canopy. This approach ensures that canopy expansion strategies are not only environmentally effective, but also aligned with equity, public health, and resilience priorities.

The Port of Seattle's Equity Index (Equity Index) is an interactive map that displays a visual representation of social and environmental disparities in King County.[23] To better understand how the benefits of Tukwila's green infrastructure align with community need, this map was used alongside the ecosystem service valuation results. By overlaying areas of low natural capital value with areas of elevated social disparity, the analysis reveals where ecosystem investments can most effectively advance community health, resilience, and equity.

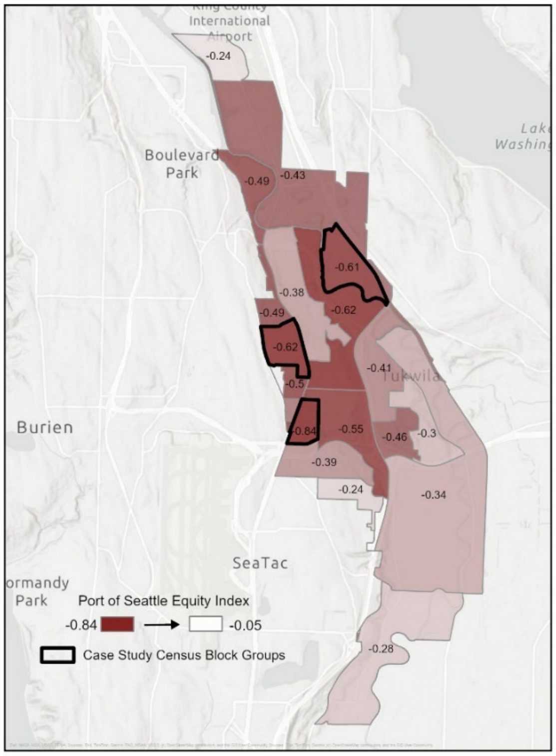


Figure 6. Equity Scores Across Tukwila Highlighting Three Case Studies

Figure 6 shows the equity scores across Tukwila, divided by census block groups, illustrating where residents experience higher cumulative environmental health risks and socioeconomic inequities compared to King County city averages. Overall, the City of Tukwila ranks among the lowest for King County in livability, environmental, and economic categories. Some census block groups in Tukwila rank among the average, relative to other areas in King County.

Using this data, the most at-risk sections of Tukwila are identified and targeted for further analysis, which include the following:

- Cascade View Neighborhood: Cascade View is a compact and highly diverse neighborhood in northwest Tukwila with roughly 1,570 residents. The Equity Index places Cascade View in the very low range overall (–0.6175), highlighting persistent structural disadvantages. The economy index score (–1.2679) signals particularly limited access to economic opportunity, while the livability index (–0.9607) points to challenges such as housing stability and other core quality-of-life conditions.
- Thorndyke Neighborhood: Thorndyke is a small, densely populated neighborhood in central Tukwila with just under 1,300 residents. The Equity Index places Thorndyke firmly in the very low range overall (–0.8404), indicating significant structural disadvantage. The economy index (–1.901) is especially low, reflecting limited employment access, lower household economic stability, or other barriers to

financial mobility. The livability index (–0.9727) also ranks very low, pointing to challenges such as housing pressure and other foundational quality-of-life factors.

- Allentown Neighborhood: Allentown is a residential, riverside neighborhood in the northern part of Tukwila with just over 1,200 residents. The Equity Index places Allentown in the very low range overall (–0.6102), indicating persistent socioeconomic disadvantage. The economy index (–0.701) underscores limited access to stable employment and household economic security, while the livability index (–0.9639) highlights challenges such as housing stability and other quality-of-life pressures.

Integrating Possible Planting Areas to Locate Highest Priority Canopy Value

In collaboration with the City of Tukwila, one research project[24] used spatial data to map "possible planting areas" (PPA). These are areas with non-canopy vegetated surfaces in Tukwila where tree establishment is feasible, excluding locations manually identified as unsuitable due to biophysical (i.e. buildings) or land-use constraints (i.e. baseball fields).

Figure 7 shows PPA across Tukwila along with data overlays from the Port of Seattle Equity Index. This demonstrates the ability to identify within these neighborhoods where canopy creation is feasible. While steps were taken to refine the PPA, areas identified for planting should be verified through at-site inspection to ensure plantings are feasible. For example, the Cascade View Neighborhood (Figure 7) identifies PPA within a cemetery, which may have limitations on planting opportunities. PPA could overestimate or show areas that, while possible, are necessarily infeasible planting areas. Utility location can also affect PPA and should be verified before implementing planting projects.

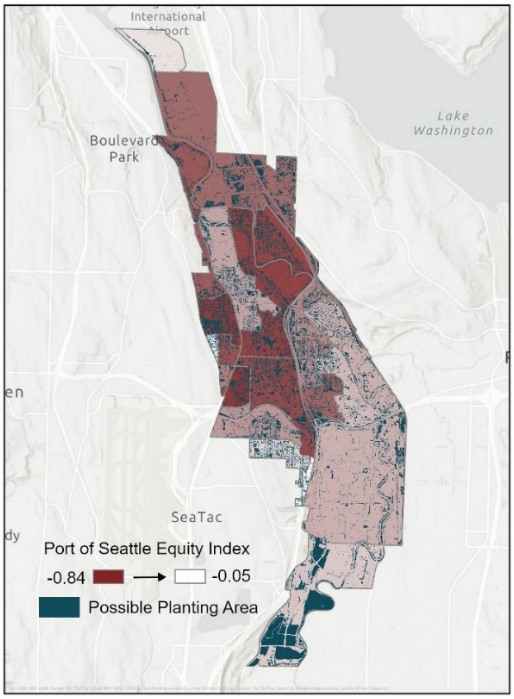


Figure 7. Possible Planting Areas in Tukwila Overlayed with the Equity Index

***Cascade View Neighborhood*:** Approximately 30 acres (21%) of the neighborhood has canopy. A total of 53 acres was identified as possible planting areas. Results show large contiguous portions of PPA throughout the residential neighborhoods, many in Right-of-Way areas. Figure 8 highlights PPAs across the Cascade View Neighborhood.

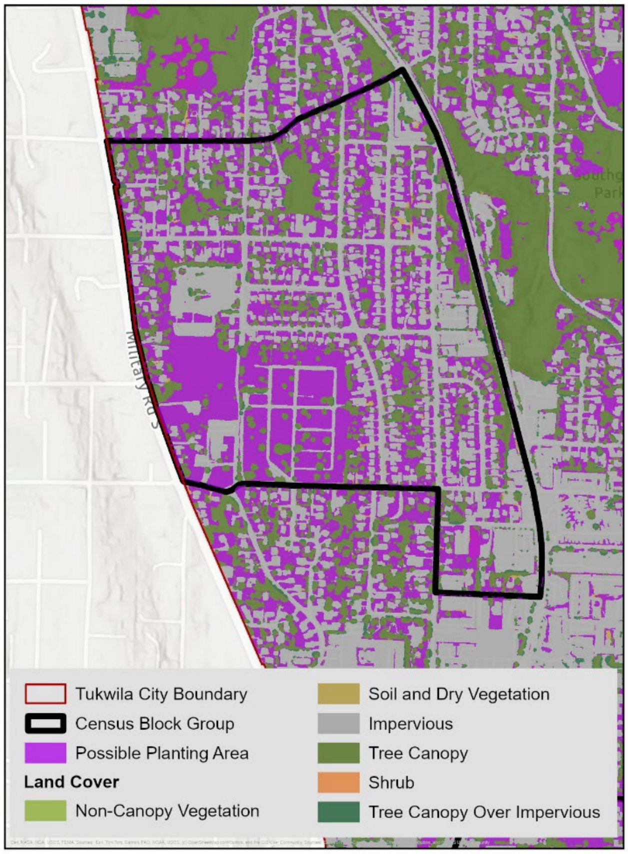


Figure 8. Cascade View Neighborhood PPA

Thorndyke Neighborhood**:** Nearly 20 acres (26%) of Thorndyke neighborhood has canopy, with 23 acres identified as PPAs. Results show that the largest contiguous portion of PPAs are near St. Thomas Catholic Church, Thorndyke Elementary, and along stretches of Tukwila International Blvd where multiple development projects recently or are currently underway. Figure 9 highlights PPAs across the neighborhood.

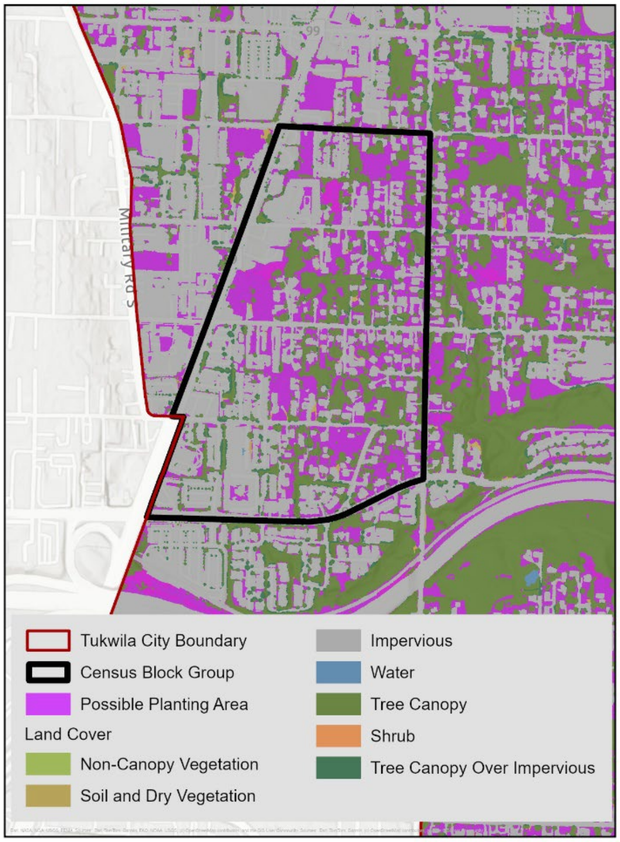


Figure 9. Thorndyke Neighborhood PPA

***Allentown Neighborhood*:** Over 43 acres (21%) of Allentown neighborhood has canopy, with 47 acres identified as PPAs. Results show that the largest contiguous portion of PPAs are near the Tukwila Community Center, Duwamish Park, and several empty lots throughout the community that appear to be converting into housing. Figure 10 highlights PPAs across the neighborhood

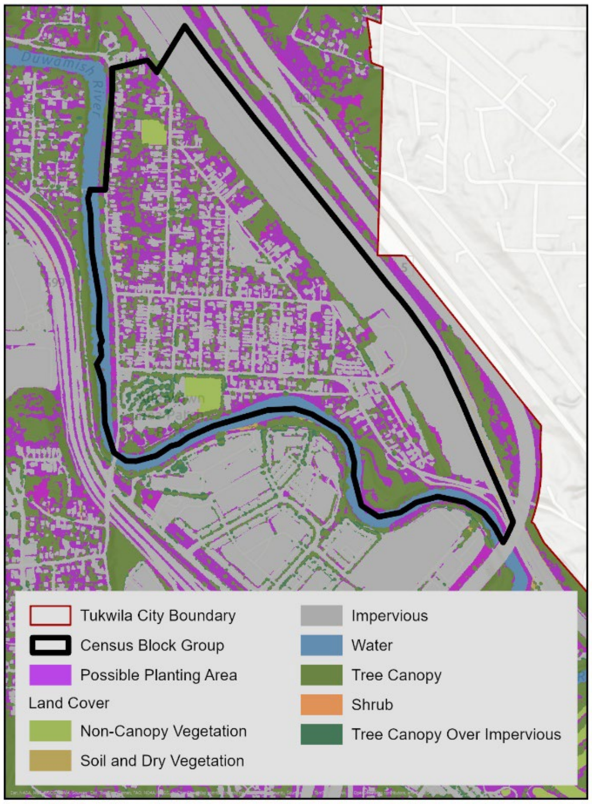


Figure 10. Allentown Neighborhood PPA

Opportunities to Prioritize Conservation of Connected Canopy

Tukwila's urban canopy is shaped not only by total canopy cover, but by the degree to which that canopy is connected across neighborhoods, rights-of-way, parks, and private parcels. While no single code section governs "connected canopy," multiple provisions in the City's tree regulations, land use standards, and public works practices collectively influence whether tree cover functions as isolated patches or as contiguous forest structure. Preserving and expanding connected canopy—particularly along right-of-way (ROW), within redevelopment areas, and between parks and open space—directly advances the City's canopy goals by strengthening the structural continuity of tree canopy rather than focusing solely on individual tree counts.

Studies of connected urban canopy show greater surface temperature reductions and mitigation of urban heat island effects where canopy is continuous and spatially aggregated, as larger patches reduce edge effects and enhance evapotranspiration and shading at scale.[25; 26] Similarly, habitat research finds that canopy connectivity improves species movement, nesting success, and overall biodiversity by linking otherwise isolated habitat patches—an effect amplified when street and ROW trees function as corridors between parks and remnant forest patches.[27; 28] Evidence also indicates that connected canopy enhances recreational experience and psychological well-being by creating perceivable green networks rather than isolated trees.[29] Importantly, research on urban equity consistently finds that canopy fragmentation and heat exposure are concentrated in historically underinvested communities; expanding contiguous canopy in these areas can therefore reduce temperature disparities, improve habitat quality, and deliver more consistent ecosystem service benefits to underrepresented residents.[30]

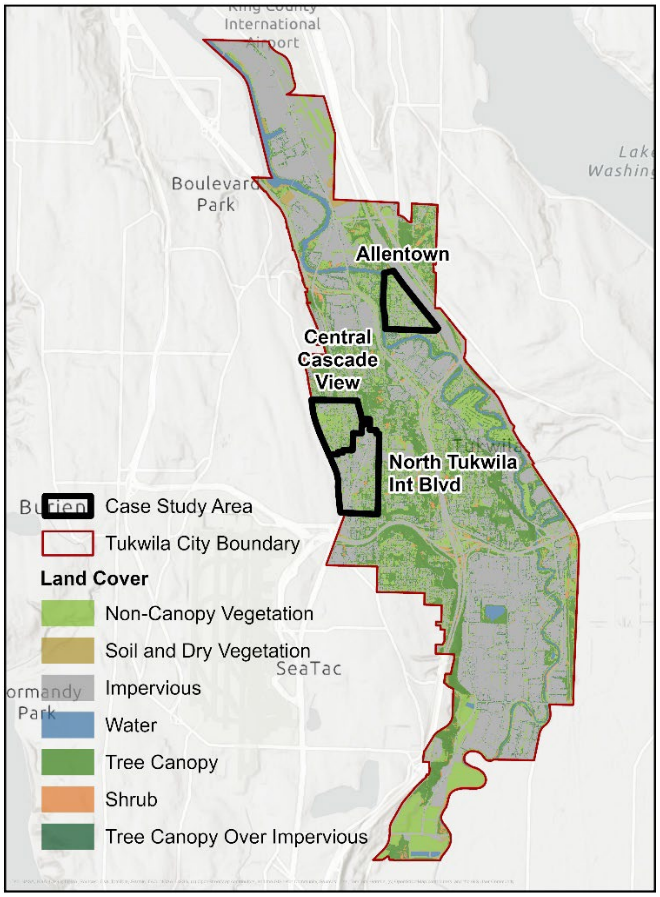


Figure 11. Tukwila Riparian Region Case Study Areas Overlayed with Canopy and PPA

Figure 11 shows three separate cases with among the highest residential population densities but least amount of contiguous canopy. What canopy does exist in each case study is essential to preserve. The remainder of this subsection provides highlights from these case studies.

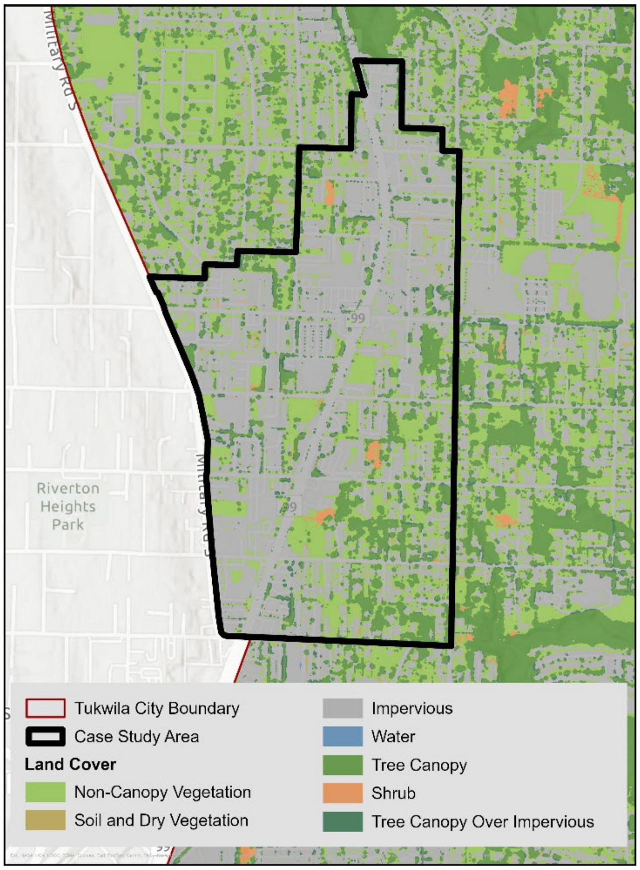


Figure 12. Northern Portion of Tukwila International Boulevard with Land Cover Overlay

Figure 12 highlights the neighborhoods surrounding Tukwila International Boulevard, which are among the most densely populated residential areas in the city, characterized by multifamily housing, mixed-use zoning, and a concentration of small commercial parcels oriented toward transit access. Zoning along the corridor supports higher residential densities relative to surrounding single-family areas, contributing to a compact urban form with limited per-parcel open space and fragmented canopy. The area is home to a high proportion of low-income households, immigrant and refugee communities, and residents with limited English proficiency. The combination of density, constrained tree space, and environmental burden underscores the importance of connected canopy preservation and expansion to improve thermal comfort, air quality buffering, and equitable access to ecosystem services.

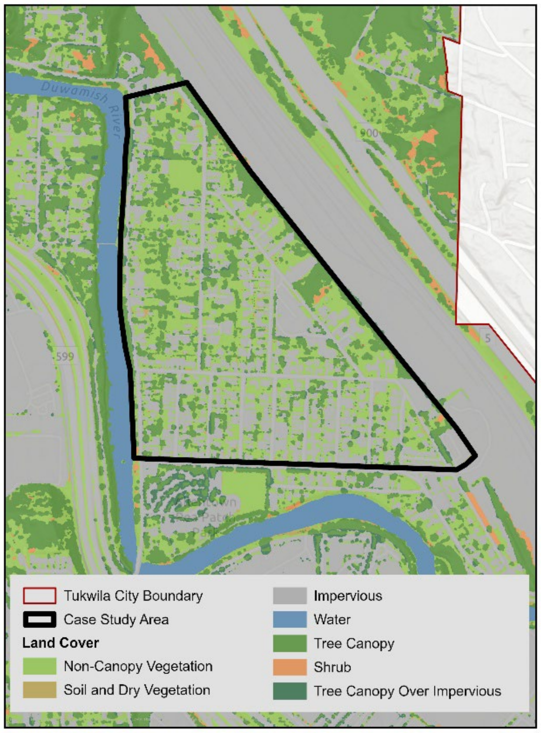


Figure 13. Allentown Neighborhood with Land Cover Overlay

Figure 13 highlighted the Allentown neighborhood, a lower-density residential area adjacent to active railroad corridors that serve regional freight movement. Proximity to rail lines and industrial uses contributes to localized air quality concerns, including diesel particulate exposure and noise, which compound existing environmental burdens. Tree canopy in Allentown is uneven and often fragmented, particularly near transportation infrastructure where impervious surfaces dominate. Strengthening connected canopy—especially along streets and near rail-adjacent corridors—would enhance pollutant interception, reduce localized heat, and improve neighborhood-scale environmental quality for residents.

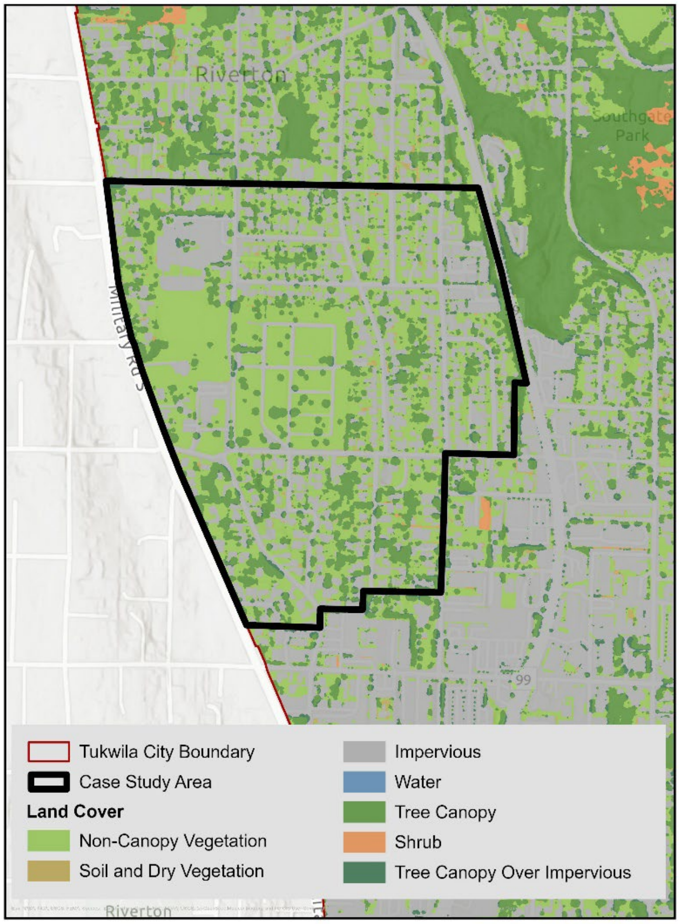


Figure 14. Central Cascade View Neighborhood with Land Cover Overlay

Cascade View is a predominantly residential neighborhood characterized by moderate-density housing and significant remaining tree cover relative to other parts of Tukwila. Unlike areas constrained by shoreline or critical area regulations, much of its forested land falls outside mapped environmental protections and steep slope designations, leaving large portions of canopy more vulnerable to incremental clearing and redevelopment. This condition makes the neighborhood's tree cover particularly sensitive to parcel-level land use changes. Maintaining and reinforcing connected canopy in Cascade View is therefore essential to sustaining habitat continuity, neighborhood cooling, and long-term ecosystem service benefits.

Taken together, these case studies demonstrate that Tukwila's neighborhoods exhibit varying degrees of canopy connectivity shaped by density, infrastructure, and regulatory context. Strengthening and protecting contiguous canopy—particularly in high-density, infrastructure-adjacent, and environmentally burdened areas—would advance canopy goals while delivering measurable heat mitigation, air quality, habitat, and equity benefits within existing land use frameworks.

Opportunities to Prioritize Investment in Canopy to Mitigate Urban Heat

Overlaying PPA with King County's Heat & Health data reveals clear opportunities to target canopy expansion where summertime temperatures are highest. Large portions of the city's vegetated, plantable areas coincide with heat-vulnerable blocks—particularly where impervious surfaces and limited shade intensify localized heat exposure. Conversely, the hottest regions of Tukwila coincide with a lack of canopy, highlighted in Figure 15.

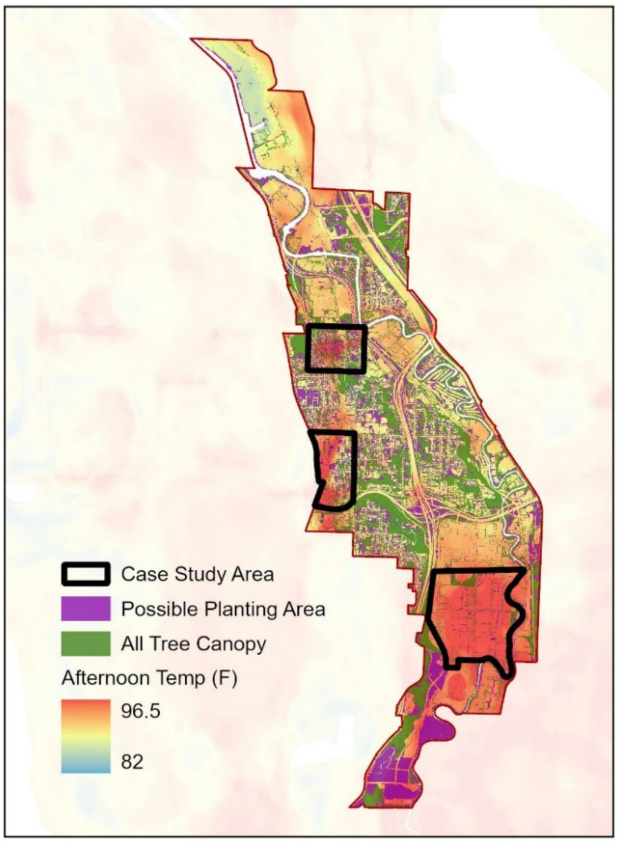


Figure 15. City of Tukwila Afternoon Temperature a Overlayed Tree Canopy and PPA

The figure above shows several areas throughout where peak summer afternoon temperatures are higher compared to other regions. Three specific regions are selected based on their contiguous peak heat surface temperatures according to the King County heat and health data.

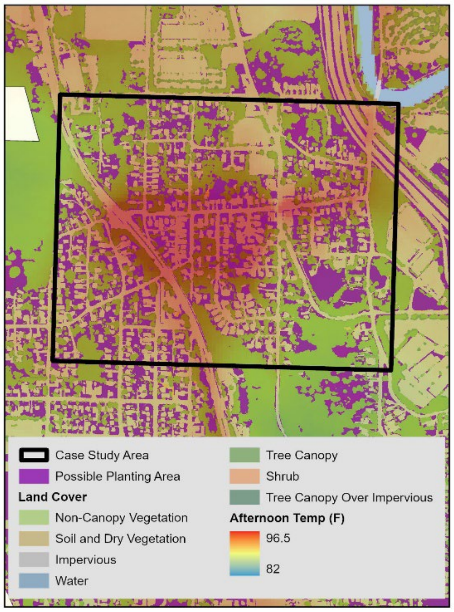


Figure 16. Riverton Neighborhood with Peak Temperature and PPA Overlays

The Riverton Neighborhood is one of the most isolated regions of Tukwila that experience the heat island effect. Nearly all PPA exists in private or commercial residential space.

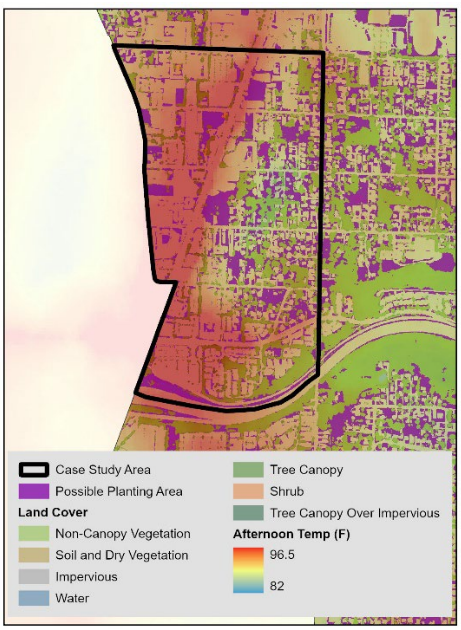


Figure 17. Tukwila International Boulevard with Peak Temperature and PPA Overlays

The Tukwila International Boulevard corridor is more extensive in commercial development and thus experiences higher peak heat events relative to neighboring communities. Ample PPA opportunities exist, particularly in lots that seem to be unoccupied or in the process of development.

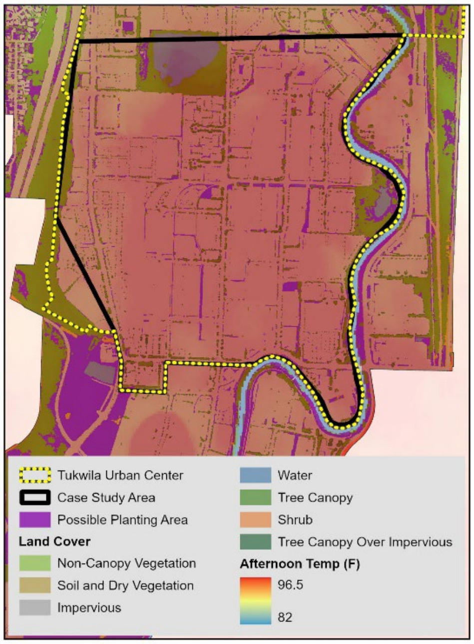


Figure 18. Tukwila Urban Center with Peak Temperature and PPA Overlays

The largest contiguous areas of elevated peak heat in Tukwila are concentrated in the Tukwila Urban Center. Extensive paving and dense industrial and commercial development leave minimal publicly accessible planted areas to mitigate heat exposure for workers, visitors, and residents without reducing impervious surfaces.

Estimating Economic Value of Investment Opportunities

This section provides recommendations and approaches for the city to connect on-the-ground restoration outcomes with broader regulatory, policy and investment strategies. By analyzing real examples of forest recovery, canopy loss, and management challenges, the city can identify where existing policies are effective and where new tools or resources are needed to protect, restore or enhance ecosystem functions. These insights help translate site-level lessons into actionable policy updates that strengthen resilience, guide future development, and ensure Tukwila's natural systems continue to provide environmental and community benefits.

Strategic Investment in Overlapping Spatial Priority Areas

This assessment has explored gaps and priority areas using economic value, equity tools, environmental exposure, invasive species data, and gaps in tree canopy. Bringing these data sources together can provide a roadmap for investment opportunities whether in the form of community tree plantings, property acquisition, right-of-way enhancement, or another type of investment.

Case Study: Canopy Investments and Excessive Heat in the Thorndyke Neighborhood

The following explores three primary overlapping priority areas: Urban heat hotspots, the Thorndyke Neighborhood, and PPA. Urban heat data is derived from the same sources presented in the Cool Air Module, which was used to isolate regions experiencing excessive heat during peak summer temperatures. Results show that in the 378-acre neighborhood, there are approximately 26.4 acres of PPA in areas where peak temperature exceeds 90°F. Figure 19 provides each overlay dataset with peak heat conditions focused nearly entirely on Tukwila International Boulevard.

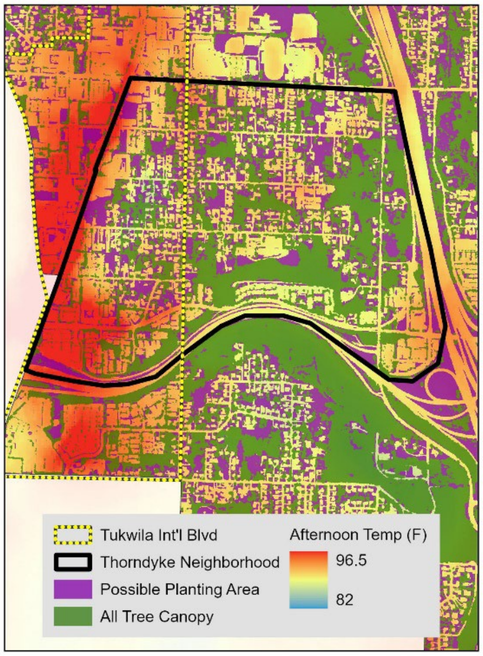


Figure 19. Thorndyke Neighborhood Overlayed with PPA and Peak Temperatures

This area has a lack of canopy, falling short of goals set by the City. Reaching the city-established canopy goals for each zoning type in the area would mean big benefits in reducing peak temperatures among other co-benefits. As an exercise, the analysis examines UTC by zoning type and current canopy cover goals. Table 4 shows the land area and UTC by zoning type and the associated canopy goal for each zoning category. Zoning types are grouped by canopy goal.

Table 4. Thorndyke neighborhood urban tree canopy goal gap.

Zone Category	Percentage Short of Goal	Urban Tree Canopy	Zoning Goal	Required Acres to meet goal
Community Residential	-6%	41%	47%	11.70
High Density Residential	-14%	26%	40%	6.24
Unzoned	-9%	20%	29%	7.01
Office and Commercial	-3%	29%	32%	1.59

If the canopy goals were met, canopy cover would increase by 26.5 acres. The total annual value would amount to $406,322 to $688,040 in ecosystem services provided. Over 50 years, this accounts for $11.3M to $19.1M. Table 5 summarizes the value of each ecosystem service.

Table 5. Ecosystem Service Value Annually and Over 50 Years in Thorndyke Neighborhood Case Study.

Ecosystem Service	Low Range Value	High Range Value
Stormwater	$101,049	$200,751
Water Quality	$110,514	$194,162
Air Quality	$11,804	$33,956
Cool Air	$13,958	$14,904
Ground Stability	$0	$0
Access to Nature	$168,997	$244,267
Acres	26.53	
Total Value	**$406,322**	**$688,040**
Asset value	**$11,271,219.08**	**$19,085,939.84**

**Unstable zones were not found in this region*

Case Study: Investments in Cascade View Neighborhood Contiguous Canopy

The following explores overlapping priority areas: Cascade View neighborhood (equity map), contiguous acreage, access to nature (module), and critical areas. As highlighted in the section above, Cascade View has limited canopy with land cover data showing approximately 21% of the neighborhood with canopy cover, the lowest among residential neighborhoods. Given the lack of canopy, the existing 25.2 acres is at risk of diminishing due to parcel development.

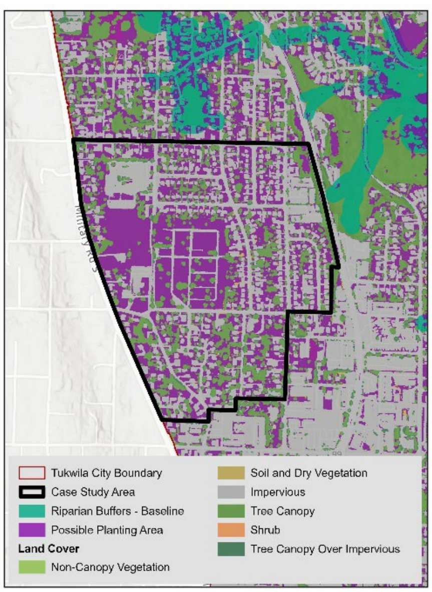


Figure 20. Central Cascade View Neighborhood with Land Cover and PPA Overlay

Using data derived from the modules presented earlier in the assessment, the total annual value of canopy in Central Cascade View is $385,761 to $653,222 in ecosystem services provided. Over 50 years, this accounts for $10.7M to $18.1M. Table 6 summarizes the value of each ecosystem service.

Table 6. Ecosystem Service Value Annually and Over 50 Years in Central Cascade View Case Study.

Ecosystem Service	Low Range Value	High Range Value
Stormwater	$95,936	$190,592
Water Quality	$104,922	$184,336
Air Quality	$11,207	$32,237
Cool Air	$13,251	$14,150
Ground Stability	$0	$0
Access to Nature	$160,445	$231,906
Acres	25.19	
Total Value	**$385,761**	**$653,222**
Asset value	**$10,700,841**	**$18,120,099**

**Unstable zones were not found in this region*

Tree Code and Citywide Canopy Coverage

Tukwila's municipal code establishes clear policy direction for protecting and expanding the city's tree canopy as a critical part of its urban environment. The city's Urban Forestry Program and Tree Regulations (TMC 18.54) emphasize that trees provide essential ecosystem services and require permits for removing significant or exceptional trees while mandating replacement or contribution to a Tree Fund. The program sets canopy maintenance standards that align with Tukwila's long-term goal of achieving approximately 29 percent citywide canopy coverage by 2034. These provisions ensure that development, maintenance, and restoration activities collectively contribute to maintaining and increasing overall tree canopy health.

Reaching the 29 percent canopy goal will require strategic leadership from the City, raising questions about which tools are most effective and where tree-planting resources can be most effectively deployed; some examples of tools include requirements such as tree regulations and stream buffers, incentives such as tax rebates, and assistance such as the annual Tree Giveaway Urban Forestry Goal 4.13 in the 2015 Comprehensive Plan outlined citywide canopy goals and specific goals for each zoning category. Table 7 shows the goals by zoning category as outlined in the 2015 Comprehensive Plan.

Table 7. 2015 Tukwila Comprehensive Plan, Urban Forestry Goal 4.13.

Zoning Category	Canopy Goal
Light Industrial	23%
Heavy Industrial	10%
Tukwila Urban Center and Tukwila South	18%
Office and Commercial	32%
Parks	43%
Public Rights of Way	To Be Determined
Community Residential[1]	47%
High-Density Residential	40%
[1]Low- and Medium-Density Residential are now classified as Community Residential, Medium-Density Residential was previously combined with High-Density Residential.	

Using 2021 data, we evaluate how existing canopy cover compared to the stated goals in the Comprehensive Plan. Table 8 shows each Comprehensive Plan Urban Forestry goal category, the percentage short of the goal, 2021 canopy cover, the stated goal, and how many acres would need to be planted to meet the stated goals.

Table 8. Percentage short of Comprehensive Plan Goals, urban tree canopy percentage, urban tree canopy goal, and acres short of goal. Data from 2021.

Comprehensive Plan Goal Categories	Percentage Short[1]	Urban Tree Canopy Percentage	Urban Tre Canopy Goal	Acres Short of Goal
Light Industrial	1%	24%	23%	0.0
Heavy Industrial	0%	10%	10%	0.7
Tukwila Urban Center & Tukwila South	-4%	14%	18%	36.4
Office and Commercial	-8%	24%	32%	19.9
Community Residential	-4%	43%	47%	73.1
High Density Residential	-10%	30%	40%	14.6
[1]Positive percentages mean the category has already met Urban Forestry Goal 4.13.				

Taking the sum of all the additional acres required to meet the Urban Forestry Goal 4.13 results in an additional 144.7 acres of canopy cover. This would result in massive economic benefits for the city and its residents. Per acre ESV estimates are conservatively estimated at between $15,314 and $25,932. Using these estimates, reaching the Urban Forestry goals outline in the Comprehensive Plan result in between $2.2M and $3.8M in annual economic benefits.

If all zoning types met their respective tree canopy goals, the city would only be 1.4% short in meeting the citywide canopy goal; notably, this does not include ROW canopy cover. The goals set out in the Comprehensive Plan support the citywide efforts to reach 29 percent canopy cover. This emphasizes the importance of both private and public efforts to meet canopy cover goals.

As stated in Table 7, Public Right-of-Way (ROW) does not currently have a UTC goal. This provides an opportunity to evaluate what the ROW UTC goal should be. ROW is often distinguished as either developed or undeveloped. Table 9 shows the land acres and the UTC and PPA acres and percentages by developed and undeveloped ROW.

Table 9. Public Right-of-Way (ROW) land acres, canopy acres, urban tree canopy (UTC) percentage, possible planting area (PPA) acres and percentage, all by developed and undeveloped ROW.

ROW Type	Land Acres	Canopy Acres	UTC %	PPA Acres	PPA %
Developed	1,117.37	225.73	20.15	219.71	19.61
Undeveloped	62.66	44.83	69.85	7.79	12.14
Combined	1181.03	270.56	22.93	227.51	19.28

Currently, ROW contains approximately 23% canopy cover, with undeveloped ROW at nearly 70% UTC and developed ROW at just over 20% UTC. Public ROW is a unique part of city infrastructure which allows for public use and transportation, utility installation and maintenance, stormwater management, road signage, and recreational use. Giving these many uses of public ROW, ground-truthing the implementation of UTC increases is critical to ensure other uses for the ROW are not diminished.

There is currently no goal for ROW UTC. Consider a case where the ROW UTC goal is 40%, on par with High Density Residential. This would be a near doubling in the ROW UTC. This is a lofty goal and would lead to big benefits in ecosystem services provision and support the city in their efforts to alleviate urban heat impacts, increase equity, and improve stormwater management. Increasing the ROW canopy to 40% would require a 200 acre increase in canopy. This is currently available in the form of PPA but would need to be ground-truthed to ensure utilities and other public ROW uses are not negatively impacted. With 200 acres planted in the ROW, using a conservative estimate of between $15,314 and $25,932 per acre in ecosystem services value, reaching this goal would result in between $3.1M and $5.2M in annual benefits.

Critical Areas Ordinance and Riparian Buffers

This analysis considers adjustments to riparian buffer definitions detailed in the prior section. Adjustments to the existing (called "baseline" throughout) riparian buffer distances would provide more protection to Tukwila's waterways and habitats, promoting enhanced ecosystem service capacity and thus value. The two hypothetical buffer distances include a moderate buffer and a Site Potential Tree Height (SPTH) buffer. The following analysis considers adjustments to the riparian corridors summarized above and their ecosystem service impact over time.

Currently, buffers vary by watercourse type and wetlands category. Table 10 below summarizes the watercourses and wetland categories of interest and associated buffer increase scenarios.

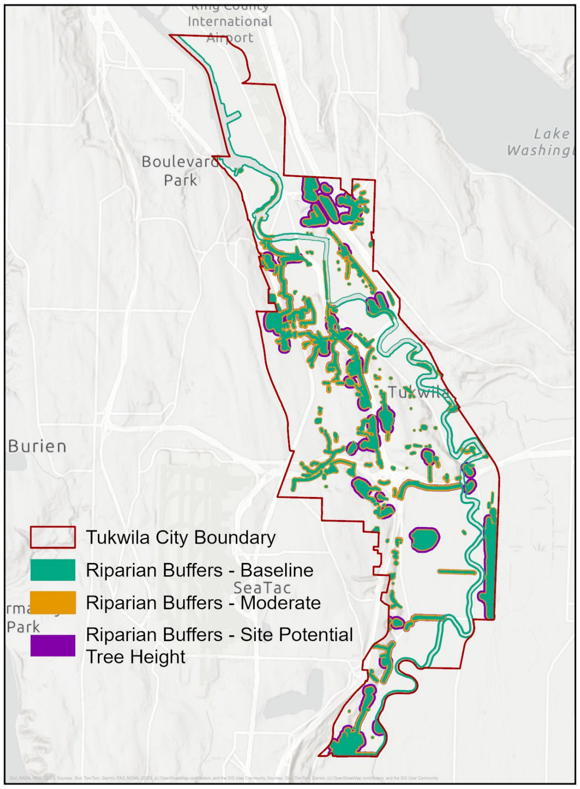
Table 10. Watercourse Type and Wetland Category with Baseline and Proposed Buffer Distances, Measured in Feet from Waterbody.

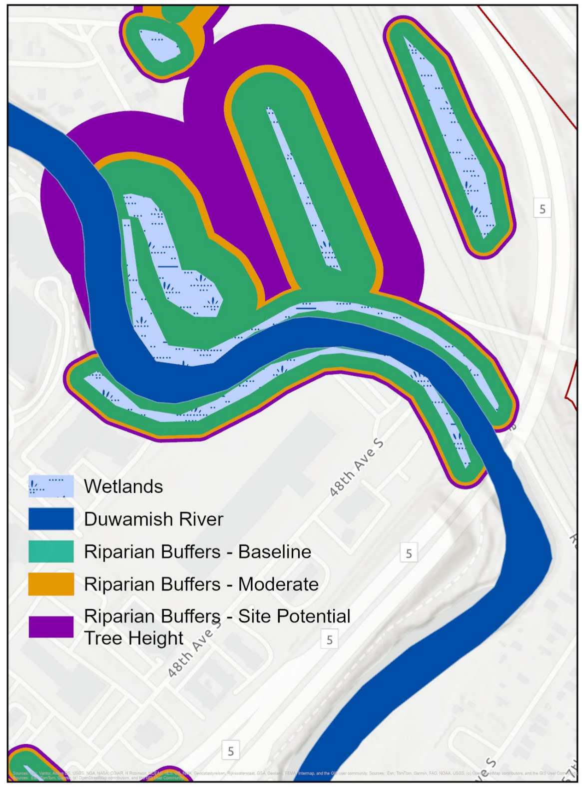
Buffer Category and Type		Current buffer (*avg of range)	Moderate Buffer	SPTH** Buffer + Wider Wetland Buffers
Watercourses	**Type Ns**	50	115	150
	Type Np	80	115	150
	Type F	100	150	202
Wetlands	**Wetlands Potential**	50	60	75***
	Wetlands Cat IV	50	60	75***
	Wetlands Cat III	115*	150	300***
	Wetlands Cat II	125*	150	300***
	Wetlands Cat I	125*	150	300***

** Wetland buffers are averaged for the purpose of this economic scenario, as true buffer widths are individually dependent on current assessments which expire after five years.*

*** Site Potential Tree Height: A science-based metric, recommended by WDFW, used to determine the necessary width of a riparian management zone, an area adjacent to a stream or river, to ensure it can provide full ecological functions.*

**** For the purpose of this economic scenario, this column of wetland buffers was shown at the widest range of possible widths per Ecology guidance; wetlands do not employ SPTH.*





Buffer scenarios were created based on WDFW's SPTH ecological function and a moderate option that fell between the current buffer and SPTH buffer. Using SPTH ensures an ecologically effective standard that relies on science rather than generic measurements. This approach guarantees the buffer is wide enough to provide vital functions, such as adequate stream shading and the supply of large woody debris, which are critical for the health of aquatic ecosystems. Ultimately, SPTH-based buffers offer superior protection tailored to the unique growth conditions and potential of each specific location.

The ecosystem service analysis presented above identifies riparian areas and calculates their economic value (see Appendix C for detail). Using the buffer definitions defined in Table 11, the following shows the increase in ecosystem service value under all buffer scenarios.

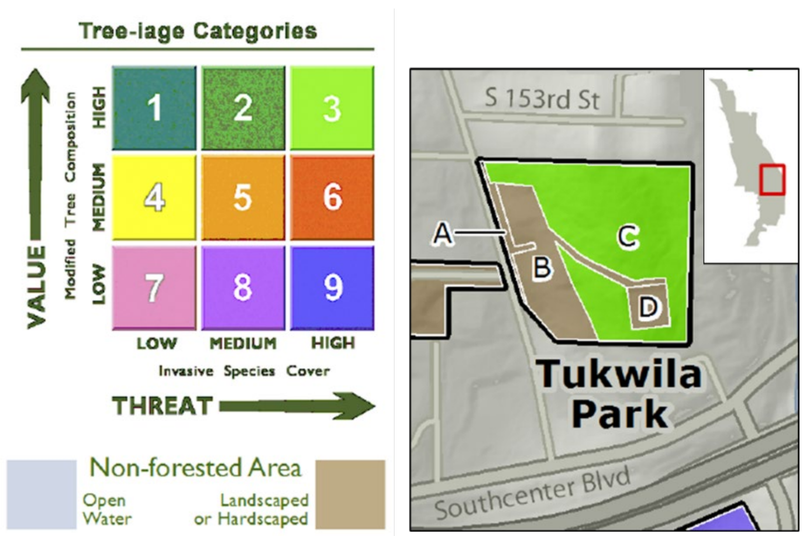
Table 11. Annual ESV of Buffer Scenarios

Buffer Scenario	Acres	Annual ESV Low	Annual ESV High
Baseline	897.17	$16,416,155	$25,155,744
Moderate	1158.05	$21,189,661	$32,470,557
SPTH	1621.95	$29,677,968	$45,477,847

Restoration Investment Opportunities

In 2015, the Green Tukwila Partnership (GTP) was established to restore and care for the city's tree canopy and natural areas over a 20-year period. The Green Tukwila 20-Year Stewardship Plan (Plan) outlines strategies to improve forest health, engage the community in long-term stewardship, and ensure the sustainability of public green spaces. The Plan provides a framework for coordinated restoration and adaptive management across Tukwila's parks by identifying where high value natural capital and heavy presence of damaging invasive species exist.

Several park plots were identified by the Plan as high priority habitat areas with extensive invasive species pressure, suggesting the need for intervention and investment. Over the last several years, multiple GTP restoration activities have taken place at targeted sites throughout the city, including at Tukwila Park. Tukwila Park is one of the city's oldest community parks, located in the Tukwila Hill neighborhood. The park features mature mixed deciduous and coniferous forested areas, and recreational amenities such as trails, picnic areas, courts and play structures. This park serves as a key neighborhood green space providing both active and passive recreation opportunities near the urban core.



In the plan, much of Tukwila Park was shown to have a high-quality habitat composition but high invasive species cover. In coordination with the City of Tukwila Department of Parks and Recreation, and using data from the Plan, the following analysis measures the effect that this high invasive species presence had on the park and the positive ecosystem service and economic impact of restoration in Tukwila Park. What follows is a discussion on the benefits of restoration for all green spaces identified in the GTP.

Impact of Invasive Species

Throughout Tukwila's parks and natural areas, invasive plant species such as English ivy, Himalayan and evergreen blackberry, holly, cherry laurel, reed canary grass, and knotweed dominate much of the understory and are identified as a major cause of biodiversity loss and forest decline. Vines like clematis and ivy climb and weaken mature trees, sometimes causing them to fall, while dense thickets of blackberry and knotweed create monocultures that degrade habitat quality. Additionally, invasive species, particularly thicket varieties, can severely limit sapling recruitment by preventing seedlings from growing; this dramatically hampers forest sustainability as existing canopy ages without saplings to replace them; the impacts are especially threatening on steep slopes that rely on tree canopy for stability. As a result, over 90% of Tukwila's forested parklands are impacted by invasive vegetation, requiring an initially intensive, long-term commitment to restoration in order to reestablish native species and restore healthy forest structure.

The impact of invasive species is studied under the lens of the six Ecosystem Service modules introduced at the beginning of this assessment. In the context of heavily forested Tukwila Park, the species of focus will be the impact of English ivy, . Once left unchecked, English ivy inundates mature trees and weakens their structure, compromising tree canopy year after year. One study conducted in City of Seattle demonstrated that severe infestations of English ivy can reduce native canopy by 42.6% on average.[31]

Using the data cited above along with GIS information gathered from the Tukwila Department of Parks and Recreation, the diminished ecosystem service value was estimated for Tukwila Park and is shown below. The average cost of restoration at Tukwila Park -- estimated by the GTP Plan as between $37,900 to $53,700 per acre ($2016) -- and the value of grants and volunteer labor was used to understand the return on investment in restoration (ROI) activities over time. Appendix C provides detail on the calculations and assumptions used to arrive at this value.

Benefits of Restoration

- $68,384 to $94,808 after 5 years
- $116,139 to $164,291 after 10 years

Return on Investment After 5 Years

- Average 2.11 Benefit Cost Ratio
- $2.11 in benefits for every $1 invested

Return on Investment After 10 Years

- Average 2.72 Benefit Cost Ratio
- $2.72 in benefits for every $1 invested

Value of Recovery and the Future of Restoration Activities

As city resources do not match the required investment needed to restore the full body of GTP sites, full implementation of the plan is on a longer-term trajectory than the initially considered 20-year window. The Tukwila Part case study demonstrates the value of full restoration, particularly in the highest priority areas identified in the plan. To date, progress across many sites has been incremental, adapting to resource constraints by utilizing primarily volunteer-based maintenance and achieving partial invasive control rather than the complete habitat restoration envisioned. The plan's later sections emphasize that sustained investment, stewardship partnerships, and consistent funding are essential to prevent further decline of forest health. Without continued intervention, invasive species will regain dominance, erode previous gains and reduce canopy resilience. Achieving the long-term vision — healthy, diverse, and self-sustaining treen canopy — will require renewing commitments beyond the original 20-year horizon, scaling restoration funding, and expanding community engagement to secure the ecological and public benefits the plan sought to deliver.

Surface Water LID Code

Tukwila's surface water regulations reinforce the city's emphasis on preserving natural systems and treating tree canopy as a functional component of water management. The stormwater program and Low Impact Development (LID) standards promote strategies that mimic natural hydrology—such as retaining existing trees and vegetation, protecting permeable soils, and routing runoff through vegetated areas for filtration and infiltration. These practices are embedded in Tukwila's development review processes, capital improvement program and compliance with its National Pollutant Discharge Elimination

System permit, and are designed to reduce pollutant loads, prevent erosion, and manage localized flooding through decentralized, nature-based solutions.

Tukwila's development and surface water codes establish a framework for integrating canopy with green infrastructure systems, but this is mediated by the technical standards the City is required to use. The City's LID definition in Tukwila Municipal Code 14.32 references its Infrastructure Design and Construction Standards and the adopted King County Surface Water Design Manual (KCSWDM). While LID is described as a preferred approach, the KCSWDM provides limited water-quality credit for bioretention compared to Washington State Department of Ecology's Stormwater Management Manual, meaning the regulatory pathway for linking trees, LID, and water-quality treatment is less direct than intended. As of now, bioretention itself remains the only state-approved technology capable of removing 6-PPD-quinone, and Tukwila has implemented these systems in a small number of right-of-way and adjacent projects. However, most LID techniques used regionally—such as bioretention planters, permeable pavement, and infiltration practices—are typically planted with shrubs or grasses rather than trees, which limits their integrative potential unless codes or standards explicitly encourage tree-compatible designs.

Against this backdrop, there is a substantial opportunity to strengthen Tukwila's approach by better connecting canopy goals to stormwater performance standards and clarifying where trees can function within LID systems. Future code updates could consider establishing tree-retention or tree-planting credits within LID requirements, enabling street and parking-lot trees to count toward stormwater management obligations, or aligning canopy targets with watershed indicators used in King County's and Ecology's manuals. Doing so would position trees as living stormwater infrastructure within the regulatory framework—allowing Tukwila to leverage the unique benefits of trees alongside LID's pollutant reduction and hydrologic functions and improve both resilience and long-term water-quality outcomes.

Recommendations and Implementation Pathway

This assessment integrates scientific, economic, and policy analyses to characterize the current condition of Tukwila's green infrastructure and demonstrate the community value of investments in trees, open spaces, and waterways. It frames these resources as measurable economic assets that provide ongoing environmental, public health, and community benefits.

The recommendations that follow translate these findings into actionable steps the city can advance through policy alignment, sustainable funding, and coordinated implementation to strengthen and expand green infrastructure across public and private lands. The assessment concludes with a workplan outlining short-, medium-, and long-term actions to support canopy restoration, climate resilience, and equitable access to nature.

Translating Analysis to On-the-Ground Implementation

Leveraging the information in this assessment is critical to furthering goals of improving green infrastructure in the community. Results from this assessment can be used in the following ways:

- **Unit costs and benefits**: Results from the economic analysis by module are provided in average per-acre estimates. The cost of removing an acre of tree canopy can be extracted from this assessment and used to demonstrate implications of development. Benefits of creating an acre of tree canopy can be used to show the benefits of investment. Appendix E highlights per acre values and other metrics that can be used to estimate approximate value of canopy throughout the city.
- **Prioritizing Investments:** The total economic benefits calculated in this assessment were calculated spatially and can be summarized in any portion within the City of Tukwila. Overlaying economic results with the Port of Seattle's Equity Tool and Tree Canopy Gap Assessment provide a means of understanding where canopy is missing, who needs it most, and what the value of adding canopy would be.
- **Understanding the Impacts of Policy Change**: Policy decisions considered in this assessment, including increasing canopy goals, adjusting riparian buffers, and improving LID Code, would have on-the-ground impacts. This assessment demonstrated the value of enhanced green infrastructure under these decisions. Future policy considerations can use the same information by extracting values per

acre. for example, increased canopy, to communicate return-on-investment over time.

- **Leverage Economic Data in Grants**: Multiple government grant processes, including FEMA's benefit-cost analysis, allow if not require benefit-cost analysis of proposed projects. The economic data provided in this assessment can be used to demonstrate the value of proposed investments where benefits otherwise are difficult to articulate. For example, restoration of forests deteriorated by invasive species requires tens of thousands of dollars in costs per acre for full recovery. Benefits associated with such projects are often not described in monetary terms, making the cost more difficult to justify.
- **Create a Spatial Tool for Stakeholder Use**: With economic data displayed across the city, a mapping tool can allow users to create unique "cutouts" of Tukwila that could apply to projects. This expands the usability of economic data to wider audiences, multiplying the investment made to understand the value of Tukwila's green infrastructure. For example, a partnership between American Forests and Washington DNR launched a Tree Equity Score Analyzer for Washington, enabling jurisdictions to identify areas of canopy deficit tied to equity and heat/health vulnerabilities. Overlaying this information with value estimates of tree canopy can be used to inform investment where it's needed most.

Policy and Program Recommendations

The following recommendations translate the assessment findings into targeted policy and program actions that can strengthen Tukwila's green infrastructure management and accelerate progress toward long-term canopy goals.

Ordinance and Policy Updates

- ***Tree Code and Citywide Canopy Coverage***: To enable more proactive growth, Tukwila could *dedicate* a stable funding souce to plan and finance planting in low-canopy, high-exposure neighborhoods, map planting schedules over time, and establish a predictable annual budget allocation for tree maintenance. The code could also explicitly require exploring alternatives to removal during development review and allow the City to require preservation of high-value trees when feasible. Seattle's updated tree regulations classify "Exceptional Trees" based on size, species, and ecological function, significantly limiting removal during development. These changes would align Tukwila's code with peer cities in the region—such as Seattle, Redmond, and Tacoma—where tree codes now integrate canopy goals, equity priorities, and ecosystem-function metrics. Tukwila could also develop a standalone Urban Forest Plan aligned with regional strategies (e.g., King County

Strategic Climate Action Plan, WRIA 9 habitat goals, and Green Cities Partnership principles) to translate code requirements into an implementable, cross-departmental program. This plan would create continuity between the code, annual work plans, funding pursuits, and on-the-ground canopy outcomes.

- ***Critical Areas and Riparian Buffers***: Tukwila should consider updating its riparian and wetland buffer standards to more clearly reflect WDFW's best available ecological science and modern best practices, using Site Potential Tree Height (SPTH) as the basis for buffer width where feasible. To support implementation, the City should create a flexible framework that pairs revised buffer standards with a mitigation hierarchy emphasizing avoidance, restoration of previously degraded buffer areas, and strategic acquisition of riparian parcels. Tukwila could also consider creating a riparian variance pathway that allows limited deviations when public benefits are demonstrated, such as public access projects, but only when ecological function is fully mitigated.
- ***Surface Water LID Code***: Tukwila should revise its LID framework to more explicitly recognize the hydrologic and water-quality benefits of trees and to reduce misalignment between the City's goals and the technical constraints of the King County Surface Water Design Manual (KCSWDM). First, the City can establish tree-compatibility criteria and guidance for LID facilities—allowing trees to be integrated into or adjacent to bioretention cells, street-side planters, and other green-infrastructure designs, where appropriate. This would draw on documented design approaches used in other municipalities—such as Portland's green street facilities or Tacoma's Right-of-Way bioswales—and help overcome KCSWDM's limited recognition of bioretention's water-quality credit.

  To promote tree–LID integration, Tukwila could adopt tree retention and planting credits within LID performance requirements, allowing developers to meet part of their stormwater obligations through tree canopy contributions that provide measurable interception and evapotranspiration benefits. This aligns with approaches used in cities such as Sacramento, Davis, and multiple other California jurisdictions where green-infrastructure compliance can be met partly through tree-based hydrologic performance. The City can also require all development applications to demonstrate how LID and tree preservation were jointly evaluated, including an alternatives analysis when tree removal occurs.

  Finally, the City could develop a technical supplement to the LID code—a Tukwila Green Infrastructure Design Guide—that provides tree-compatible LID templates, planting palettes, acceptable soil volumes, and maintenance guidance. This supplement would help resolve inconsistencies between the KCSWDM, Ecology's Manual, and Tukwila's canopy goals, while supporting both staff and applicants in implementing multi-benefit, nature-based solutions

Cross Departmental Integration

Through further cross-departmental collaboration, Tukwila can continue to ensure that tree-planting efforts align with right-of-way improvements, infrastructure maintenance and community equity goals. Under the city's 2024 Surface Water Comprehensive Plan, the section on implementation states the need for "interdepartmental and regional cooperation to achieve multi-benefit solutions" in natural lands and restoration work. Additionally, in the city's Implementation Strategies for its Comprehensive/Development code update, one of the tasks is to "establish an interdepartmental working group to focus on implementing Urban Forestry Plan goals and Green Tukwila Plan goals." The City does not have an Urban Forestry Plan; while grant funding is likely available to develop one, lack of staff and funding limits its relevance due to significant implementation constraints.

The following provides unique examples of cross-departmental integration throughout the country. Tukwila may be able to adopt or adapt similar strategies to further city canopy goals:

- Vancouver, Washington's 2025–2026 Urban Forestry Work Plan explicitly directs its forestry program to support Public Works, Parks, and Community Development departments — reviewing development plans, ensuring street-tree design in capital projects, and enforcing tree ordinances.[32]
- In the City of Seattle, nine departments share responsibility for urban forestry; they established a Core Team & Inter-departmental Team to coordinate tree planting, right-of-way work, policy, and infrastructure.[33]
- Sacramento's Urban Forest Plan was adopted with a cross-disciplinary Implementation Working Group composed of staff from Public Works, City Operations, Planning, Building, and other sustainability-focused teams to integrate canopy goals with city operations, planning, and equity objectives.[34]
- Bellevue requires permits for removal of significant landmark trees and encourages project redesign when development or infrastructure conflicts arise. City code and development review processes emphasize retaining mature trees in place and modifying impervious layouts to meet tree density and canopy objectives.[35]
- Seattle's Department of Transportation redesigned a sidewalk repair project to preserve existing street trees. Instead of the original alignment that threatened multiple mature trees, the sidewalk was shifted into the former flex lane and community engagement was used to prioritize every healthy tree along the corridor.

SDOT arborists collaborate with engineers to prune roots, reroute pavements, or narrow sidewalks where necessary to reduce tree loss.[36]

- Raleigh's urban forestry division coordinates with Transportation Field Operations on tree-impact permits: any work on or near city trees triggers review, and the Transportation group helps manage sidewalk-root conflicts.
- Austin requires all infrastructure and private development projects to coordinate with certified arborists within Development Services and Watershed Protection. The city manages trees as "green stormwater assets" and coordinates permit review across departments.[37]
- Charlotte's Tree Ordinance links development review, tree protection, and capital projects. Transportation and stormwater staff are required to coordinate early with Urban Forestry for street trees, bioretention, and canopy mitigation.[38]
- Louisville uses an interdepartmental "Tree Advisory Group" that includes Public Works and Sustainability to coordinate canopy targets, funding requests, and enforcement actions related to tree preservation and planting.[39]

Funding Mechanisms

This section outlines a suite of funding pathways that can support both near-term canopy projects and long-term program stability, ranging from external grants to permanent local revenue tools. It also clarifies how the city can pair these mechanisms with project-ready concepts and cross-department coordination to strengthen competitiveness and accelerate implementation.

Opportunistic and Competitive Funding

Opportunistic and competitive funding funds time-limited, competitive grants and programs that can finance discrete planting, restoration, and pilot projects (near-term action), as well as larger capital and resilience projects (medium-term) when Tukwila bundles shovel-ready work. These sources typically require clear project scopes, measurable environmental outcomes, matching or leveraged funds, and demonstrated partnerships — all areas where the assessment's ESV results and cross-departmental commitments will strengthen applications. Below is a curated list of relevant funding opportunities (federal, state, county, watershed and philanthropic) with typical award ranges. The same table is provided in Appendix D with more information on core eligibility/requirements, and a summary of fit for Tukwila.

Table 12. One-Time Funding Sources

Funding Source	Typical award / size
Washington State — DNR Urban & Community Forestry / Evergreen Washington passthrough	Distributed $7–8M (2024 passthrough); individual WA awards commonly $10,000–$350,000.
King County — 3 Million Trees / Community Climate Resilience Grants & related programs	Varies by program; county campaigns and grant rounds typically range $10,000–$500,000 depending on project scope.
WRIA 9 / Local Salmon Recovery & Re-Green the Green funds	Project funding typically $10,000 – $500,000+ per project depending on source (SRFB/PSAR/RCO allocations).
NOAA & Puget Sound Partnership / RCO (state) — Estuary and Salmon Restoration Program (ESRP) & RCO grants	State RCO rounds frequently total millions across programs; single awards vary widely ($50k–$5M depending on program).
National Fish & Wildlife Foundation (NFWF) — Five Star & Urban Waters; other initiatives	Program funding rounds often award $25,000–$300,000+ per project; national competitions can be larger.
EPA — Competitive Grants (Climate Pollution Reduction Grants, Environmental Justice & Urban Waters programs)	Large national programs (CPRG/IRA funds) total hundreds of millions to billions across competitions; individual awards vary widely (from ~$100k to multi-million).
USDA Forest Service — Urban & Community Forestry (U&CF)	Historically ~$30–40M annually; state/local challenge grants and passthroughs: WA DNR distributed ~$7–8M in 2024; individual awards commonly range $10,000–$350,000.
FEMA — Building Resilient Infrastructure & Communities (BRIC)	Large awards; project funding often ranges from hundreds of thousands to tens of millions depending on scale and whether submitted by state/tribal applicants.
NOAA — Community-based Habitat Restoration / Transformational Restoration	Awards vary; typical NOAA habitat grants $75,000–$3,000,000 (project-dependent); transformational rounds can be larger.

Even with only limited areas in Tukwila mapped within the 100-year floodplain, FEMA's Pre-Disaster Mitigation (PDM) grants remain relevant because eligibility is based on hazard mitigation outcomes rather than strict floodplain boundaries; projects such as levee strengthening, bank stabilization, and integrated green-infrastructure retrofits can still qualify when they demonstrably reduce future risk. This means Tukwila can use PDM funding to support levee and flood-risk mitigation work along the Green River, especially when paired with riparian canopy and habitat enhancements that strengthen overall project benefits.

Shifts in federal administration often reshape funding priorities, particularly for climate, resilience, and environmental justice programs, which can influence both the scale of competitive grant rounds and the criteria used to score applications. Programs such as USDA Urban & Community Forestry, EPA climate and Environmental Justice grants, and NOAA restoration funds may face changes in annual appropriations or policy emphasis, making it important for Tukwila to maintain a diversified pipeline and be prepared to pivot quickly as funding landscapes shift.

Permanent Funding Streams

Permanent funding streams differ from opportunistic grants in that they provide predictable, recurring revenue to sustain long-term tree maintenance, planting, monitoring, and program staffing. Unlike competitive funding, these mechanisms require political will, policy change, and sustained stakeholder engagement—making them more difficult to establish but essential for a durable, well-resourced urban forestry program.

- ***Dedicated Stormwater Utility Allocation***
  Tukwila already operates a storm and surface water utility, which allows the city to allocate a portion of fee revenue to natural-infrastructure functions[7] such as tree canopy for runoff reduction, infiltration, and compliance with LID/NPDES requirements. A defined percentage or annual appropriation could formally embed canopy funding in the utility's budget.
- ***Urban Forestry Fund (Tree Replacement / Mitigation Fees)***
  Fees collected from development impacts, tree removals, or insufficient onsite mitigation can be pooled into a restricted Urban Forestry Fund used for planting, maintenance, and monitoring. Many cities use this model to support predictable annual planting even when development fluctuates.
  Example: The City of Nashville passed an ordinance in 2021 that dedicated a portion of building permit fees to the "Tree Fund." This fund was managed by the Water Department which operated stormwater mitigation projects across the county. Nashville collaborated with the Cumberland River Compact who managed a tree giveaway program biannually.
- ***Developer Impact Fees or Green Infrastructure Impact Fees***
  Cities can establish impact fees tied to environmental services, tree preservation, or green infrastructure. When new development increases impervious surface or environmental burden, fees can be directed toward planting in priority areas or funding citywide canopy targets.
- ***Right-of-Way (ROW) Capital Project Set-Asides***
  Require a fixed percentage of transportation or public-works capital budgets to be dedicated to street trees, soil volume improvements, and installation of LID-

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[7] Tukwila Municipal Code 14.28.050 Storm and Surface Water Utility Fund "All disbursements for costs of planning, construction, acquiring, maintaining, operating and improving the utility facilities, whether such facilities are natural, constructed or both, and administering the utility, shall be made from the storm and surface water utility fund."

compatible canopy. This ensures that every major capital project contributes to long-term canopy goals.

- ***Long-Term Interlocal Agreements (King County, KCD, or Utility Partnerships)***
  Multi-year agreements with King Conservation District or regional utility providers can establish recurring funding for riparian restoration, stewardship, and canopy expansion—particularly where programs intersect with watershed health or climate adaptation.
- ***Business Improvement District (BID) or Commercial District Assessments***
  In commercial or mixed-use areas, a BID or local assessment district can fund streetscape trees, maintenance, and enhancements that support walkability and economic activity. These spread costs across benefiting properties while reducing burden on the city.
- ***Utility-Bill Round-Up Program***
  Residents voluntarily "round up" utility bills to the nearest dollar, directing small but cumulative funding to tree canopy or green infrastructure. This is low-cost to administer and builds visible community ownership.
- ***Tree Loss Fee (Emerging Practice)***
  Applicants pay proportional fees to compensate for the temporal loss of ecosystem services resulting from permitted tree removals; this occurs alongside replacement to mitigate for the reduced benefits that young trees provide versus mature trees. (see Decatur, GA)
- ***Tree Benefit Charge (Emerging Practice)***
  Some cities are exploring a nominal fee dedicated to urban forest maintenance, justified by quantifying benefits such as avoided stormwater costs or heat mitigation. Although politically sensitive, it creates a clear linkage between public benefit and public investment.
  Example: Madison, Wisconsin has an Urban Forestry Special Charge on its monthly municipal services (water) bill.[40] In 2025, the special charge is $7.56 a month for residential customers. The City of Pittsburgh recommends a dedicated urban forest maintenance fee to fund cyclical pruning, planting, inspection, and risk management in the Urban Forest Master Plan.
- ***General Fund Baseline Budget Allocation***
  A modest but recurring allocation within Tukwila's general fund would support core staffing, tree maintenance cycles, and community programs. This approach provides some stability and can be paired with periodic external grants. This approach can be at risk of budget reductions if not deemed a necessary program.

Community Incentive Programs

Tukwila can expand its canopy impact by offering small but strategic incentive programs that directly support residents, businesses, and community groups in planting and maintaining trees. Programs like the city's Tree Giveaway are good examples of such programs. While the city would serve as the primary funder, partnerships with King Conservation District, nonprofits, and regional agencies can significantly broaden the scale and reach of these programs. The following concepts outline practical incentive pathways Tukwila could establish or co-develop to accelerate canopy gains on private and community-managed lands.

- ***Commercial and Multifamily Green Infrastructure Grants***
  Matching funds for businesses and multifamily properties to retrofit landscaping, add parking-lot trees, or install LID-compatible plantings.
  Example: Portland Clean River Rewards provides stormwater fee credits for private properties installing vegetated facilities and tree-based stormwater solutions. [41]

- ***ROW Partnership Planting Program***
  City installs and establishes street trees while residents or businesses agree to basic maintenance (watering during establishment).
  Example: Boise Community Forestry coordinates street-tree installations with adjacent property owners. [42]

- ***Low-Income Homeowner Tree Support Fund***
  Free trees plus installation and multi-year maintenance assistance for income-qualified households.
  Example: Louisville's Trees Louisville & Metro Government Urban Forestry Initiatives support planting in underserved areas and help reduce cost barriers. [43]

- ***Invasive Vegetation Removal + Replanting Assistance***
  A cost-sharing program for ivy, blackberry, or knotweed removal on private property followed by subsidized replanting with native trees.
  Example: KCD's Landowner Incentive Program (LIP) provides financial cost-sharing to help private landowners implement best management practices, such as invasive weed removal and native buffer planting. [44]

- ***Community Group Mini-Grants for Planting & Stewardship***
  Annual mini-grants for neighborhood groups, cultural organizations, and schools to conduct tree planting, restoration, or stewardship events.
  Example: KCD Member Jurisdiction Grant Program awards funding to King County cities and the County for local projects that improve natural resources, including

mini-grants for community-led initiatives like invasive species removal and neighborhood garden restoration.[45]

- ***Tree Ambassador or Steward Stipend Program***
  Stipends and training for residents to monitor young trees, organize planting events, or support community engagement.
  Example: Vancouver, WA Urban Forestry volunteer stewardship programs train residents to support street-tree care and neighborhood canopy efforts.[46]

- ***Developer Incentive Credits (Voluntary / Tiered)***
  Offer expedited permitting, density bonuses, or mitigation-fee reductions for developments that exceed tree-preservation or planting standards.
  Example: Charlotte Tree Ordinance includes incentive mechanisms and negotiated mitigation credits encouraging higher canopy outcomes.[47]

- ***Stormwater Fee Credit for Trees***
  Create a credit for private properties that install trees and landscaping that reduce runoff, improve infiltration, or intercept stormwater.
  Example: Portland Clean River Rewards ties fee reductions to onsite stormwater management, including vegetation and canopy.[48]

- ***Depave Programs***
  Create partnerships and incentive pathways that support removal of unnecessary impervious surfaces and replacement with green infrastructure on both public and private land.
  Example: Depave Puget Sound works with local governments, nonprofits, and community groups to identify and remove underused asphalt, replacing it with trees, rain gardens, and permeable landscapes. In Tukwila, Depave Puget Sound has partnered on community-led depaving projects at schools and public facilities.[49]

Strategic Framework for Green Infrastructure Investment

Tukwila's green infrastructure represents a system of living assets whose benefits can be expanded through coordinated, data-driven investment. In order to effectively use the results of this assessment, the city has an opportunity to align the green infrastructure values within regional and citywide policy and planning documents, using them to further identify and overlap priorities, and propose measurable indicators to guide progress toward canopy coverage achievement, restoration, resilience, and equitable distribution.

Vision Alignment

Vision alignment ensures that Tukwila's natural-infrastructure strategy is reinforced by, and coordinated with, the broader regional and state frameworks already shaping urban forestry, climate resilience, and riparian health. Positioning local actions within these established initiatives strengthens policy coherence, improves competitiveness for funding, and ensures that Tukwila's canopy goals advance shared environmental and community outcomes across the region. The following are local and regional strategies where we recommend Tukwila begin to use the results of this assessment to align strategies and policy priorities:

- City of Tukwila Comprehensive Plan (2024–2044) – advancing canopy restoration and climate resilience goals through integrated land use and open space strategies.
- Green Tukwila 20-Year Stewardship Plan – supporting community-based restoration and long-term forest management.
- King County 2025 Strategic Climate Action Plan – aligning with regional climate adaptation, tree canopy equity, and heat mitigation objectives.
- King County 30-Year Forest Plan, Urban Canopy Priority - In King County's 30-Year Forest Plan one of the priority areas is "Urban Canopy": increase tree canopy in urban areas, especially where canopy is lowest; maintain and improve health of existing tree canopy.
- King County Extreme Heat Mitigation Strategy - The Extreme Heat Mitigation Strategy for King County includes tree canopy investments, green infrastructure and outreach in high-heat, low-canopy neighborhoods, multilingual materials, and partnerships with local jurisdictions and organizations.
- WRIA 9 Re-Green the Green: Riparian Revegetation Strategy (Green/Duwamish & Central Puget Sound Watershed) - In the watershed planning area for WRIA 9, the strategy emphasizes revegetation of urban and riparian corridors, which includes tree-planting, urban vegetation, and canopy expansion along streams and urban areas.
- Washington State Department of Natural Resources Urban & Community Forestry Program - Offers education, technical assistance, financial assistance and recognition for municipalities, tribes and counties to develop their tree canopy.
- Washington State HEAL Act – Requiring state agencies to incorporate environmental justice into decision-making and prioritize investments that reduce environmental and health disparities in overburdened communities.[50]

Using Performance Measures to Benchmark Canopy Progress

A consistent, transparent performance-measurement framework is fundamental for demonstrating whether Tukwila's natural-infrastructure investments are producing the intended ecological, equity, and resilience outcomes. Establishing clear indicators enables the city to track progress over time, compare results across neighborhoods and project types, and adjust programs as conditions change or new priorities emerge. Performance measures also strengthen funding applications and policy decisions by providing quantifiable evidence of benefits. Such measures could include:

- Percent increase in total and equitable tree canopy coverage by census tract.
- Acres of invasive species removed or restored to native vegetation.
- Number of community and private property trees planted or maintained.
- Reduction in urban heat exposure and stormwater runoff volume in target areas.
- Annual investment leveraged from public and external funding sources.

These metrics provide a clear framework for measuring how policy and investment decisions translate into measurable ecological and social outcomes—reinforcing the link between Tukwila's sustainability vision and tangible, site-level urban forestry action.

Implementation Roadmap and Workplan

Short-Term Actions (1–2 years)

In the short term, the city should concentrate on actions that reduce uncertainty, build internal capacity, and leverage external partners. This means identifying restoration and planting projects that are already scoped or partially designed—particularly those tied to stormwater or habitat objectives—and aligning them with near-term funding cycles. The city has multiple shovel-ready opportunities in riparian corridors, high-priority park units, and invasive-infested slopes that qualify for regional and state grant programs. These projects can serve as early demonstrations while the fuller Urban Forest Plan is being developed.

- The city could further strengthen coordination with existing regional efforts, particularly the King County basin teams, WRIA 9 salmon recovery partners, and King Conservation District. In the short term, this means jointly reviewing upcoming grant calendars, confirming cost-share structures, and identifying which partners can provide match, design support, or maintenance commitments. A brief annual coordination meeting—focused on project timing, monitoring expectations, and available funding—would reduce duplicated effort and ensure Tukwila maximizes external investment.

- From an administrative standpoint, the city should finalize a shared urban forest dataset. This includes creating and/or consolidating current canopy assessments, tree inventories, stormwater models, and relevant GIS layers into a structured dataset usable across departments. A short-term deliverable could be a unified “baseline conditions” map and a simple scoring framework for prioritizing parcels based on stormwater value, equity gaps, or risk of canopy loss; different tools could be identified tailored to the site conditions, I.E. public/private, parcel/ROW, un/developed, etc. This provides the technical backbone for an “Urban Forest Plan” (detailed later) and strengthens future grant applications.

- The city could further establish basic groundwork on funding cycles. This includes preparing a two-year grant pipeline—built around programs such as the KCD Member Jurisdiction Grants, DNR Urban Forestry grants, and Puget Sound acquisition/restoration funds —and identifying where internal match will or will not be available. At the same time, staff should evaluate long-term funding mechanisms (such as a tree benefit charge, mitigation bank, or stormwater-linked canopy credit) to determine their legal feasibility and administrative burden before committing them to an Urban Forest Plan.

- Finally, the city should begin building predictable governance structures by clarifying the tree canopy roles of different departments and individuals, such as which department leads on permitting standards, which owns long-term maintenance, utilization of City Arborist, etc. Mapping out how interdepartmental coordination will occur is also crucial, I.E. when capital projects affect canopy, responding to acute pest/disease threats, storm recovery, promoting urban forestry Comprehensive Plan goals, etc. An internal protocol—covering information-sharing, BMP’s, coordinated SOP’s, minimum review steps, and documentation standards—can be implemented efficiently.

Medium-Term (3–5 years)

Over the medium term, Tukwila should transition from foundational planning into programmatic implementation and structural changes that secure long-term canopy outcomes. With a unified technical baseline in place, the City can begin applying its prioritization framework to identify where meaningful canopy gains are both feasible and durable. This includes using updated canopy assessments, stormwater modeling outputs, and equity gap analyses to map priority neighborhoods, parcels, and corridors where planting, restoration, or protection will yield the highest combined ecological and community benefits.

- Tukwila already treats trees as functional components of stormwater management and resilience; a dedicated Urban Forest Plan will convert that practice into an explicit, fundable, and enforceable program. A formal plan creates a shared technical basis and governance structure, so canopy outcomes are embedded in capital planning, permits, and maintenance budgets rather than treated as ad-hoc add-ons. It also makes Tukwila more competitive for regional and state funding and aligns municipal action with county and watershed strategies.

  A Tukwila Urban Forest Plan should establish shared goals across departments, integrate regional partners, and unify existing datasets into a single technical foundation that guides canopy protection, planting priorities, stormwater performance, and equity outcomes. The plan would embed three-related standards into capital projects, outline threats, align with regional and state programs, and provide a sustainability road map for City land managers. Engaging in long-term tree maintenance. It should also outline a practical funding strategy that pairs near-term grant opportunities with permanent city-supported financing, supported by a phased implementation workplan and defined staffing roles. Performance indicators—such as canopy change, stormwater benefits, grant leverage, invasive-species reduction, and tree health and survival—would anchor progress tracking, while community engagement and monitoring frameworks ensure adaptive management and long-term accountability.

- During this period, the City should begin identifying canopy gaps that are not readily remedied through existing channels and evaluate viable properties for acquisition or long-term easements. Emphasis should be placed on parcels within canopy-poor critical area buffers, underserved residential blocks, and heat-vulnerable districts—particularly those identified in this report as having limited public land available for canopy expansion. A medium-term goal should be producing a ranked list of acquisition targets, with cost estimates, feasibility constraints, and potential funding mechanisms (e.g., conservation futures, KCD, RCO, and stormwater-aligned acquisition programs).

- The City should also prepare for an update to the Green Tukwila Partnership 20-year stewardship plan. After nearly a decade of implementation, Tukwila has enough performance, cost, and volunteer-engagement data to identify what worked, what failed, and where resources were insufficient. A medium-term effort should incorporate lessons learned from the first cycle—particularly around invasive species recurrence, planting survivorship, steep-slope restoration, and long-term maintenance needs—and translate them into a revised stewardship strategy that is aligned with City staffing and funding realities.

- Regulatory alignment should also become a focus. Tukwila should phase in updated development standards, tree-protection triggers, critical-area buffers, and planting requirements according to best available science, adopted City goals and current case-law. This includes consideration of adding protections for large trees and groves, consideration of canopy coverage goals on the parcel level, canopy coverage over impervious surfaces, and utilizing current legal advice to regulate trees based on the ecosystem services they supply both individual parcels and citywide as green infrastructure. The City should also begin integrating tree-related benefits and obligations into both maintenance activities and in capital project scoping so that road, utility, and parks efforts incorporate canopy actions as standard, not optional, components.

- At this time work should increase interdepartmental tree canopy coordination and add capacity and governance structure. This could include establishing an interdepartmental city lands urban forest working group to coordinate tree canopy strategy on city-owned lands, integrate the City Arborist interdepartmentally, share information, provide grant coordination, and finalizing long-term data management protocols.

- Finally, the medium-term horizon is the appropriate window to pilot incentive programs and private-property engagement models. Simple tools—surface water rebates for tree canopy, neighborhood heat-reduction mini-grants, a Depave pilot program, or voluntary maintenance agreements—can be tested and refined before scaling. These efforts help address canopy deficits on parcels the City cannot acquire or control through regulation alone.

Long-Term (5+ years)

Over the long term, Tukwila should focus on institutionalizing the urban forest program so canopy outcomes become self-sustaining regardless of staffing or budget fluctuations. By this stage, the City should publish the updated Green Tukwila Partnership 20-year stewardship plan and fully integrate its restoration priorities, maintenance cycles, and monitoring commitments into departmental work programs and capital budgeting. This provides a predictable framework for invasive control, long-term planting maintenance, and replacement planning across parks, streetscapes, and natural areas.

- The City should complete updates to the Parks, Recreation, and Open Space (PROS) Plan, incorporating new estimates of park visitation, access patterns, stewardship of and access to natural areas, and community preferences. This allows long-range parks investments—acquisition, amenities, and restoration—to reflect canopy and climate priorities, and ensures that parks planning, adopted City goals, and the (future) Urban Forest Plan reinforce one another rather than operate in separate tracks.

- Long-term work should include expanding land acquisition or easement strategies established in the medium term as contained in the (future) Urban Forestry Plan.
- As regulatory standards mature, the City should evaluate whether its tree and critical area codes, fee-in-lieu structure, and private-property incentives are generating measurable gains and revise them where they underperform.

- Finally, long-term efforts should emphasize durable governance and predictable funding. This includes formalizing recurring revenue sources aligned with stormwater or climate programs; maintaining a consistent monitoring and reporting framework; and ensuring that the City's urban forest position(s) remain supported, that data, models, plans and canopy assessments are updated at regular intervals. Over time, these measures will allow Tukwila to move from project-by-project canopy improvements to a stable, long-horizon urban forest system that reliably delivers stormwater, climate, and community benefits.

Political and Community Buy-In

Political and community support will determine how successful Tukwila's green - infrastructure strategy is moving from analysis into implementation. Building this support requires communication of benefits, visible early successes, and engagement that reflects the priorities of residents, businesses, and elected leaders. Clear communication of benefits is challenging and requires translation in bite-size portions. The following explores techniques to use findings from this analysis to engage different stakeholders.

Engaging Decision Makers and Stakeholders

- ***Supporting materials***: Condensing the analysis into concise, visually clear summaries allow elected officials and department leaders to quickly grasp key findings, funding opportunities, and recommended actions. These briefs can be tailored for different audiences, making the broader technical assessment easier to reference during decision-making processes.

- ***Amplifying performance targets***: Clear, publicly stated metrics—such as canopy goals, equity priorities, or stormwater reductions—give decision makers a concrete way to track progress and signal accountability. Regular assessments on these targets build credibility and keeps natural-infrastructure goals visible across departments and council priorities.
- ***Articulating every investment as a return on investment:*** Framing tree planting, maintenance, and restoration as investments with quantifiable financial and community returns strengthens budget conversations. Using ESV values and other benefits against project cost estimates helps decision makers understand that green infrastructure reduces long-term liabilities, improves public health, and supports climate resilience.
- ***Championing advocates***: Advocates can be local NGOs, key city staff, council members, and passionate community members. Identifying and supporting these champions can accelerate policy momentum, especially when they understand both the technical findings and the political landscape. These advocates help translate canopy goals into organizational priorities and reinforce the message that natural-infrastructure investments are essential city services, not discretionary add-ons. In the City of Redmond, city council members became "Forest Stewards" associated with a program that links the parks department, volunteers, and community groups to restore forested parks and train stewards around urban forestry. [51]

Mobilizing Community Support

- ***Connecting champions with community***: Linking policy champions with neighborhood groups, cultural organizations, and business associations helps ground canopy goals in community experience. These relationships build trust and ensure that investment priorities reflect lived needs, not just technical assessments. Seattle's Trees for Neighborhoods program connects City leadership and urban forestry staff with community organizations and residents to co-develop tree planting priorities, particularly in underserved neighborhoods. [52]
- ***Communicating the value of volunteers***: Highlighting the measurable impact of volunteer labor—from invasive removal to young-tree care—reinforces community ownership and stretches limited city funding. Clear documentation of volunteer contributions also strengthens future grant applications and public recognition efforts.

- ***Push communications that link ecosystem value to health, equity, and livability outcomes***: Simple, repeated messaging that ties tree canopy to cooling, clean air, safer walking conditions, and neighborhood pride helps residents understand the direct benefits to daily life. These narratives make green infrastructure relevant across diverse communities and encourage broader participation.
- ***Leveraging existing programs***: Building established efforts such as Green Tukwila, KCD partnerships, or school-based initiatives allows the city to expand reach without creating new programs from scratch. For example, under the Evergreen Communities Act, Washington Department of Natural Resources (WA DNR) launched the Evergreen Community Recognition Program to incentivize municipalities for commitments to urban forestry. Using and communicating programs like these strengthens community visibility and provides ready-made platforms for engagement and stewardship.

To conclude, a recent study[53] on how sustainability goals influence site-level tree canopy decisions provides several lessons that Tukwila can use to strengthen political and community engagement. Practitioners across North America rely on ecosystem-service framing as a communication tool, because concise, audience-specific messaging about benefits are far more effective than technical reports. The study also reinforces that early wins, visible improvements, and compelling stories about how "more, bigger, healthier trees" serve community well-being resonate strongly with both elected leaders and residents. Finally, the findings highlight how interdepartmental silos and resource constraints undermine alignment with city goals—underscoring the importance of coordinated messaging and clear governance structures in Tukwila's urban forest plan.

Appendix A: Ecosystem Service Framework Details

In 2021, the United Nations Statistical Commission adopted the System of Environmental-Economic Accounting—Ecosystem Accounting (SEEA) as an international statistical standard. Developed through collaboration among statisticians, economists, and ecologists from national statistical offices and international organizations, the SEEA EA provides a spatially based framework for organizing biophysical information about ecosystems and measuring ecosystem services. A key objective is to make visible the contributions of nature to the economy and people while assessing the impacts of economic activity on the environment.[54] This framework establishes a comprehensive reference list of ecosystem services organized into three broad categories according to the types of contributions ecosystems make to human well-being. These categories are as follows:

Provisioning Services

Services that represent the contributions of ecosystems to the benefits that are harvested or captured by humans.

Table 13. Biomass Provisioning Services

Service Name	Description
Crop provisioning services	Ecosystem contributions to the growth of cultivated plants that are harvested by humans for nutrition, materials or energy
Grazed biomass provisioning services	Ecosystem contributions to the growth of biomass that is grazed by livestock for nutrition, materials or energy
Livestock provisioning services	Ecosystem contributions to the growth of animals raised in captivity (e.g., for meat, milk, eggs)
Aquaculture provisioning services	Ecosystem contributions to the growth of aquatic cultivated resources (fish, shellfish, algae) raised in controlled or semi-controlled environments
Wood provisioning services	Ecosystem contributions to the growth of trees and woody biomass in both cultivated and natural settings that is harvested for timber, fuel or other uses

Service Name	Description
Wild fish and other natural aquatic biomass provisioning services	Ecosystem contributions to the growth of naturally occurring fish and other aquatic organisms that are captured or harvested
Wild animals, plants and other biomass provisioning services	Ecosystem contributions to the growth of wild animals, plants and other organisms (excluding aquatic) that are captured, harvested or gathered

Table 14. Other Provisioning Services

Service Name	Description
Genetic material services	Ecosystem contributions generated from wild and cultivated biological diversity that are used as inputs for breeding programs, genetic technologies and other applications
Water supply	The contribution of ecosystems to the movement and regulation of water as it moves through the water cycle and supports the extraction of water for use by economic units

Regulating And Maintenance Services

Services resulting from the ability of ecosystems to regulate biological processes and influence climate, hydrological and biochemical cycles.

Table 15. Mediation of Wastes and Toxics

Service Name	Description
Bio-remediation services	Ecosystem contributions to the treatment and decomposition of organic wastes through the actions of micro-organisms, flora and fauna in terrestrial and aquatic ecosystems
Filtration services	Ecosystem contributions to the filtration, retention or storage of pollutants from the air, freshwater and marine water through abiotic and biotic processes

Table 16. Flow Regulation Services

Service Name	Description
Water flow regulation services	Ecosystem contributions to the regulation of the timing and quantity of water runoff, stream flow, groundwater recharge and timing and magnitude of floods
Storm mitigation services	Ecosystem contributions to the mitigation of the impacts of storm events (including hurricanes, cyclones, tsunamis) through wave attenuation, surge protection, wind resistance
Ventilation services	Ecosystem contributions to the maintenance of favorable atmospheric conditions through influence on air circulation patterns and wind movements
Soil erosion control services	Ecosystem contributions to the retention of soil through the stabilizing effects of vegetation and biotic features of soil
Solid waste remediation services	Ecosystem contributions to the decomposition and assimilation of organic and inorganic materials through burial and accumulation in terrestrial and aquatic ecosystems

Table 17. Maintenance of Physical, Chemical and Biological Conditions

Service Name	Description
Pollination services	Ecosystem contributions to the fertilization of crops and wild plant species through the activity of pollinator species
Biological control services	Ecosystem contributions to the limitation of damage to crops, livestock and human health through the action of predator and parasite species
Nursery population and habitat services	Ecosystem contributions to the maintenance of habitats and ecological connectivity that support the breeding, feeding, resting and migration of species

Service Name	Description
Global climate regulation services	Ecosystem contributions to the regulation of the chemical composition of the atmosphere and oceans that affect global climate patterns, including through CO2 absorption and sequestration
Baseline flow regulation services	Ecosystem contributions to the regulation of baseline flows of water in rivers, streams and aquifers during periods of low precipitation
Local (micro and meso) climate regulation services	Ecosystem contributions to the regulation of local temperature, precipitation and humidity through transpiration, shading and other biophysical processes
Noise attenuation services	Ecosystem contributions to the reduction of the impact of noise through the absorptive and reflective capacities of biological and abiotic structures
Atmospheric composition regulation services	Ecosystem contributions to the regulation of concentrations of atmospheric gases (excluding those linked to global climate regulation) through processes such as air filtration by vegetation

Cultural Services

Services related to the experiential and intellectual interactions people have with ecosystems.

Table 18. Cultural Services

Service Name	Description
Recreation-related services	Ecosystem contributions through the biophysical characteristics and qualities of ecosystems that enable people to engage in recreational activities and derive physical and psychological benefits
Visual amenity services	Ecosystem contributions to local living conditions through the biophysical characteristics and qualities of ecosystems that are

Service Name	Description
	appreciated through viewing or experiencing natural landscapes and seascapes
Education, scientific and research services	Ecosystem contributions to education, training, and the advancement of science through the opportunities for study, observation, experimentation, and knowledge generation provided by ecosystems
Spiritual, artistic and symbolic services	Ecosystem contributions to intellectual and representative interactions where the biophysical characteristics and qualities of ecosystems inspire, inform or are the subject of spiritual connection, artistic expression, cultural identity and other intangible cultural benefits
Other cultural services	Other ecosystem contributions to human well-being through intellectual and representational interactions beyond those explicitly listed above

Appendix B: Module Technical Details

Stormwater

To estimate the stormwater benefits from forest infrastructure in the city, we need to estimate the total interception of water from canopy cover and forest soils. Tree canopy covers both impervious and impervious surfaces.

The simplest form to understand the stormwater benefit from tree canopy cover can be written as stormwater retained per acre of canopy, multiplied by the dollar per cubic foot ($/cf) cost of stormwater management, equals the economic benefit of stormwater capture, or

$$Retention\left(\frac{cf}{acre}\right) x\ Cost\left(\frac{\$}{cf}\right) = benefit\left(\frac{\$}{acre}\right)$$

The first step is estimating stormwater capture from different land covers. The Rational Method uses runoff coefficients for estimating runoff volumes. Runoff coefficients can be used to estimate the total amount of runoff that is generated relative to the total precipitation. King County Department of Natural Resources and Parks produce a Surface Water Design Manual (SWDM), most recently updated November 2024, which outlines relevant runoff coefficients for a wide range of land cover categories. Figure 21 shows the table taken directly from the Surface Water Design Manual. Table 3.2.1.A Runoff Coefficients – "*C*" Values for the Rational Method, outlines "General Land Covers" and their associated runoff coefficients, or *C*. This runoff coefficient is applied to varying storm events to estimate the total volume of runoff from each storm.

TABLE 3.2.1.A RUNOFF COEFFICIENTS - "*C*" VALUES FOR THE RATIONAL METHOD			
General Land Covers		**Single Family Residential Areas***	
Land Cover	*C*	Land Cover Density	*C*
Dense forest	0.10	0.20 DU/GA (1 unit per 5 ac.)	0.17
Light forest	0.15	0.40 DU/GA (1 unit per 2.5 ac.)	0.20
Pasture	0.20	0.80 DU/GA (1 unit per 1.25 ac.)	0.27
Lawns	0.25	1.00 DU/GA	0.30
Playgrounds	0.30	1.50 DU/GA	0.33
Gravel areas	0.80	2.00 DU/GA	0.36
Pavement and roofs	0.90	2.50 DU/GA	0.39
Open water (pond, lakes, wetlands)	1.00	3.00 DU/GA	0.42
		3.50 DU/GA	0.45
		4.00 DU/GA	0.48
		4.50 DU/GA	0.51
		5.00 DU/GA	0.54
		5.50 DU/GA	0.57
		6.00 DU/GA	0.60

* Based on average 2,500 square feet per lot of impervious coverage.
For combinations of land covers listed above, an area-weighted "$C_c \times A_t$" sum should be computed based on the equation $C_c \times A_t = (C_1 \times A_1) + (C_2 \times A_2) + ... + (C_n \times A_n)$, where $A_t = (A_1 + A_2 + ... + A_n)$, the total drainage basin area.

Figure 21. Runoff coefficients selected by King County Department of Parks and Natural Resources.

In this analysis, we are particularly interested in how canopy cover compares to impervious surfaces in retaining stormwater. The "Pavement and roofs" category is the land cover that most resembles impervious surface. The analysis uses dense forest for canopy over pervious and light forest for canopy over impervious. To show the tradeoff between impervious surfaces and canopy cover for stormwater capture, the runoff coefficient for pavement and roofs was subtracted by the runoff coefficient for each other land cover category (excluding open water to avoid the negative runoff value). This results in the reduced runoff for each land cover compared to impervious surface. Table 19 shows the estimated runoff retained relative to impervious.

Table 19. Land cover and associated runoff capture relative to impervious.

Land Cover	Surface Water Design Manual Classifications	Runoff Coefficient (C)	Runoff capture Relative to Impervious
Tree Canopy over Pervious	Dense Forest	0.10	0.80
Tree Canopy over Impervious	Light Forest	0.15	0.75
Non-Canopy Vegetation	Lawns	0.25	0.65
Shrub/Scrub	Pasture	0.20	0.60
Impervious	Pavement and roofs	0.90	0.00
Soil & Dry Vegetation	Gravel Areas	0.80	0.10
Water	Open Water	1	0

With the runoff capture relative to impervious estimated, this can be applied to varying storm events to estimate the total volume of water runoff from landscapes in Tukwila. To estimate the total volume of water runoff, the analysis uses the 2-year, 10-year, 25-year, and 100-year storm events. The King County SWDM show isopluvial maps for each storm event, which outlines the precipitation in inches for each storm event over a 24-hour period. Figure 22 shows the 2-year, 24-hour isopluvial map. These isopluvial maps are overlapped with the land cover map to show how many inches of rain fall on varying acres on the landscape.

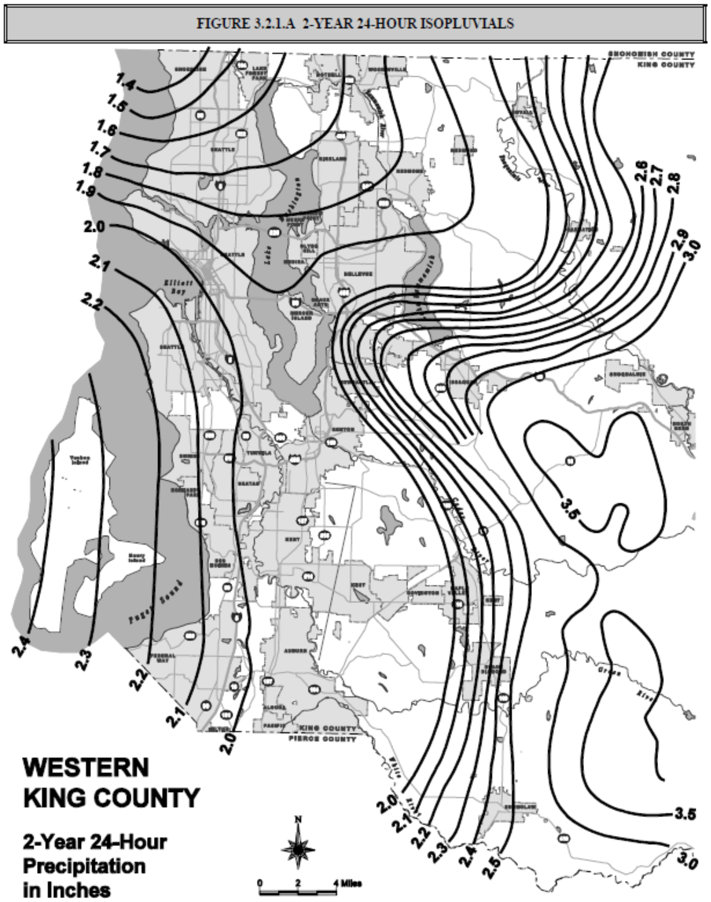


Figure 22. 2-year, 24-hour isopluvials map. Source: King County Surface Water Design Manual (2024).

The precipitation data is used to estimate the cubic feet of runoff from varying land covers. Using GIS, the analysis identifies the acres of each land cover and the precipitation for each storm event, resulting in the inches or rain over each land cover type and the total acres by land cover type. The land cover categories are also separated by those acres within and outside of a riparian buffer. Table 20 shows an example of the outputs provided for the 2-year storm.

Table 20. 2-year storm event rainfall, riparian, and acreages for impervious, canopy over impervious, and canopy over pervious.

Land Cover	Storm	Rainfall (inches)	Riparian	Acres
Tree Canopy over Pervious	2	1.9	Y	486.8
Tree Canopy over Impervious	2	1.9	Y	20.1
Impervious	2	1.9	Y	267.9
Tree Canopy over Pervious	2	1.9	N	818.4
Tree Canopy over Impervious	2	1.9	N	106.6
Impervious	2	1.9	N	2286.4
Tree Canopy over Pervious	2	2	Y	21.9
Tree Canopy over Impervious	2	2	Y	1.5
Impervious	2	2	Y	30.2
Tree Canopy over Pervious	2	2	N	28.3
Tree Canopy over Impervious	2	2	N	7.2
Impervious	2	2	N	492.6

Similar outputs are provided for the 10-year, 25-year, and 100-year storm events. With this information, we can calculate the total acre-inch of water volume (inches of rain multiplied by acres of land cover). Acre-inches can be converted to cubic feet (CF). The total CF of water volume that falls on each land cover type is multiplied by the runoff capture relative to impervious to estimate the total water volume retained by each land cover type. Table 21 shows those calculations with the 2-year storm. Impervious acreages are excluded from the calculation because stormwater capture estimates are relative to impervious land cover.

Table 21. 2-year storm event water volume and runoff capture volume.

Land Cover	Rainfall (inches)	Riparian	Acres	Water Volume (Acre-Inch)	Runoff Capture Relative to Impervious	Runoff Capture Volume (CF)
Tree Canopy over Pervious	1.9	Y	486.8	924.9	0.8	2,685,836.27
Tree Canopy over Impervious	1.9	Y	20.0	38.1	0.75	103,776.03
Tree Canopy over Pervious	1.9	N	818.4	1555.0	0.8	4,515,757.54
Tree Canopy over Impervious	1.9	N	106.6	202.5	0.75	551,334.87
Tree Canopy over Pervious	2	Y	21.9	43.8	0.8	127,316.35
Tree Canopy over Impervious	2	Y	1.5	2.9	0.75	7,897.67
Tree Canopy over Pervious	2	N	28.3	56.7	0.8	164,533.17
Tree Canopy over Impervious	2	N	7.2	14.4	0.75	39,110.58
Total			1,490.7	2,838.3		8,195,562.48

For the 2-year storm, canopy cover retains over 8 million cubic feet of water over a 24-hour period. This same process is applied to the 10-year, 25-year, and 100-year storms. The total runoff capture volumes by storm event are summarized in Table 22.

Table 22. Total runoff capture volume.

Storm Event	Runoff Capture Volume (CF)
2-year	8,195,562.48
10-year	12,134,109.04
25-year	14,204,970.32
100-year	16,898,565.08

These are storm events which are designated based on the probability of each event occurring. To annualize the impact of each storm event, the analysis uses the probability of the storm event occurring using the annual exceedance probability (AEP). For these storm events, the probability of occurrence in any given year is shown in Table 23.

Table 23. Annual exceedance probability by storm event.

Storm Event	Annual Exceedance Probability
2-year	50%
10-year	10%
25-year	4%
100-year	1%

Multiplying the annual exceedance probability by the total runoff capture volume results in the annualized runoff capture benefit of canopy coverage. To estimate the avoided cost of stormwater management from canopy coverage in Tukwila, the analysis applies stormwater infrastructure costs which are provided in dollars be cubic feet ($/CF). Table 24 shows a range of stormwater infrastructure costs from a variety of sources.

Table 24. Stormwater infrastructure costs.

Infrastructure Types	Study	2025 USD
Retention Basin (Low)	USEPA, 2009	$0.94
Retention Basin (High)	USEPA, 2009	$1.87
Wet Pond - Medium Density Residential	King County, 2012	$1.04
Wet Pond - Low Density Residential	King County, 2012	$1.28
Large Detention Basin	Barr, 2011	$2.87
Bioretention System	Ballestero, 2005	$7.96
Surface Sand Filter	Ballestero, 2005	$14.63
Detention Basin	Skragg et al., 2020	$0.85

The analysis uses the Retention Basin (Low and High) stormwater infrastructure costs as a conservative estimate of the avoided cost of stormwater infrastructure. The Retention Basin values provided show the $/CF value between $0.94 and $1.87 in 2025 dollars. These values are applied to the annualized capture volume to estimate the annual benefit in stormwater capture from canopy cover. The results are shown in Table 25.

Table 25. Stormwater benefits.

Storm Event	Runoff Capture Volume (CF)	Annual Exceedance Probability	Annual Benefit, Low	Annual Benefit, High
2-year	8,195,562.48	50%	$3,847,156.57	$7,643,017.73
10-year	12,134,109.04	10%	$1,139,197.40	$2,263,205.50
25-year	14,204,970.32	4%	$533,447.17	$1,059,781.71
100-year	16,898,565.08	1%	$158,650.31	$315,185.28
Total			$5,678,451.45	$11,281,190.22

The annual benefit from stormwater capture from tree canopy is between $5 million and $11 million.

Water Quality

To estimate the water quality benefits from forest infrastructure in the city, we need to estimate the total interception of water from canopy cover and forest soils. Tree canopy covers both impervious and impervious surfaces. This format follows the same methodology as the stormwater module as shown above.

The simplest form to understand the water quality benefit from canopy cover can be written as rainfall retained per acre of canopy, multiplied by the dollar per cubic foot ($/cf) cost of water treatment, equals the economic benefit of water quality, or

$$Water\ Volume\ \left(\frac{cf}{acre}\right) x\ Cost\ \left(\frac{\$}{cf}\right) = benefit(\frac{\$}{acre})$$

To see the technical details of the rainfall and stormwater capture estimates, see the Stormwater section above. The resulting water volume capture from canopy cover in Tukwila is shown in Table 26. The water volumes are separated by riparian and non-riparian land cover.

Table 26. Stormwater capture by land cover and riparian status.

Land Cover	Riparian Status	Sum of Annualized Capture
Tree Canopy over Pervious	Riparian	2,076,194.63
Tree Canopy over Impervious	Riparian	82,400.85
Tree Canopy over Pervious	Non-Riparian	3,454,026.65
Tree Canopy over Impervious	Non-Riparian	435,754.48
Total	Total	6,048,376.61

This total water volume is applied to several water treatment cost estimates to calculate the avoided cost of water treatment from tree canopy cover. The water treatment cost estimates rely on two case studies reported by the EPA: 1) a water reuse case study from Fairfax County, Virginia and 2) a water reuse cases study from Richmond Hill, Georgia. The project highlights are shown below (Table 27).

Table 27. Water treatment cost case studies.

Category	Richmond Hill, GA	Fairfax County, VA
Treatment Capacity (gallons per day)	3 million	6.6 million
Overall Cost	$25 million	$16 million
Source of Water	Treated municipal wastewater	Treated municipal wastewater
Reuse Application	Landscape irrigation; Environmental restoration	Non-potable landscape and irrigation; industrial

Using these project highlights, the dollar per cubic foot cost of water treatment can be estimated. There are two methods used in this analysis to annualize the capital costs associated with each treatment plant: 1) average annual amortized cost and 2) equivalent annual cost. For the average annual amortization cost, the analysis uses an amortization schedule using an escalation rate (i.e., inflation) and discount rate to estimate the annual cost of capital over the life of the project. The lifespan of the project is assumed to be 30 years. The escalation rate used is the target inflation rate (2%) as set by the Federal

Reserve. The discount rate used is the US Army Corps of Engineers discount rate for water resource projects (3%). The cost per cubic foot is calculated by taking the overall cost divided by the treatment capacity. The values used for the amortization schedule are shown in Table 28.

Table 28. Case study details for calculating water treatment costs.

Category	Richmond Hill, GA	Fairfax County, VA
Project lifespan	30 years	30 years
Escalation Rate	2%	2%
Discount Rate	3%	3%
Cost per cubic foot	$62.34	$18.13

The cost per cubic foot is divided by the number of years the project will last, which is assumed to be 30 years. That cost per year estimate is then escalated and amortized over the 30-year period to estimate the average annual amortized cost. With these project details, the amortization schedule is shown in Table 29.

Table 29. Amortization calculation for each case study.

	Richmond Hill, GA		Fairfax County, VA	
Year	Escalated	Amortized	Escalated	Amortized
0	$2.08	$2.08	$0.60	$0.60
1	$2.12	$2.06	$0.62	$0.60
2	$2.16	$2.04	$0.63	$0.59
3	$2.21	$2.02	$0.64	$0.59
4	$2.25	$2.00	$0.65	$0.58
5	$2.29	$1.98	$0.67	$0.58
6	$2.34	$1.96	$0.68	$0.57
7	$2.39	$1.94	$0.69	$0.56
8	$2.43	$1.92	$0.71	$0.56
9	$2.48	$1.90	$0.72	$0.55
10	$2.53	$1.88	$0.74	$0.55
11	$2.58	$1.87	$0.75	$0.54
12	$2.64	$1.85	$0.77	$0.54
13	$2.69	$1.83	$0.78	$0.53
14	$2.74	$1.81	$0.80	$0.53
15	$2.80	$1.80	$0.81	$0.52
16	$2.85	$1.78	$0.83	$0.52
17	$2.91	$1.76	$0.85	$0.51
18	$2.97	$1.74	$0.86	$0.51
19	$3.03	$1.73	$0.88	$0.50
20	$3.09	$1.71	$0.90	$0.50
21	$3.15	$1.69	$0.92	$0.49
22	$3.21	$1.68	$0.93	$0.49
23	$3.28	$1.66	$0.95	$0.48
24	$3.34	$1.64	$0.97	$0.48
25	$3.41	$1.63	$0.99	$0.47
26	$3.48	$1.61	$1.01	$0.47
27	$3.55	$1.60	$1.03	$0.46
28	$3.62	$1.58	$1.05	$0.46
29	$3.69	$1.57	$1.07	$0.46

The annual cost over the lifetime of the project is then averaged over the period to reflect the annual average amortized cost of the project. This average annual amortized cost is shown in Table 30.

Table 30. Estimated average annual amortized cost per cubic foot for each case study.

Project	Average Annual Amortized Cost per Cubic Foot
Richmond Hill, GA	$1.81
Fairfax County, VA	$0.53

The second method for estimating the annual cost of capital is the equivalent annual cost method. This method relies on the following formula, also called the annuity factor.

$$Annuity\ Factor = \frac{1 - \left(\frac{1}{(1+r)^t}\right)}{r}$$

Where *r* is the discount rate, and *t* is the project lifespan. Using the discount rate, 3%, and the project lifespan, 30 years, the resulting annuity factor is 19.6. The cost per cubic foot is divided by the annuity factor to estimate the equivalent annual cost, shown in Table 31.

Table 31. Estimated equivalent annual cost per cubic foot of water treatment.

Project	Equivalent Annual Cost
Richmond Hill, GA	$3.18
Fairfax County, VA	$0.93

The clear distinction between these two case studies is the reuse application after treatment. The Richmond Hill, GA case study can be applied to landscape irrigation and environmental restoration, compared to the Fairfax County, VA case study which can only be used for non-potable landscape, irrigation, and industrial applications. The ability for water reuse to be applied to environmental restoration speaks to the level of water quality available from the Richmond Hill treatment plant. The analysis assumes that the Richmond Hill, GA case study would be a more appropriate riparian habitat benefit, as the water treatment required to ensure riparian habitat does not negatively impact water bodies would need to be at higher quality than the treatment plant in Fairfax County, VA. For this reason, the analysis applies the Richmond Hill, GA case study values to riparian land cover and the Fairfax County, VA case study values to non-riparian land cover.

The two methods to annualize capital cost shown above provide a range of values that can be applied to the annualized water volume captured by canopy cover.

Table 32. Annual water quality benefits.

Land Cover	Riparian Status	Low Value	High Value
Tree Canopy over Pervious	Riparian	$3,758,438.17	$6,603,174.22
Tree Canopy over Impervious	Riparian	$149,166.41	$262,069.43
Tree Canopy over Pervious	Non-Riparian	$1,818,956.54	$3,195,712.26
Tree Canopy over Impervious	Non-Riparian	$229,476.65	$403,165.95
Total	Total	$5,956,037.77	$10,464,121.86

Air Quality

To estimate air quality benefits of tree canopy cover in the City of Tukwila, this analysis uses i-Tree Landscape, which applies established, peer-reviewed relationships between tree canopy and pollutant removal. Rather than measuring individual trees, Landscape combines local hourly air-pollution and meteorological data with canopy extent to estimate how much pollution is removed by vegetation through processes such as deposition and interception, producing area-based ecosystem service values appropriate for scenario analysis.

Landscape allows for the selection of Census Block Groups to estimate the benefits of trees using local hourly pollution data and other meteorological data. Landscape is specifically a web-based tool. To implement the tool, the analysis selected all Census Block Groups that overlap with the City of Tukwila. Figure 23 shows the Census Block Groups that were selected in the analysis.

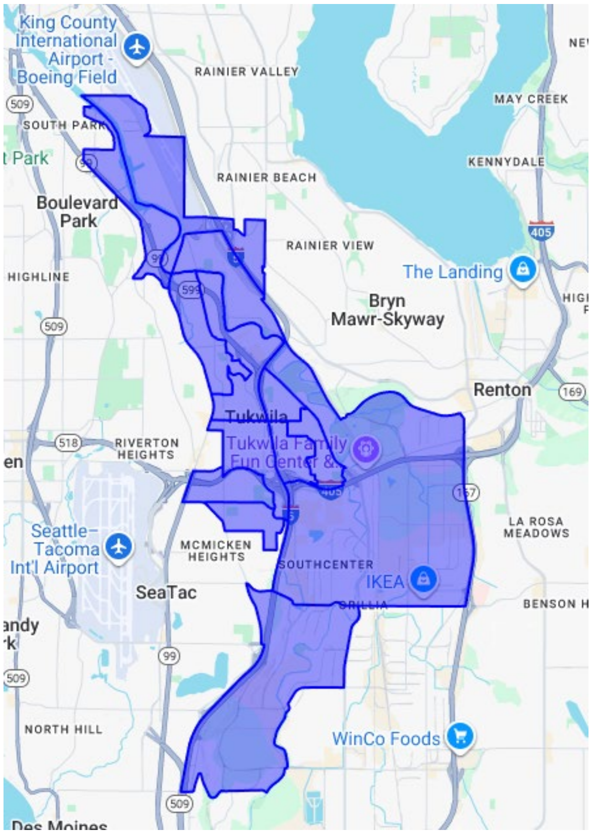


Figure 23. Selected Census Block Groups to estimate air quality benefits from i-Tree.

The only major discrepancy in the Tukwila City boundary and the Census Block Groups selected is the eastern portion of the map east of Southcenter towards Highway 167. To account for this, the analysis uses the land cover and air pollution metrics to estimate a per acre benefit of canopy cover that can be applied to the PlanIT Geo land cover assessment data which was provided to us for the analysis. The outputs from the air pollution model include CO, NO_2, O_3, $PM_{2.5}$, SO_2, and PM_{10}. Impacts include the pounds per year (lb/year) captured by canopy cover and the associated dollar per year ($/year) benefit from that air pollution capture. Additionally, some of the pollutants include health related impacts such as hospital admissions, acute respiratory symptoms, asthma exacerbation, and school loss days. These are reported as avoided health impacts from canopy cover. Table 33 shows the pollutants, the lb/year absorbed, and $/year benefits from the i-Tree model run for the area represented in Figure 23.

Table 33. i-Tree outputs by pollutant.

Pollutants	lbs./yr	$/yr
CO	1,853.4	$1,278
NO_2	20,081.2	$4,818
O_3	50,093.6	$93,664
$PM_{2.5}$	2,370.2	$339,187
SO_2	2,230.0	$181
PM_{10}	33,261.3	$107,861

The health-related benefits from the i-Tree model run are shown in Table 34.

Table 34. Health-related impacts from air quality benefits. Source: i-Tree.

Pollutants	Emergency Room Visits	Hospital Admissions	Acute Respiratory Symptoms	Asthma Exacerbation	Mortality	School Loss Days	Hospital Admissions, Respiratory
CO	0	0	0	0	0	0	0
NO_2	11.51	0.15	151.92	57.28	0	0	0
O_3	223.24	2.99	1091.03	0	0	949.89	0
$PM_{2.5}$	814.74	0	3445.89	4154.88	0.02	0	10.54
SO_2	0.42	0	5.71	2.27	0	0	0
PM_{10}	0	0	0	0	0	0	0

The i-Tree model estimated approximately 1,802.7 acres of canopy cover in the study area selected. This is used to estimate the per acre value for each of the outputs. Table 35 shows the per acre values for both captured pollutants and the associated dollar values.

Table 35. i-Tree outputs converted to per acre values.

Pollutants	lbs./yr	$/yr
CO	1.03	$0.71
NO_2	11.14	$2.67
O_3	27.79	$51.96
$PM_{2.5}$	1.31	$188.15
SO_2	1.24	$0.10
PM_{10}	18.45	$59.83

Applying these per acre values to the acres of canopy in the City of Tukwila, we can estimate the total air quality benefits from tree canopy in Tukwila.

Table 36. Estimated air quality benefits applied to City of Tukwila tree canopy cover.

Pollutants	Value
CO	$1,057.02
NO_2	$3,984.93
O_3	$77,468.81
$PM_{2.5}$	$280,539.09
SO_2	$149.70
PM_{10}	$89,211.05
Total	$452,410.61

The analysis shows that the tree canopy in Tukwila provides over $450,000 in air quality benefits annually.

Cool Air

To estimate the cool air benefits of tree canopy cover in the City of Tukwila, we calculate the increased healthcare costs and reduced utility costs associated with tree canopy cover. There is significant evidence that canopy cover can reduce urban heat, thereby reducing heat-related illnesses and air-conditioning costs. Table 37 shows several studies of park areas and how these large areas impact summer daytime temperatures.

Table 37. Literature review of canopy cover impacts on summer daytime temperatures.

Study	Park size (acres)	Cover	Location	Climate	Summer daytime air temperature reduction	Measurement specification
Taha et al. 1991	12.13	Small trees (H=5m, 25% canopy); belt of tall evergreens (90% cover)	Davis, CA (USA)	Mediterranean hot dry summer	5.5 °C	Peak temp reduction (17:00) 12m downwind of >300m canopy vs upwind open field; October, clear sky
Taha et al. 1991	12.13	Small trees (H=5m, 25% canopy); belt of tall evergreens (90% cover)	Davis, CA (USA)	Mediterranean hot dry summer	1.5 °C	Same as above, but 112m downwind
Spronken-Smith & Oke 1998	3.46	Botanical garden	Sacramento, CA (USA)	Mediterranean hot dry summer	1.2 °C	Max summer daytime (Aug) difference vs non-park
Spronken-Smith & Oke 1998	988.4	Dense conifer rainforest (Stanley Park)	Vancouver, BC (Canada)	Mediterranean cool summer	4.0 °C	Max daytime difference vs non-forest
Taleghani et al. 2014	n/d	Heavily treed park	Portland, OR (USA)	Mediterranean warm	5.8 °C	Max temp difference heavily treed park vs parking lot

In addition to large open spaces, smaller scale canopy has been shown to reduce summer daytime temperatures. Work by Streiling & Matzarakis (2003) shows that tree clusters or even a single tree can reduce daytime air temperatures by over 1.4 degrees Fahrenheit. Several studies have examined canopy wide increases and the effects on temperature. Table 38 shows several studies which point to temperature reductions due to changes in canopy cover.

Table 38. Literature review of large scale or city-wide canopy cover impacts on summer daytime temperatures.

Study	Model Used	Canopy change	Summer daytime air temperature effect	Note
Wang et al. 2024	Meta-analysis	+1%	-0.18ºC	City Level, sampled from Baltimore, Sacramento
Kroeger et al. 2018	Meta-analysis	+15%	-1.3 to 1.7 ºC	Analysis of 27 US cities, reduction in peak temperatures
Lungman et al. 2023	Meta-analysis	+15%	-0.4 ºC	Increase in canopy from 15% to 30%, specific to European cities
City of Seattle OSE Office 2021 Tree Canopy Assessment	2016 LiDAR + UTC Analysis	+13%	-0.5 ºC	Based on 2016 canopy data

Canopy-wide assessments related to temperature show much smaller effects compared to smaller scale analysis. This is largely due to the scale at which temperature estimates are being made. The tree canopy's ability to reduce temperatures is spatially explicit, meaning that the primary benefit is to the area near canopy cover.

For the health-related impacts, the analysis relies on results from Jageler et al. (2024), as presented to the Association of Environmental and Resource Economists, which shows that for every 10 additional days of extreme heat above 90 degrees, annual Medicare transfer payments increase by nearly 1%, equivalent to a $11.78 (2024$) increase per capita.

To apply this increase per capita in Medicare costs, the analysis estimates the number of individuals on Medicare living in the City of Tukwila. Approximately 12.8% of King County residents are Medicare enrollees. If we apply that percentage to the population in Tukwila (approximately 21,000), the estimated number of individuals on Medicare is between 2,300 and 2,600 people.[8] The estimated number of days that are 90 degrees or more in Tukwila are 8 days per year. Using the increased Medicare costs per person, the number of individuals on Medicare, and the number of days over 90 degrees, we can estimate the increased health costs from urban heat. Table 38 shows the calculation.

[8] Local reviewers suggested this value was an underestimate. Lack of available data did not allow for more local figure.

Table 39. Estimates of healthcare impacts from urban heat.

Category	Value, Low	Value, High
Increased Medicare payments per ten days over 90°F	$11.78	$11.78
Individuals on Medicare	2,300	2,600
Number of days over 90°F	8	8
Increased Costs	$21,675.20	$24,502.4

In addition to increased medical costs, shading from urban canopy cover can reduce utility costs through reduced air conditioning use. Endreny et al. (2018) estimated the utility savings from tree canopy using i-Tree in large urban centers globally and found a utility savings of approximately $1,934.40 per acre of canopy cover. There have been local efforts to estimate utility savings from canopy cover. The Green Cities Research Alliance (2012) conducted a residential utilities savings analysis in the City of Seattle. The authors found that the total canopy cover of 15,167 acres resulted in $5.9 million in 2011 dollars. This is a utility savings of $389 per acre. Inflating to 2025 dollars, which is $561.72 per acre. Applying this to the canopy cover in Tukwila results in $818,524 in utility savings.

Ground Stability

To estimate the benefit of ground stability in the City of Tukwila, the analysis relies on the rate of extreme storms, the probability of slides on unstable slopes, and the difference in slope stability between forested and unforested slopes.

The analysis uses 50-year and 100-year storms, which have an event probability of 2% and 1%, respectively. To estimate the probability of shallow slides in unstable zones, the analysis relies on Dietrich et al. (2001), which provides a validation of the Shallow Landslide Model (SHALSTAB) for forest management. The analysis found that the probability of shallow slides in unstable zones is between 60% and 80%. Forested areas in these unstable zones saw a 30% to 50% reduction in landslide events relative to non-forested areas. With this information, GIS is used to identify the acres of unstable areas as defined by FEMA Unstable Areas and existing landslide inventory. The analysis relies on parcel data and assessed values to identify the buildings that are at risk from landslides. With this information, an estimate of landslide damages can be estimated using scenarios of both forested and unforested slopes. The difference between the two scenarios is the benefit of slope stability from canopy cover in Tukwila. The description of variables is shown in Table 40.

Table 40. Slope stability variables, descriptions, and results.

Category	Value, Low	Value, High
Storm Event Probability	2%	1%
Probability of Shallow Slides in Unstable Zones	60%	80%
Reduction Risk from Forested Slopes in Unstable Areas	30%	50%
Acres of Unstable Areas	525.04	525.04
Assessed Property Value of Properties at Risk	$900,566,606	$900,566,606
Damages with unforested slopes	$7,204,533	$10,806,799
Damages with forested slopes	$3,602,266	$3,242,040
Reduction in Damages Attributed to Canopy	$3,602,266	$7,564,759
Per Acre Benefit	$6,860.94	$14,407.97

Access to Nature

Exercise in Parks and Greenspaces

The health benefits of exercise in nature were calculated using the data points below.

- **Average annual medical care cost difference between active and inactive adults (2019$)**
  Based on a peer-reviewed study[55] in *American Journal of Health Promotion*, which provides age-specific low and high estimates of excess medical spending attributable to physical inactivity (ranging from $800–$2,500 depending on age cohort). A weighted average cost differential ($1,026–$1,514) was calculated from the same source by applying age-distribution weights to the reported cost ranges to generate an overall per-person estimate.

- **Tukwila residents living within a 10-minute walk of a park (19,508)**
  Drawn from Trust for Public Land's ParkServe database, which reports walk-access populations for U.S. cities using network-based accessibility analysis.
- **Share of exercise occurring in parks for individuals living within 0.5 miles**
  Based on the NIH-indexed study[56] evaluating how proximity to parks influences physical activity behavior; the study quantifies the proportion of total exercise time that occurs in parks for residents within a half-mile distance.
- **Share of Tukwila residents meeting physical-activity recommendations (15.4%)**
  Taken from King County's City Health Profiles dataset,[57] which reports local adherence to CDC physical-activity guidelines using population-level surveillance data.

Mental Health Benefits

The mental health benefits of exposure to nature were calculated using the data points below.

- **All-cause healthcare cost for adults newly diagnosed with major depressive disorder (2021$)**
  Drawn from a peer-reviewed analysis published in the *Journal of Managed Care & Specialty Pharmacy*,[58] which reports mean annual healthcare spending of $10,074 for newly diagnosed adults.
- **Population of Tukwila within a 10-minute walk (19,508)**
  Drawn from Trust for Public Land's ParkServe database, which reports walk-access populations for U.S. cities using network-based accessibility analysis.
- **Share of Tukwila population experiencing mental health conditions**
  Uses the National Alliance on Mental Illness (NAMI) Washington State fact sheet[59] indicating that approximately one in five adults experience a mental health condition annually; applied as a 20 percent prevalence assumption for Tukwila.
- **Share of individuals with mental health conditions who benefit from park exposure (between 16% and 23%)**
  Derived from the cited academic study evaluating mental-health-related improvements associated with park engagement; the study reports multiple benefit estimates depending on method and sample.

Urban Center Property Value

To estimate the value of tree canopy in urban centers, the benefit transfer method (BTM) was employed. BTM allows for the estimation of ecosystem service values at varying scales when analysis of primary data is unavailable. This is achieved by transferring values estimated in a previous study (i.e., study or source site) in a different location, to the area of interest, or target location (i.e., policy or target site). There are two primary forms of benefit transfer: unit value transfers and function transfers.

Currently, multiple academic articles and federal agencies publish criteria and best practices to ensure valid benefit transfer. Criteria were first recommended by Boyle and Bergstrom[60], which states that, under ideal conditions, the study and policy sites, populations, and welfare measures are matched as closely as possible. Since then, guidelines have been proposed to ensure appropriate value transfer when variation in study and policy site is present. These guidelines were used to conduct benefit transfer value estimates of Tukwila tree canopy.

Transfer studies primarily used in this analysis came from McPherson et al 2005[61] and Nowak et al 2002.[62] Both provide multiple ecosystem service values per acre of urban forest canopy in various US cities. Multiple environmental contexts are associated with these values, including differences in the value of trees in urban centers within proximity to a waterway, such as a river. These estimates were extracted, converted to 2025 dollars, and applied to each acre of canopy in the Tukwila urban centers. A summary of this data is provided in Table 41.

Table 41. ESV of Tree Canopy by Urban Center and Riparian Context

Land Cover	Urban Center	Within Riparian Buffer?	Acres	Low ESV	High ESV
Tree Canopy	Tukwila Int'l Blvd	N	40.41	$25,706	$25,706
Tree Canopy over Impervious	Tukwila Int'l Blvd	N	10.57	$6,724	$6,724
Tree Canopy	Tukwila Int'l Blvd	Y	11.21	$68,321	$100,683
Tree Canopy over Impervious	Tukwila Int'l Blvd	Y	0.82	$4,998	$7,365
Tree Canopy	Tukwila Urban Center	N	52.88	$33,638	$33,638
Tree Canopy over Impervious	Tukwila Urban Center	N	25.5	$16,221	$16,221
Tree Canopy	Tukwila Urban Center	Y	45.45	$277,000	$408,211
Tree Canopy over Impervious	Tukwila Urban Center	Y	3.23	$19,686	$29,010

Appendix C: Details of Invasive Species Restoration ROI

Ecosystem service value of Tukwila park restoration was based on three primary factors.

1. ESV calculations from the modules presented in this report
2. Value of ecosystem services diminished by ivy, blackberry, and laurel.
3. Recovery of ecosystem service value following restoration activities.

ESV Calculations from Modules

Per acre ecosystem services were taken from three of the six modules presented above. Stormwater, Air Quality, and Access to Nature module values were considered in this ROI calculation due to the impact of invasive species on foliation and access to trails. Water Quality, Cool Air, and Ground Stability modules were excluded due to the lack of impact from invasive species on functions provided by the forest related to these modules.

Total ESV was calculated using per acre value multiplied by all acres of the park identified as having invasive species presence (4.26 acres) adjusted by the percentage of the invasives addressed by restoration activities (approximately 70% according to city staff).

Diminished Ecosystem Service Value from Invasive Species and Restoration Recovery

The reduction in ESV was estimated using literature that studied the impact of English ivy on tree canopy in Seattle Parks.[63] That study found that plots with a heavy ivy presence in parks comparable to Tukwila Park exhibited a 53.7% reduction in native canopy relative to plots without ivy. This reduction factor was applied to total ecosystem service values to estimate diminished benefits in the Stormwater and Air Quality modules, reflecting canopy-related impacts. Recovery time following restoration was also derived from the same study, which included a five-year observation plot showing that areas where ivy was removed were not significantly different from never-invaded plots after five years. Accordingly, a five-year recovery period was assumed for year-over-year asset value calculations.

A different approach was taken for the Access to Nature module. Working with Tukwila staff, the estimated impact due to Laurel and Himalayan Blackberry before restoration was described as about 50% of trails having hindrance or blockages when the vegetation was not maintained. This estimate 50% reduction value was assumed and associated with the calculated value of Access to Nature per acre estimates. Recovery rates were based on restoration activity timeframes where, after initial removal of invasive species, two additional weeding and treatment rounds were required, on average, to eradicate invasive species. As done above, this 3-year recovery rate was assumed in the year-over-year asset value calculation.

Return on Investment Calculation

Converted to 2025 dollars, the cost of restoration was estimated to be $51,923. Over 70% of a restored Tukwila Park (4.26 acres), the total cost is approximately $154,731.

Benefits were measured using estimates of pre-restoration and post-restoration ecosystem service value, using defoliation induced by English ivy as a proxy for ecosystem service capacity, or services provided. Only two modules were included in the analysis related to the impact of defoliation: Stormwater and Air Quality modules. The estimated reduction in ecosystem service capacity was ~53.7%. A third module was included in the scope of the analysis: Access to Nature. Presence of Himalayan Blackberry and Laurel, when left unchecked, block trails and pathways. This impact was estimated to be approximately 50%, reducing the ecosystems service value by half.

Recovery following restoration, or the time required for the impact of invasive species to be mitigated, was assumed a straight-line recovery over the assumed recovery time period. For example, for both Stormwater and Air Quality modules, the defoliation recovery period was assumed to be 5 years. This estimate was based on recovery timeframes cited in the literature related to English ivy referenced above.[64] In this case, if ecosystem service value was diminished by 53.7%, one year following restoration, value was diminished by only 42.96% (or four-fifths of 53.7%). Along similar lines, the recovery time for Access to Nature was only three years. This was based on data gathered from volunteer efforts on the phases required to remove, treat, and finally eradicate blackberry and laurel invasive species.

Appendix D: Detail on Funding Mechanisms

Funding Source	Typical award / size	Requirements (typical)	Summary / fit for Tukwila
Washington State — DNR Urban & Community Forestry / Evergreen Washington passthrough	WA DNR distributed $7–8M (2024 passthrough); individual WA awards commonly $10,000–$350,000.	Applicants: cities, counties, tribes, nonprofits. Projects must meet community forestry objectives, equity considerations, and often reporting/monitoring requirements.	Highly relevant: state program is tailored to WA jurisdictions, supports both planting and community capacity building, and often leverages USDA U&CF funds passed through the state. Tukwila should prioritize these grants for neighborhood canopy and stewardship projects.
King County — 3 Million Trees / Community Climate Resilience Grants & related programs	Varies by program; county campaigns and grant rounds typically range $10,000–$500,000 depending on project scope.	Non-profit (501C3), community groups, and partners can apply; emphasis on equity, community stewardship, and measurable climate/health outcomes.	King County initiatives provide both technical support and direct funding for city-scale planting campaigns and community projects; strong match to Tukwila's Green Tukwila objectives and neighborhood equity targeting.
WRIA 9 / Local Salmon Recovery & Re-Green the Green funds	Project funding typically $10,000 – $500,000+ per project depending on source (SRFB/PSAR/RCO allocations). govlink.org	Funds require alignment with salmon recovery priorities, watershed planning, and often local match; projects generally focus on riparian revegetation, acquisition, and restoration.	For riparian canopy and streamside revegetation, WRIA9 funding is directly applicable; packaging tree planting as salmon-habitat restoration increases access to these funds. govlink.org
NOAA & Puget Sound Partnership / RCO (state) — Estuary and Salmon Restoration Program (ESRP) & RCO grants	State RCO rounds frequently total millions across programs; single awards vary widely ($50k–$5M depending on program).	Projects must support Puget Sound recovery priorities, estuary/shores restoration, or salmon recovery; strong technical justification and matching funds typical.	Strategic fit for larger shoreline or estuary projects where tree canopy expansion and bank revegetation are core restoration actions. Tukwila can pair municipal commitments with RCO-eligible project designs.
National Fish & Wildlife Foundation (NFWF) — Five Star & Urban Waters; other initiatives	Program funding rounds often award $25,000–$300,000+ per project; national competitions can be larger.	Projects require local partnerships, community engagement, and measurable habitat/water quality outcomes; match is typically required.	NFWF programs are well-suited to community-led planting, invasive removal, and urban watershed projects, and they emphasize volunteer engagement — a good match for Tukwila's Green Tukwila partnerships.

Funding Source	Typical award / size	Requirements (typical)	Summary / fit for Tukwila
EPA — Competitive Grants (Climate Pollution Reduction Grants, Environmental Justice & Urban Waters programs)	Large national programs (CPRG/IRA funds) total hundreds of millions to billions across competitions; individual awards vary widely (from ~$100k to multi-million).	Applicants: states, metro areas, tribes, local governments, and consortia; projects must reduce pollution, address environmental justice, or improve community health. Competitive scoring favors measurable emissions/benefit outcomes and strong local partnerships.	If Tukwila partners with county/regional consortia and frames canopy projects as air-pollution/heat-mitigation or EJ investments, the city can be included in larger multi-jurisdictional applications that access these larger funding pools.
USDA Forest Service — Urban & Community Forestry (U&CF)	Federal program historically ~$30–40M annually; state/local challenge grants and passthroughs: WA DNR distributed ~$7–8M in 2024; individual awards commonly range $10,000–$350,000.	Local governments, tribes, non-profits eligible; projects must advance urban/community forestry outcomes (planting, stewardship, training). Matching or in-kind leverage often encouraged.	Primary source for planting, technical assistance, workforce/training and capacity building; Washington DNR passthroughs make this especially accessible for Tukwila projects, and award sizes match neighborhood-to-city scale initiatives.
FEMA — Building Resilient Infrastructure & Communities (BRIC)	Large awards; project funding often ranges from hundreds of thousands to tens of millions depending on scale and whether submitted by state/tribal applicants.	States or large sub-applicants typically apply; projects must demonstrate mitigation, substantial benefit/cost ratio, and partnerships. Applicants often need match and strong technical packages.	Good fit for larger watershed-scale green infrastructure or combined capital projects (e.g., large riparian revegetation tied to flood risk reduction). Tukwila would likely participate via a King County or state applicant or as a subapplicant.
NOAA — Community-based Habitat Restoration / Transformational Restoration	Awards vary; typical NOAA habitat grants $75,000–$3,000,000 (project-dependent); transformational rounds can be larger.	Projects must restore coastal or freshwater habitat, benefit fisheries (salmon), include monitoring, and often require local matching or in-kind contributions.	Ideal for riparian/revegetation projects in the Green-Duwamish watershed where tree planting supports salmon habitat and can be framed as habitat restoration with measurable metrics. Strong partnership with WRIA9 increases competitiveness.

CITY OF TUKWILA GREEN INFRASTRUCTURE ASSESSMENT - MARCH 2026

TREE CANOPY VALUE

THE VALUE OF TREE CANOPY IN CITY OF TUKWILA

Trees are a valuable green infrastructure asset. The value of trees can vary depending on age, species and location within an urban landscape. Conifers provide year-round shade and benefits for absorbing stormwater, whereas deciduous trees are most valuable for producing shade and stormwater benefit during the summer months when they have leaves. In total, a large tree with an expansive tree canopy typically provides the greatest value as a green infrastructure asset.

A large mature urban tree can remove roughly 60–70 times more air pollution annually than a small young tree.

Air temperature directly under the shade of a tree can be up to 25˚ F cooler than surrounding areas impacted by urban heat.

AVERAGE ECOSYSTEM SERVICE VALUE PER YEAR PER ACRE

STORMWATER
$5,687/year per acre

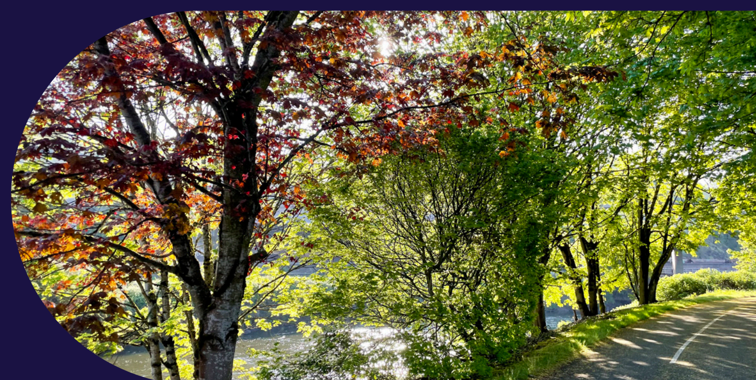
ACCESS TO NATURE
$7,788/year per acre

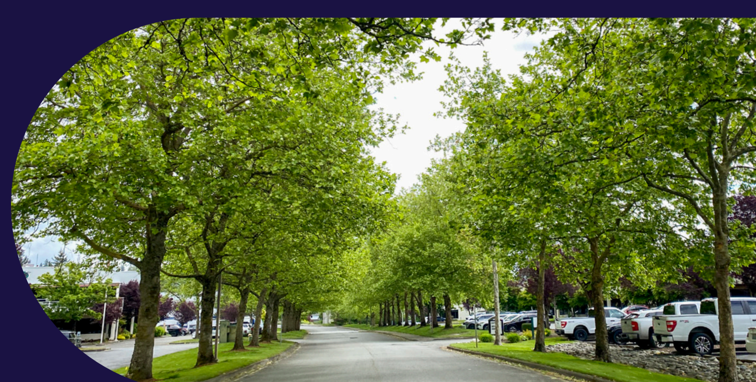
WATER QUALITY
$5,742/year per acre

GROUND STABILITY
$5,583,513/year per acre

AIR QUALITY
$862/year per acre

COOL AIR
$544/year per acre





RESTORATION OF INVASIVE SPECIES: EXAMPLE, ENGLISH IVY

5 YEARS

RETURN ON INVESTMENT
- 2.11 Average Benefit Cost Ratio
- $2.11 in Benefits for Every $1 Invested

10 YEARS

RETURN ON INVESTMENT
- 2.72 Average Benefit Cost Ratio
- $2.72 in Benefits for Every $1 Invested

Appendix E: One Pager Metrics

Trees are valuable. The value that trees provide can vary by many factors such as age, species, and the location within the urban landscape. Conifers provide year-round shade, whereas deciduous trees often have a greater basal leaf area during the growing season. One major factor is the size and overall canopy coverage of a single tree.

- Large mature urban tree (≈30-inch DBH) can remove roughly 60–70 times more air pollution annually than a small young tree (≈3-inch DBH).[9]
- A 30-inch diameter tree can store up to about 90 times more carbon than a 6-inch diameter tree.[10]
- Large mature tree can have roughly 50–100 times the leaf area of a small young tree.[11]

These differences play a critical role in how ecosystem services are valued. Research shows that trees can grow 0.23 inches per year for slowing growing species and as much as 0.43 inches per year for fast growing species.

At planting, a young bigleaf maple tree (5 years old) may have a span of 8 to 15 feet when at 2-to-3-inch diameter at breast height.[12] This translates to canopy coverage of a young bigleaf maple as much as 0.0003 acres (well over 1,000 trees to cover 1 acre). Bigleaf maple can growth 100 feet tall spanning 50 feet wide.[13] This means that the canopy covers approximately 0.06 to 0.12 acres.[14] A newly planted tree will require decades to achieve the size and benefit of a mature bigleaf maple. Ten mature bigleaf maple trees could encompass as much as an acre of canopy coverage.

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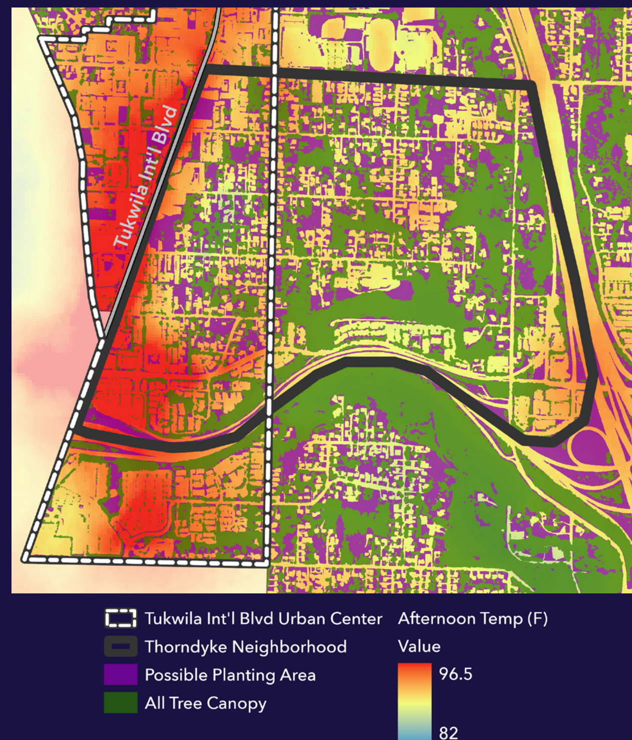
CASE STUDY

CANOPY INVESTMENTS & EXCESSIVE HEAT IN THE THORNDYKE NEIGHBORHOOD

Demonstrates how tree canopy investments can be prioritized by understanding overlapping priority areas including urban heat hotspots, equity, and areas with little to no trees where there is room to plant more. Local data on the urban heat across the city was used to isolate regions experiencing excessive heat during peak summer temperatures. Results show that in the 378-acre Thorndyke neighborhood, there are approximately 26.4 acres of possible planting areas where peak temperature exceeds 90°F.

This lack of tree canopy in this area not only falls short of the city's tree canopy goal, it is also resulting in an inequitable living condition for residents. A focused tree planting strategy in the Thorndyke neighborhood would result in improved living conditions for residents by reducing peak temperatures, capturing stormwater, improving water quality, improving air quality, and supporting greater access to nature. Throughout this Assessment, tree canopy is examined by zoning type and current city canopy cover goals, providing data to influence policy decisions and target future tree planting and preservation projects where they are needed most.

The highest temperatures in the Thorndyke Neighborhood occur almost entirely along Tukwila International Boulevard.



TOTAL CURRENT ECOSYSTEM SERVICE VALUE
$406,000 - $688,000

50-YEAR ECOSYSTEM SERVICE VALUE
$11.3 M - $19.1 M

If all canopy goals in the Thorndyke Neighborhood were met, tree canopy cover would increase by over 25 acres across the 380 acre neighborhood.

THORNDYKE NEIGHBORHOOD URBAN TREE CANOPY GOAL GAP

ZONING CATEGORY	% SHORT OF GOAL	CURRENT CANOPY COVER	CANOPY COVER GOAL
COMMUNITY RESIDENTIAL	-6%	41%	47%
HIGH DENSITY RESIDENTIAL	-14%	26%	40%
OFFICE & COMMERCIAL	-3%	29%	32%

Appendix F: Endnotes

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