URBAN TREE CANOPY

ASSESSMENT

COVINGTON, WASHINGTON

SEPTEMBER | 2018

King Conservation District

plan-it GEO

city of covington growing toward greatness

AN ASSESSMENT OF
URBAN TREE CANOPY

COVINGTON, WASHINGTON

Someone is sitting in the shade today because someone planted a tree a long time ago.
-Warren Buffet

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PREPARED FOR
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TABLE OF
CONTENTS

1,130

ACRES OF TREE CANOPY

EXECUTIVE SUMMARY

PURPOSE OF THIS ANALYSIS

The City of Covington is located within King County, Washington, in the Seattle metropolitan area (Figure 1). It is approximately 6 square miles or 3,868 acres of which 3,814 are land acres. Covington has placed a high priority on ensuring the long-term health of its urban forest resource, and this assessment demonstrates their commitment to protecting, maintaining, and expanding the city's tree canopy. The primary goal of this assessment was to provide a baseline and benchmark of the City's tree canopy and interpret the results across a range of geographic boundaries.

URBAN TREE CANOPY IN COVINGTON

Results of this study indicated that in 2017, the city of Covington contained 30 percent urban tree canopy (or 1,130 of the city's 3,868 total acres); 17 percent non-canopy vegetation (665 acres); 9 percent soil/dry vegetation (353 acres); 43 percent impervious (1666 acres); and 1 percent water (54 acres). Of the city's 70 percent of land area not presently occupied by tree canopy, 16 percent (615 acres) was suitable for future tree plantings, and 54 percent (2,069 acres) was unsuitable due to its current land use or other restraint. In further dividing the city's urban tree canopy, 56 percent was deciduous, 44 percent was evergreen, and 9 percent of all canopy was overhanging impervious surfaces.

ASSESSMENT BOUNDARIES

This study assessed urban tree canopy (UTC) and possible planting areas (PPA) at multiple geographic scales in order to provide actionable information to a diverse range of audiences. By identifying what resources and opportunities exist at these scales, the City can be more proactive in their approach to protect and expand their urban tree canopy. Metrics were generated at the following geographies: the citywide boundary (1); drainage basins (7); future land use classes (12); census block groups (24); and parcels (6,820). Additionally, the city's urban tree canopy was subdivided into deciduous and evergreen classes and delineated as overhanging impervious surfaces or not.

RECOMMENDATIONS

The results of this analysis can be used to develop a continuing strategy to protect and expand Covington's urban forest. The UTC and PPA metrics should be used as a guide to determine where the city has been successful in protecting and expanding its urban forest resource, while also targeting areas to concentrate future efforts based on needs, benefits, and available planting space. Covington can use these results to ensure that their urban forest policies and management practices continue to prioritize its maintenance, health, and growth.

Figure 1. | Covington occupies approximately 6 square miles in King County, Washington.

30% URBAN TREE CANOPY

44% IMPERVIOUS SURFACE

16% POSSIBLE PLANTING AREA

Figure 2. | Based on an analysis of 2017 high-resolution imagery, Covington contains 30% tree canopy, 16% areas that could support canopy in the future, and 44% total impervious areas.

PROJECT METHODOLOGY

This section describes the methods through which land cover, urban tree canopy, and possible planting areas were mapped. These datasets provide the foundation for the metrics reported at the selected target geographies.

DATA SOURCES

This assessment utilized 2017 high-resolution (1-meter) multispectral imagery from the U.S. Department of Agriculture's National Agriculture Imagery Program (NAIP) and 2016 LiDAR data from King County, Washington to derive the land cover data set. The NAIP imagery is used to classify all types of land cover, whereas the LiDAR is most useful for distinguishing tree canopy from other types of vegetation. Additional GIS layers provided by the City of Covington were also incorporated into the analysis.

MAPPING LAND COVER

An initial land cover dataset was to be created prior to mapping tree canopy and assessing change. The land cover data set is the most fundamental component of an urban tree canopy assessment. An object-based image analysis (OBIA) software program called Feature Analyst was used to classify features through an iterative approach. In this process, objects' spectral signatures across four bands (blue, green, red, and near-infrared), textures, pattern relationships, and object height were considered. This remote sensing process used the NAIP imagery and LiDAR to derive five initial land cover classes. These classes are shown in Figure 3.

After manual classification improvement and quality control were performed on the remote sensing products, additional data layers from the city (such as buildings, roads, and other impervious surfaces) were utilized to capture finer feature detail and further categorize the land cover dataset.

Figure 3. | Five (5) distinct land cover classes were identified in the 2017 tree canopy assessment: urban tree canopy, non-canopy vegetation, bare soil and dry vegetation, impervious (paved) surfaces, and water.

CLASSIFYING URBAN TREE CANOPY

Following the remote sensing classification and final QA/QC of the tree canopy data layer, this output was used as a mask to extract generalized tree species composition using a Normalized Difference Vegetation Index (NDVI), LiDAR height information, supervised training, and an iterative machine learning approach. Leaf-off aerial photography from Google Earth was used to obtain training and verification samples of deciduous and evergreen trees. Generalized tree species composition mapping was performed at a scale to classify larger groves of trees but not individual trees. There were no accuracy standards required or assessed for this classification. Using impervious surface data provided by the city (buildings, roads, parking lots, etc.), the amount of deciduous and evergreen tree canopy overhanging impervious surfaces was also quantified to assist with hydrologic modeling.

IDENTIFYING POSSIBLE PLANTING AREAS AND UNSUITABLE AREAS FOR PLANTING

In addition to quantifying Covington's existing tree canopy cover, another metric of interest in this assessment was the area where tree canopy could be expanded. To assess this, all land area in Covington that was not existing tree canopy coverage was classified as either possible planting area (PPA) or unsuitable for planting. Possible planting areas were derived from the Non-Canopy Vegetation class. Unsuitable areas, or areas where it was not feasible to plant trees due to biophysical or land use restraints (e.g. airport runways, golf course playing areas, recreation fields, etc.), were manually delineated and overlaid with the existing land cover data set (Figure 4). The final results were reported as PPA and Unsuitable Vegetation, Unsuitable Impervious, Unsuitable Soil, and Total Unsuitable.

Figure 4. | Vegetated areas where it would be biophysically feasible for tree plantings but undesirable based on their current usage (left) were delineated in the data as "Unsuitable" (right). These areas included recreational sports fields, golf courses, and other open space.

DEFINING ASSESSMENT LEVELS

In order to best inform the City Council and all of Covington's various stakeholders, urban tree canopy and other associated metrics were tabulated across a variety of geographic boundaries (Figure 5). These boundaries include the city boundary, watersheds, land use classes, drainage basins, census block groups, and parcels.

- The City of Covington's citywide boundary is the one (1) main area of interest over which all metrics are summarized. One (1) HUC-12 watershed also encompasses this boundary.

- Since trees play an important role in stormwater management, the city's seven (7) drainage basins were assessed.

- Twelve (12) future land use classes provided by the City were analyzed to assess differences in tree canopy across different human uses of land.

- Twenty-four (24) census block groups were assessed to provide information at a small geographic scale. Census block groups (CBGs) are used by the U.S. Census Bureau to assure statistical consistency when tracking populations across the United States and can be valuable indicators of environmental justice as they are directly linked with demographic and socioeconomic data.

- The smallest unit of analysis was parcels, of which there were nearly seven thousand (6,820) in total. This unit is helpful for assessing the canopy on an individual piece of property.

Figure 5. | Five distinct geographic boundaries were explored in this analysis: the full city boundary, drainage basins, future land use classes, census block groups, and parcels.

STATE OF THE CANOPY AND KEY FINDINGS

This section presents the key findings of this study including the land cover base map and canopy analysis results which were analyzed across various geographic assessment boundaries. These results, or metrics, help inform a strategic approach to identifying existing canopy to preserve and future planting areas. Land cover percentages are based on the total area of interest while urban tree canopy, possible planting area, and unsuitable percentages are based on land area. Water bodies are excluded from land area because they are typically unsuitable for planting new trees without significant modification.

CITYWIDE LAND COVER

In 2017, tree canopy constituted 30 percent of Covington's land cover; non-canopy vegetation was 17 percent; soil/dry vegetation was 9 percent; impervious was 43 percent; and water was 1 percent. These results are presented in Table 1 below and Figure 6 on the next page.

Table 1. | Generalized land cover classification results

Covington	City Boundary	Tree Canopy	Non-Canopy Vegetation	Impervious Surfaces	Soil & Dry Vegetation	Water
Acres	3,868	1,130	665	1,666	353	54
% of Total	100%	30%	17%	43%	9%	1%

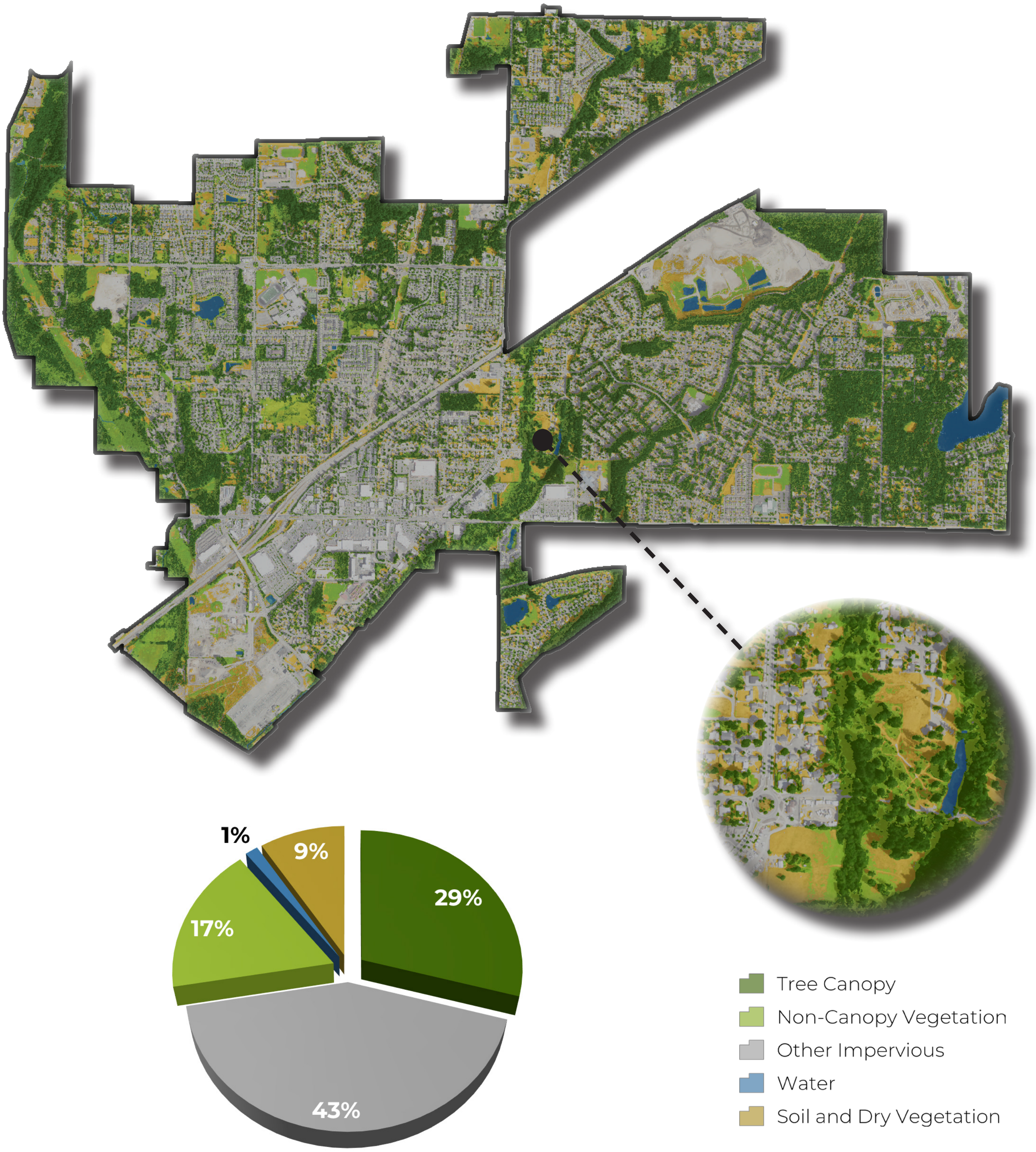


Figure 6. | Land cover classes for Covington, Washington based on 2017 NAIP imagery and 2016 PSLC LiDAR data. (Percentages based on land acres.)

CITYWIDE URBAN TREE CANOPY

This urban tree canopy assessment utilized the land cover map as a foundation to determine Possible Planting Areas throughout the City. Additional layers and information regarding land considered unsuitable for planting were also incorporated into the analysis. Note that the results of this study are based on land area as opposed to total area (note the difference between Total Acres and Land Acres in Table 2).

Results of this study indicate that within the city of Covington, 1,130 acres are covered with urban tree canopy, making up 30 percent of the city's 3,814 land acres; 615 acres are covered with other vegetation where it would be possible to plant trees (PPA), making up 16 percent of the city; and the other 2,069 acres were considered unsuitable for tree planting, making up 54 percent of the city. The unsuitable areas include recreational sports fields, golf course playing areas, and areas of bare soil and dry vegetation.

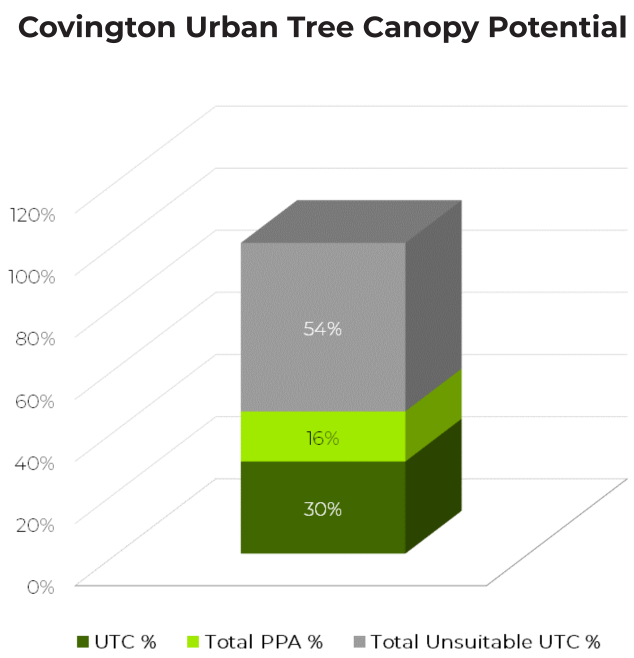


Figure 7. | Urban tree canopy, potential planting area, and area unsuitable for UTC in the City of Covington.

Table 2. | Urban tree canopy assessment results, by acres and percent. (Percentages based on total acres.)

City of Covington	Acres	%
Total Area	3,868	100%
Land Area	3,814	99%
Urban Tree Canopy	1,130	30%
Possible Planting Area - Vegetation	615	16%
Unsuitable Vegetation	50	1%
Unsuitable Impervious	1,666	44%
Unsuitable Soil	353	9%
Total Unsuitable Areas	2,069	54%

Figure 8. | Urban tree canopy, possible planting area, and area unsuitable for UTC in the city of Covington.

The city's 1,131 acres of urban tree canopy were further divided into several subcategories based on whether the trees were deciduous (broad-leafed) or evergreen, and whether their canopy had an impervious or pervious understory. Tree canopy overhanging an impervious surface can provide many benefits through ecosystem services such as localized cooling provided by shading of impervious surfaces and increased stormwater absorption. Results indicated that Covington's UTC was relatively evenly split between the two types with 56 percent deciduous canopy and 44 percent evergreen canopy. In Covington, 9 percent of all tree canopy had an impervious understory.

Table 3. | Detailed urban tree canopy classifications.

City of Covington	Acres	%
Deciduous Urban Tree Canopy	636	56%
Evergreen Urban Tree Canopy	495	44%
Tree Canopy with Impervious Understory	99	9%

URBAN TREE CANOPY BY DRAINAGE BASIN

UTC and PPA were also assessed for the HUC-12 watersheds found within Covington. Delineated by the U.S. Geological Survey, each unique 12-digit identification code represents a different subwatershed. Watersheds are commonly analyzed to explore differences in tree canopy across a naturally-occurring geographic boundary. However, since only one watershed intersects the city boundary (Big Soos Creek), all metrics were synonymous with the full city boundary's described above. To provide a finer-scale view of the relationship between tree canopy and watersheds, UTC and PPA were assessed for the city's 7 local drainage basins.

The two basins with the lowest existing canopy cover were Jenkins Creek and Little Soos Creek, each with 26 percent UTC, whereas the Lake Lucerne/Pipe Lake basin had nearly double that with 49 percent UTC. PPA ranged from 14 percent in Jenkins Creek to 22 percent in the Little Soos Northeast Tributary. The largest watershed, Jenkins Creek, contained the greatest proportion of the city's overall UTC (35 percent) and PPA (34 percent) despite its relatively low existing UTC and PPA percentages.

Table 4. | Urban tree canopy in Covington by drainage basin.

Drainage Basin	Land Area		Urban Tree Canopy			Possible Planting Area		
	Acres	*Dist.*	*Acres*	*%*	*Dist.*	*Acres*	*%*	*Dist.*
Big Soos Creek	857	22%	265	31%	23%	178	21%	29%
Cranmar Creek	342	9%	137	40%	12%	56	16%	9%
Jenkins Creek	1512	40%	395	26%	35%	207	14%	34%
Lake Lucerne/Pipe Lake	108	3%	53	49%	5%	20	19%	3%
Little Soos Creek	671	18%	173	26%	15%	100	15%	16%
Little Soos Northeast Tributary	95	3%	29	30%	3%	21	22%	3%
North Jenkins Creek Tributary	228	6%	77	34%	7%	34	15%	5%
Totals	**3,814**	**100%**	**1,130**	**30%**	**100%**	**615**	**16%**	**100%**

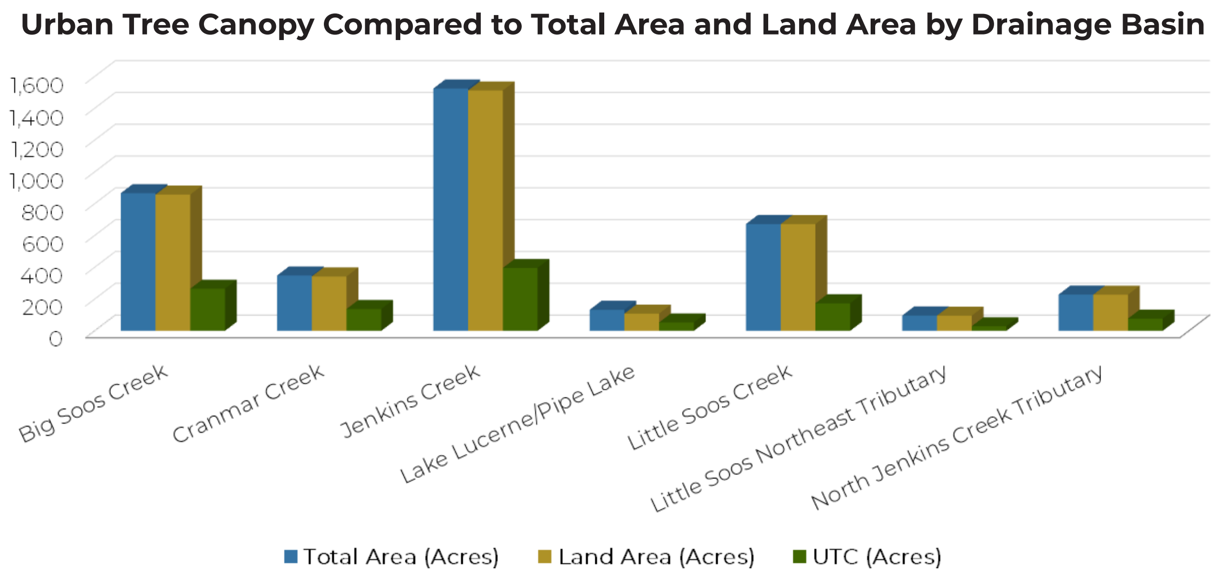


Figure 9. | Urban tree canopy in Covington by drainage basin.

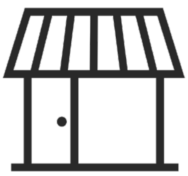
URBAN TREE CANOPY BY LAND USE

UTC and PPA were assessed for 12 different future land use categories (Table 5) provided by the City of Covington. Land use classes with the lowest UTC included industrial (14 percent), downtown (16 percent), and roadways (19 percent), while the highest were public areas (42 percent), low-density residential (41 percent), and urban separator (40 percent). Medium-density residential areas offered the greatest opportunities for future canopy expansion, with 19 percent PPA contributing 27 percent of the city's total PPA. Community and neighborhood commercial classes did not offer any PPA, each contributing less than 1 percent of the citywide total.

Table 5. | Urban tree canopy assessment results by land use. UTC and PPA results include acres, percent of area covered by UTC or PPA (%), and distribution of the city's total UTC or PPA within each and use (dist.).

Land Use	Land Area		Urban Tree Canopy			Possible Planting Area		
	Acres	Dist.	Acres	%	Dist.	Acres	%	Dist.
Community Commercial	4	0%	2	41%	0%	1	18%	0%
Downtown	372	11%	60	16%	6%	41	11%	7%
Industrial	100	3%	14	14%	1%	10	10%	2%
Lakepointe Urban Village Subarea	202	6%	59	29%	6%	37	18%	6%
Urban Separator (1du/ac)	210	6%	83	40%	8%	68	33%	13%
Low Density Residential (4du/ac)	623	19%	254	41%	24%	109	17%	18%
Medium Density Residential (6du/ac)	877	27%	257	29%	25%	165	19%	27%
High Density Residential (8du/ac)	430	13%	133	31%	13%	60	14%	10%
Multi-Family Residential (18du/ac)	20	1%	6	28%	1%	5	23%	1%
Neighborhood Commercial	5	0%	1	23%	0%	1	14%	0%
Public Parks, Recreational Facilities and Schools	419	13%	176	42%	17%	86	20%	16%
Roadway	21	1%	4	19%	0%	1	6%	0%
Totals	**3,285**	**100%**	**1,047**	**32%**	**100%**	**583**	**18%**	**100%**





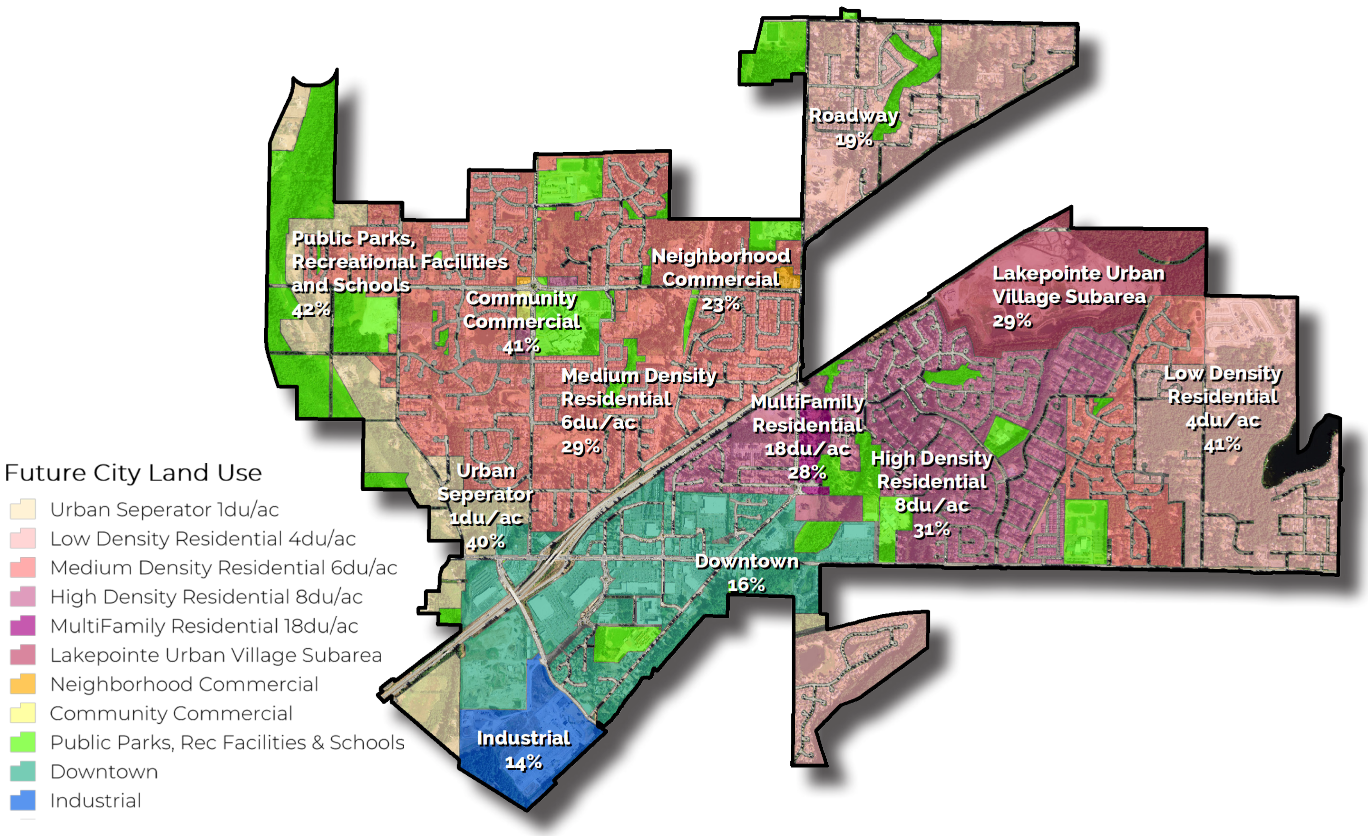


Figure 10. | Urban tree canopy in Covington by future city land use.

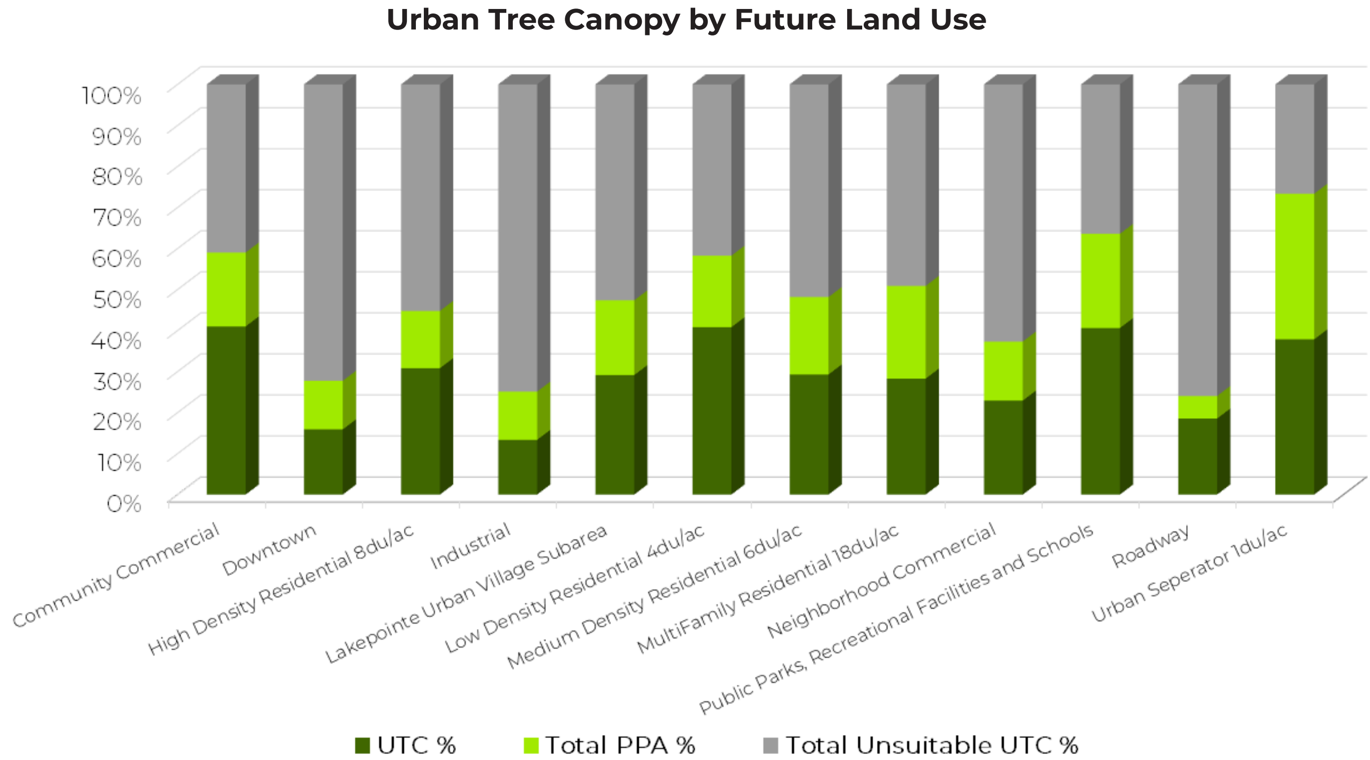


Figure 11. | Urban tree canopy, potential planting area, and area unsuitable for UTC by land use.

URBAN TREE CANOPY BY CENSUS BLOCK GROUP

UTC and PPA were assessed at the census block group level. This geographic unit of measure is linked to all demographic and socioeconomic U.S. census data which makes it useful for assessing the equitable distribution of tree canopy within a city. Results indicated that Covington's UTC is not uniformly distributed throughout the city boundary. Some of the City's 24 census block groups contained just 13-14 percent cover while another contained 62 percent. PPA also varied greatly and ranged from 5 to 38 percent. For the complete results by census block group, refer to the UTC Results spreadsheet.

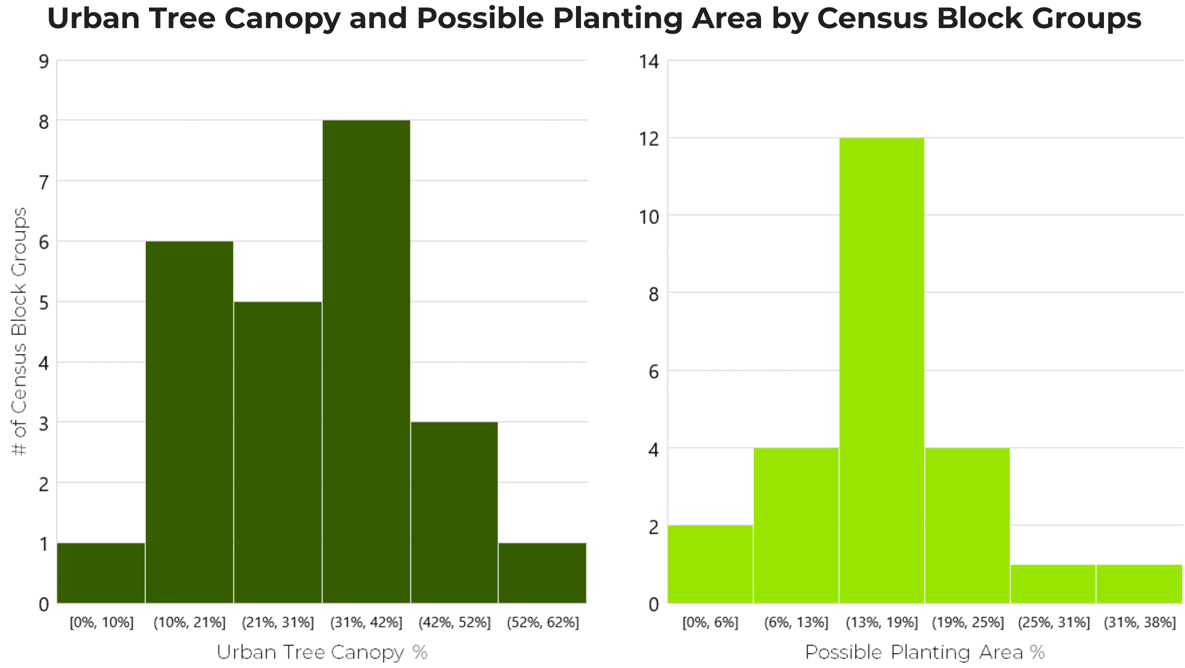


Figure 12. | Urban tree canopy (left) and possible planting area in Covington by U.S. census block groups.

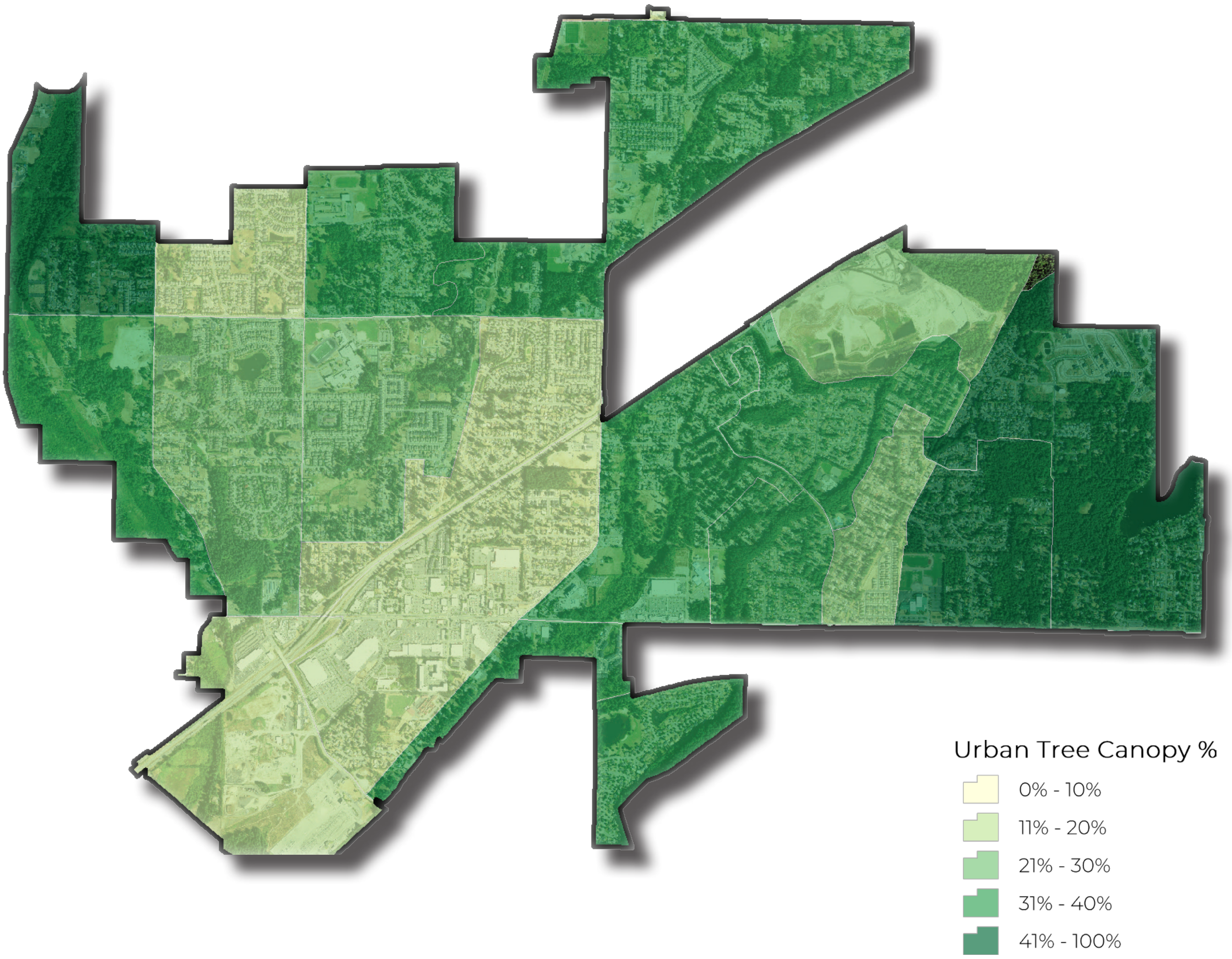


Figure 13. | Urban tree canopy in Covington by U.S. census block groups.

URBAN TREE CANOPY BY PARCELS

UTC and PPA were assessed within the city's 6,820 parcels. This unit of measure provides the finest possible scale at which to assess canopy short of quantifying every individual tree, defining UTC and PPA metrics for every piece of public or privately-owned property within the City. Resulted showed that ten of Covington's parcels were completely covered with canopy and 337 had no canopy at all. The average UTC of all parcels was 22 percent compared to the citywide average of 30 percent, indicating that the majority of parcels have a lower UTC and the city's overall canopy cover is strongly influenced by a few heavily forested parcels. In fact, 74 percent of parcels had a UTC below 30 percent, 55 percent were below 20 percent UTC, and 30 percent were below 10 percent UTC, while 8 percent had a UTC of 50 percent or greater. For the full UTC results by parcel, refer to the Parcels shapefile and attribute table in the UTC Results.

RECOMMENDATIONS

An important step in preserving, protecting, and maintaining a city's valuable urban forest resource is to have a canopy assessment performed on a regular interval. The City of Covington has started this process by assessing their canopy in 2017. As the City continues to grow and change, they will be able to use these recommendations to ensure that their urban forest policies and management practices continue to prioritize its maintenance, health, and growth.

In 2017, Covington had 30% existing urban tree canopy and 16% possible planting area.

A nation-wide analysis conducted by USFS researchers stated that under ideal conditions, forested states such as Washington could achieve a canopy cover of 40-60%. With an existing canopy cover of 30 percent and PPA of 16 percent, Covington will need to be strategic with its future planning and development to ensure the sustained health of its trees if it hopes to meet this goal. The City can put these results to work to preserve, promote, and expand tree its canopy.

The results of this assessment should be used to encourage investment in forest monitoring, maintenance, and management; to prepare supportive information for local budget requests/grant applications; and to develop targeted presentations for city leaders, planners, engineers, resource managers, and the public on the functional benefits of trees in addressing environmental issues. The land cover data should be disseminated to diverse partners for urban forestry and other applications while the data is current and most useful for decision-making and implementation planning. The information from this study can help establish canopy cover goals for the short- and long-term.

The City of Covington and its various stakeholders can utilize the results of the UTC and PPA analyses to identify the best locations to focus future tree planting and canopy expansion efforts. While the City has a fair amount of canopy coverage throughout its entire area, breaking up the results by several different geographic boundaries demonstrated that this canopy is not evenly distributed. For example, Covington's downtown center land use had one of the lowest canopy covers in the city at 16%, whereas other land uses such as low-density residential and urban separator had more than twice that. Since downtown regions often have higher population densities and greater percentages of impervious surface coverage, Covington's downtown center would be a prime location for future tree plantings to maximize the benefits of trees for the greatest number of people.

To maximize citywide canopy expansion, Covington's residential areas are a great place to prioritize as they cover the majority of the City's area and contain the vast majority of its PPA. The City should conduct public outreach in residential areas to engage residents interested in working together to improve the neighborhoods where they live. The Urban Separator 1du/ac residential land use has high existing UTC (40%) and the highest PPA vegetation area

THE URBAN SEPARATOR HAS THE MOST POSSIBLE PLANTING AREA.

percentage (33%), so existing tree maintenance and planting efforts should be evaluated to preserve and enhance tree canopy in these areas. The results by geographic area (such as census block group) can also be overlaid with the land use layer to determine which residential areas have the greatest need.

These results can be used as a guide to determine which areas would receive the greatest benefits from the investment of valuable time and resources into Covington's urban forest. In addition to the examples above, the City can also use the provided Canopy Planner tool to explore a wide range of targeted, in-depth planting scenarios based on several prioritization criteria such as current tree canopy, possible planting area, and several socio-demographic factors. Canopy Planner allows stakeholders to visualize existing land cover and create custom weighted priority planting maps.

Finally, Covington should integrate this data into its larger citywide planning efforts. While valuable, this assessment is only the first step in protecting, preserving, and expanding Covington's valuable urban forest resource. The city must establish set policies and guidelines for the preservation of tree canopy amidst future development and planning. The UTC data can assist implementation of the 2015-2035 City Comprehensive Plan (Natural Environment Goals and Policies) and the 2013 Urban Forestry Strategic Plan. Specifically, a canopy goal should be established as recommended in the 2013 Urban Forestry Strategic Plan (recommendation #2, page 3 and 14). Covington's urban forest provides the City with a wealth of environmental, social, and even economic benefits which relate back to greater community interest in citywide initiatives and priorities. These results and tools can be used to interpret where these gains would be felt most significantly in accordance with the city's broader goals and vision for its future.

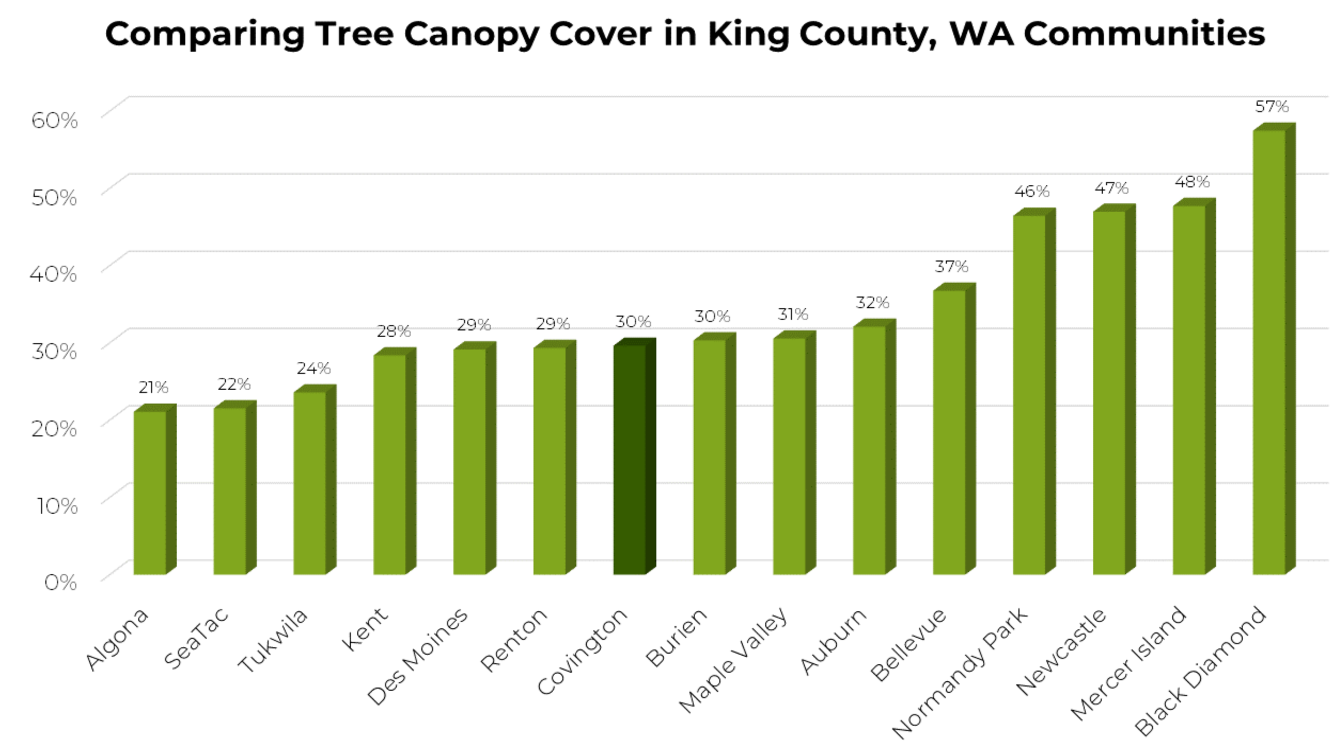


Figure 14. | A comparison of tree canopy in all 15 cities mapped in the 2017 South King County UTC Assessment.

APPENDIX

ACCURACY ASSESSMENT

Classification accuracy serves two main purposes. Firstly, accuracy assessments provide information to technicians producing the classification about where processes need to be improved and where they are effective. Secondly, measures of accuracy provide information about how to use the classification and how well land cover classes are expected to estimate actual land cover on the ground. Even with high resolution imagery, very small differences in classification methodology and image quality can have a large impact on overall map area estimations.

The classification accuracy error matrix illustrated in Table A1 contain confidence intervals that report the high and low values that could be expected for any comparison between the classification data and what actual, on the ground land cover was in 2017. This accuracy assessment was completed using high resolution aerial imagery, with computer and manual verification. No field verification was completed.

THE INTERNAL ACCURACY ASSESSMENT WAS COMPLETED IN THESE STEPS

1. Ninety (90) sample points, or approximately 15 points per square mile area in Covington (6 sq. miles), were randomly distributed across the study area and assigned a random numeric value.
2. Each sample point was then referenced using the NAIP aerial photo and assigned one of five generalized land cover classes ("Ref_ID") mentioned above by a technician.
3. In the event that the reference value could not be discerned from the imagery, the point was dropped from the accuracy analysis. In this case, no points were dropped.
4. An automated script was then used to assign values from the classification raster to each point ("Eval_ID"). The classification supervisor provides unbiased feedback to quality control technicians regarding the types of corrections required. Misclassified points (where reference ID does not equal evaluation ID) and corresponding land cover are inspected for necessary corrections to the land cover.[1]

Accuracy is re-evaluated (repeat steps 3 & 4) until an acceptable classification accuracy is achieved.

SAMPLE ERROR MATRIX INTERPRETATION

Statistical relationships between the reference pixels (representing the true conditions on the ground) and the intersecting classified pixels are used to understand how closely the entire classified map represents Covington's landscape. The error matrices shown in Table A1 represent the intersection of reference pixels manually identified by a human observer (columns) and classification category of pixels in the classified image (rows). The gray boxes along the diagonals of the matrix represent agreement between the two-pixel maps. Off-diagonal values represent the

1 Note that by correcting locations associated with accuracy points, bias is introduced to the error matrix results. This means that matrix results based on a new set of randomly collected accuracy points may result in significantly different accuracy values.

number of pixels manually referenced to the column class that were classified as another category in the classification image. Overall accuracy is computed by dividing the total number of correct pixels by the total number of pixels reported in the matrix (24 + 12 + 44 + 2 + 1 = 83 / 90 = 92 percent), and the matrix can be used to calculate per class accuracy percent's. For example, 25 points were manually identified in the reference map as Tree Canopy, and 24 of those pixels were classified as Tree Canopy in the classification map. This relationship is called the "Producer's Accuracy" and is calculated by dividing the agreement pixel total (diagonal) by the reference pixel total (column total). Therefore, the Producer's Accuracy for Tree Canopy is calculated as: (24/25 = .96), meaning that we can expect that ~96 percent of all 2017 tree canopy in the Covington, WA study area was classified as Tree Canopy in the 2017 classification map.

Conversely, the "User's Accuracy" is calculated by dividing the total number of agreement pixels by the total number of classified pixels in the row category. For example, 24 classification pixels intersecting reference pixels were classified as Tree Canopy, but one pixel was identified as Vegetation in the reference map. Therefore, the User's Accuracy for Tree Canopy is calculated as: (24/25 = 0.96), meaning that ~96 percent of the pixels classified as Tree Canopy in the classification were actual tree canopy. It is important to recognize the Producer's and User's accuracy percent values are based on a sample of the true ground cover, represented by the reference pixels at each sample point. Interpretation of the sample error matrix results indicates this land cover, and more importantly, tree canopy, were accurately mapped in Covington in 2017. The largest sources of classification confusion exist between tree canopy and vegetation.

Table A1. | Error matrix for land cover classifications in Covington, WA (2017).

Classification Data	Reference Data: Tree Canopy	Vegetation	Impervious	Soil / Dry Veg.	Water	Total Reference Pixels
Tree Canopy	24	1	0	0	0	25
Vegetation	1	12	2	1	0	16
Impervious	0	0	44	0	0	44
Soil / Dry Veg.	0	0	2	2	0	4
Water	0	0	0	0	1	1
Total	25	13	48	3	1	90

Overall Accuracy = 92%

Producer's Accuracy	
Tree Canopy	96%
Veg. / Open Space	92%
Impervious	92%
Bare Ground / Soil	67%
Water	100%

User's Accuracy	
Tree Canopy	96%
Veg. / Open Space	75%
Impervious	100%
Bare Ground / Soil	50%
Water	100%

ACCURACY ASSESSMENT RESULTS

Interpretation of the sample error matrix offers some important insights when evaluating Covington's urban tree canopy coverage and how land cover reported by the derived rasters and the human eye. The high accuracy of the 2017 data indicates that Covington's current tree canopy can be safely assumed to match the figures stated in this report (approximately 30 percent).

I-TREE HYDRO STORMWATER ANALYSIS

i-Tree Hydro is a tool designed to simulate the impacts that tree canopy cover, impervious surfaces, and other land cover types have on the hydrological cycle. Users of the tool can make use of existing input datasets provided by i-Tree or they can incorporate their own data for hourly weather, streamflow, and elevation (either a digital elevation model (DEM) or one of Hydro's pre-formatted topographic index files). One or many different land cover scenarios can be defined in order to estimate the impact on stormwater runoff. Reports detailing these impacts can be exported. Additional parameters can be configured such as soil texture and conductivity. However, these variables are recommended for more advanced users. The default regional values that are provided should be sufficient for the average user.

For the purposes of this study, a simplified version of the model was used utilizing only pre-existing data already available in i-Tree Hydro. A topographic index was chosen to represent the area of interest (see Appendix 2, page 47 of the i-Tree Hydro User's Manual for more information on topographic indexes). Baseline land cover conditions created by this tree canopy assessment were incorporated. To create an alternate land cover scenario, all existing tree canopy was removed and converted to herbaceous or impervious land cover to show a drastic case where all canopy cover in Covington was removed. The results, provided in total stormwater runoff over a specified period of time, can help natural resource managers and urban planners engage in meaningful discussions to better describe the impacts of land cover changes in their cities. The results in Table A2, below, are presented as raw numbers (cubic feet) and a percent change (%) from the base case scenario. At the time of publication, Plan-It Geo is engaged in a comprehensive analysis of the i-Tree Hydro tool's applications in western Washington. This project will provide much more detailed modeling scenarios and offer guidance on best practices. This project is anticipated to be completed in 2019.

Table A2. | Stormwater runoff values using existing the existing land cover and an alternate scenario where all tree canopy was removed. (Continued on next page.)

Land Cover	Base (%)	Alternate (%)	Change (%)
Tree Canopy	29.2%	0.0%	-29.2%
Pervious Under Tree Canopy	26.7%	0.0%	-26.7%
Impervious Under Tree Canopy	2.5%	0.0%	-2.5%
Shrub	0.0%	0.0%	0.0%
Herbaceous	17.2%	43.9%	26.7%
Water	1.4%	1.4%	0.0%
Impervious	43.1%	45.6%	2.5%
Soil	9.1%	9.1%	0.0%

Streamflow Predictions	Base (m^3)	Alternate (m^3)	Change (%)
Total Flow	2,194.0	2,219.2	1.0%
Base Flow	90.8	91.8	1.0%
Pervious Runoff	674.7	690.3	2.0%
Impervious Runoff	1,428.5	1,437.1	1.0%

GLOSSARY/KEY TERMS

Land Acres: Total land area, in acres, of the assessment boundary (excludes water).

Non-Canopy Vegetation: Areas of grass and open space where tree canopy does not exist.

Possible Planting Area - Vegetation: Areas of grass and open space where tree canopy does not exist, and it is biophysically possible to plant trees.

Possible Planting Area - Impervious: Paved areas void of tree canopy, excluding buildings and roads, where it is biophysically possible to establish tree canopy. Examples include parking lots and sidewalks.

Possible Planting Area - Total: The combination of PPA Vegetation area and PPA Impervious area.

Shrub: Low-lying vegetation that was classified based on interpretation of shadows and texture in vegetation. Shrubs produce little to no shadow and appeared smooth in texture compared to tree canopy.

Soil/Dry Vegetation: Areas of bare soil and/or dried, dead vegetation.

Total Acres: Total area, in acres, of the assessment boundary.

Unsuitable Impervious: Areas of impervious surfaces that are not suitable for tree planting. These include buildings and roads.

Unsuitable Planting Area: Areas where it is not feasible to plant trees. Airports, ball fields, golf courses, etc. were manually defined as unsuitable planting areas.

Unsuitable Soil: Areas of soil/dry vegetation considered unsuitable for tree planting. Irrigation and other modifiers may be required to keep a tree alive in these areas.

Unsuitable Vegetation: Areas of non-canopy vegetation that are not suitable for tree planting due to their land use.

Urban Tree Canopy (UTC): The “layer of leaves, branches and stems that cover the ground” (Raciti et al., 2006) when viewed from above; the metric used to quantify the extent, function, and value of Covington’s urban forest. Tree canopy was generally taller than 10-15 feet tall.

Water: Areas of open, surface water not including swimming pools.

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URBAN TREE CANOPY

ASSESSMENT

COVINGTON, WASHINGTON

King Conservation District

plan-it GEO

city of covington growing toward greatness