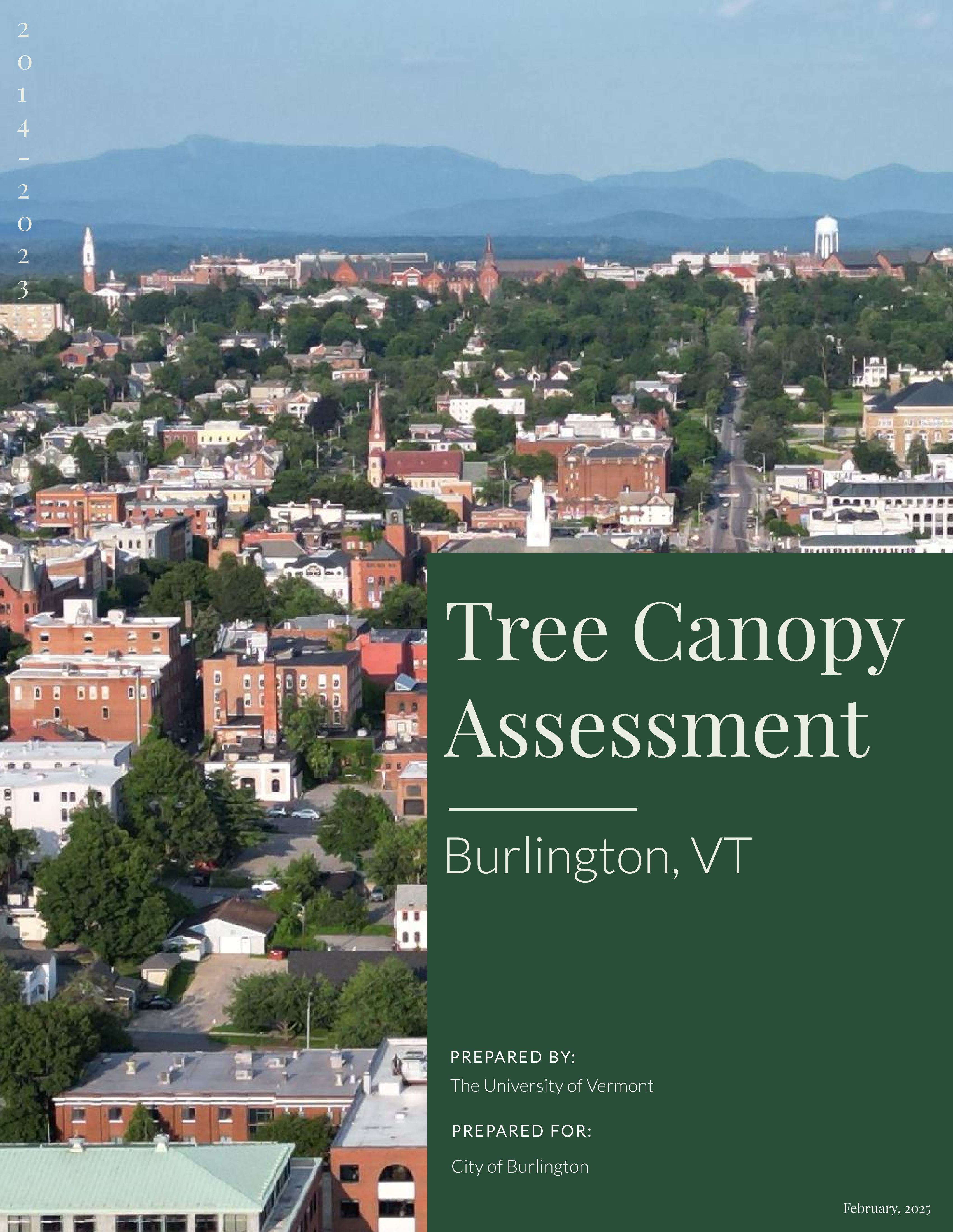


2014–2023

Tree Canopy Assessment

Burlington, VT

PREPARED BY:
The University of Vermont

PREPARED FOR:
City of Burlington

February, 2025

THE NEED FOR GREEN

Trees provide essential ecosystem services in Burlington, like reducing stormwater runoff, cooling the pavement in the summer and providing wildlife habitat. Trees are an indispensable part of the region's infrastructure. Research shows that these green assets can improve social cohesion, reduce crime, and raise property values. A healthy and robust tree canopy is crucial to building a more livable and prosperous town.

As with any community, Burlington faces a host of environmental challenges while seeking to balance development and conservation. A healthy and robust tree canopy is crucial for maintaining this balance, providing the city's residents with a resource that will impact the health and well-being of generations to come.

TREE CANOPY ASSESSMENT

For decades governments have mapped and monitored their infrastructure to support effective management practices. Traditionally, that mapping has primarily focused on gray infrastructure, including features such as roads and buildings. Left out of this mapping has been an accounting of the green infrastructure.

The Tree Canopy Assessment protocols were developed by the USDA Forest Service to help communities better understand their green infrastructure through tree canopy mapping and analytics. Tree canopy is the layer of leaves, branches, and stems that provide tree coverage of the ground when viewed from above. A Tree Canopy Assessment can provide vital information to help governments and residents chart a greener future by helping them understand the tree canopy they have, how it has changed, and where there is room to plant trees. Tree Canopy Assessments have been carried out for over 100 communities in North America. This study assessed tree canopy for Burlington over the 2014 - 2023 period.

TREE CANOPY BY THE NUMBERS

Burlington is losing tree canopy. Tree canopy change was computed by mapping the no change, gains, and losses in tree canopy from 2014 - 2023.

40%
2023 EXISTING TREE CANOPY

2,620
2023 EXISTING TREE CANOPY ACRES

-109
2014 - 2023 ACRES CHANGE

-1.6%
2014 - 2023 ABSOLUTE CHANGE

Change in tree canopy from 2014 - 2023

2014 Tree Canopy %
41.6%

2023 Tree Canopy %
40%

-1.6%
Absolute change in tree canopy

-4%
Relative change in tree canopy

228
Acres of Gain

337
Acres of Loss

Burlington was estimated to have 111,912 individual trees in 2023.

Losses in tree canopy are outpacing gains, resulting in a net decrease in tree canopy.

Growth of existing tree canopy is the biggest contributor to tree canopy gains.

FINDINGS

Despite net tree canopy losses, local gains in tree canopy coverage were possible thanks to preservation and planting initiatives.

Tree canopy loss is neither evenly distributed nor similar. It varies from removal of individual trees in backyards to clearing of patches of trees for new construction.

Burlington can improve environmental equity by prioritizing tree plantings in neighborhoods most susceptible to environmental risk.

To enhance urban resilience, Burlington can improve access to trees and the benefits that they provide.

Growth of existing tree canopy is the biggest contributor to Burlington's tree canopy gains.

Land use history, urban forestry initiatives, natural processes, and landowner decisions, all play a role in influencing the current state of tree canopy in the city.

37.5% of Burlington's tree canopy exists on residential parcels. Engaging with land owners will be key to managing the city's tree canopy.

33% of Burlington's land area is covered by grass or shrub area that could theoretically be used to plant more trees and increase canopy cover.

RECOMMENDATIONS

Preserving existing tree canopy is the most effective means for securing future tree canopy, as loss is an event but gain is a process.

Planting new trees in areas where tree canopy is low or in locations where there has been tree canopy removed will also help the city grow canopy.

Having trees with a broad age distribution and a variety of species will ensure that a robust and healthy tree canopy is possible over time.

Community education is crucial if tree canopy is to be maintained over time. Residents that are knowledgeable about the value of trees will help the city stay green for years to come.

Integrate the tree canopy change assessment data into planning decisions at all levels of government from individual park improvements, to comprehensive planning and zoning initiatives, to citywide ordinances.

Reassess the tree canopy at 3-5 year intervals to monitor change and make strategic management decisions.

Tree canopy assessments require high-quality, high-resolution data. Continue to invest in LiDAR and imagery to support these assessments and other mapping needs.

Field data collection efforts should be used to compliment this assessment as information on tree species, size, and health can only be obtained through on-the-ground inventories.

THE TREE CANOPY ASSESSMENT PROCESS

This project employed the USDA Forest Service's Urban Tree Canopy assessment protocols and made use of federal, state, and local investments in geospatial data. Tree canopy assessments should be completed at regular intervals, every 3-5 years.

Remotely sensed data forms the foundation of the tree canopy assessment. We use high-resolution aerial imagery and LiDAR to map tree canopy and other land cover features.

The land cover data consist of tree canopy, grass/shrub, bare soil, water, buildings, roads/railroads, and other impervious features.

The land cover data are summarized by various geographical units, ranging from the property parcel to the watershed to the municipal boundary.

These summaries, in the form of tree canopy metrics, are an exhaustive geospatial database that enables the Existing and Possible Tree Canopy to be analyzed.

The tree canopy metrics data analytics provide basic summary statistics in addition to inferences on the relationship between tree canopy and other variables.

The report (this document) summarizes the project methods, results, and findings.

The presentation, given to partners and stakeholders in the region, provides the opportunity to ask questions about the assessment.

The Importance of Good Data

This assessment would not have been possible without Burlington's investment in high-quality geospatial data, particularly LiDAR. These investments pay dividends for a variety of uses, from stormwater management to solar potential mapping. This LiDAR will help Burlington advance risk management plans by creating the tree centroids needed to run a risk analysis. Good data supports good governance.

MAPPING THE TREE CANOPY FROM ABOVE

Tree canopy assessments rely on remotely sensed data in the form of aerial imagery and light detection and ranging (LiDAR) data. These datasets, which have been acquired by various governmental agencies in the region, are the foundational information for tree canopy mapping. Imagery provides information that enables features to be distinguished by their spectral (color) properties. As trees and shrubs can appear spectrally similar, or obscured by shadow, LiDAR, which consists of 3D height information, enhances the accuracy of the mapping. Tree canopy mapping is performed using a scientifically rigorous process that integrates cutting-edge automated feature extraction technologies with detailed manual reviews and editing. This combination of sensor and mapping technologies enabled the city's tree canopy to be mapped in greater detail and with better accuracy than ever before. From a single street tree along a roadside to a patch of trees in a park, every tree in Burlington was accounted for.

Tree Canopy Mapping

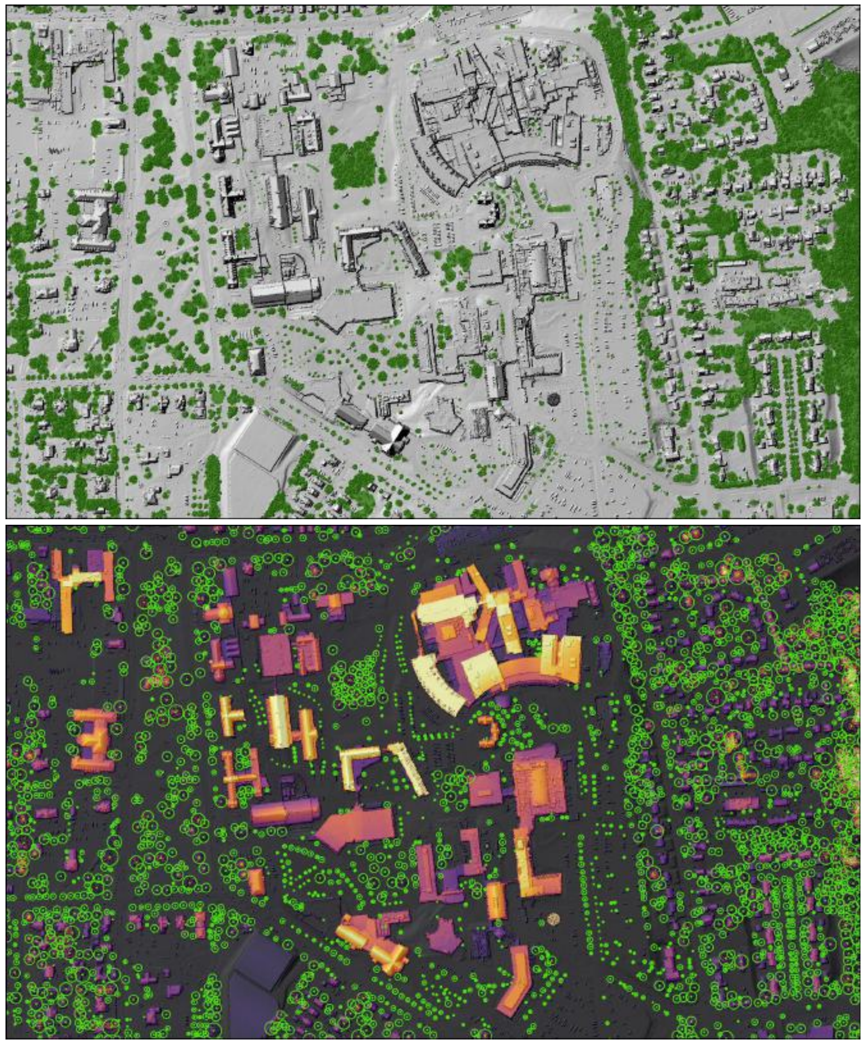


Figure 1. Locations of individual trees and their crowns (top) that were derived from the 2023 LiDAR (bottom).

The high-resolution land cover that forms the foundation of this project was generated from the most recent LiDAR, which was acquired in 2023. Compared to national tree canopy datasets, which map at a resolution of 30-meters, this project generated maps that were over 1,000 times more detailed and better account for all of the city's tree canopy.

Land Cover Mapping

Figure 2. High-resolution land cover developed for this project.

TREE COUNT

111,912+ Individual Trees

Burlington has over 111,912 individual trees, an estimate that was derived from the 2023 LiDAR data.

Tree Crowns & Centroids

Trees, particularly individual ones located in parks, on streets, on college greens, and on residential lands, require attention, care, and maintenance to thrive. In addition to quantifying the town's tree canopy acreage and percent coverage, this study produced an estimate of the number of individual trees in Burlington. This analysis was performed using the 2023 LiDAR data. While not a replacement for field-based inventories, LiDAR provides a unique advantage in that all of Burlington's trees can be counted. With Burlington having an estimated over 111,912 trees, it is important that tree maintenance remains a high priority for land managers. Tree maintenance and care activities will ensure that these critical green infrastructure assets thrive in a challenging urban environment.

Figure 3. Tree centroids (dots) and tree crowns (circles) mapped from the 2023 LiDAR. Tree mapping from LiDAR involves finding relative high points for each tree, then tracing down until a height inflection point is reached, marking the edge of the crown. This approach to individual tree mapping is most accurate where there is a clear differentiation in tree crowns and is less accurate in forested stands where crowns may overlap.

EQUITY & ENVIRONMENTAL JUSTICE

Environmental Equity & Urban Resilience

Like many cities in the United States, Burlington faces environmental risks and challenges relating to the urban environment. Trees, when properly cared for, can serve as a solution to create a sustainable and more resilient Burlington. However, resiliency requires preparedness to overcome shocks to Burlington and the community, and a crucial component of Burlington resilience are its residents.

Thus, to enhance urban resilience, we recommend Burlington targets neighborhoods lacking access to tree canopy cover, and for tree planting prioritization to be further informed by the distribution of demographic groups that are typically more susceptible to environmental risks. These include historically marginalized populations like racial and ethnic minorities and residents living in poverty.

In Burlington, distributions of census blocks with greater presence of Non-White residents and little tree canopy cover closely resemble the distributions of census blocks with greater presence of poverty and little tree canopy. It is likely that these demographics, which are typically interrelated, are also more exposed to environmental challenges due to a lack of trees available to provide important benefits that mitigate them.

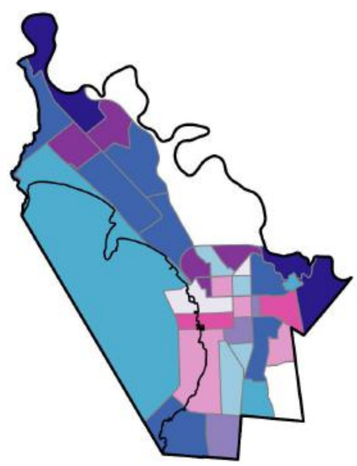
SUCEPTIBILITY AND INEQUITY

-

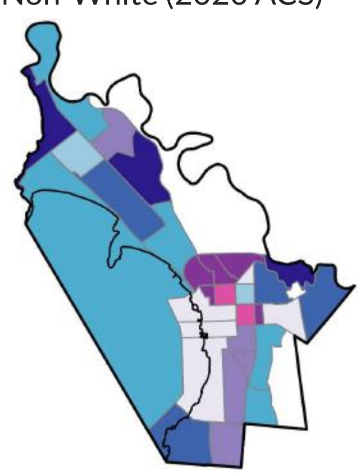
VARIOUS DEMOGRAPHICS* ARE AT GREATER RISK AGAINST ISSUES THAT IMPACT CITIES

*Other demographics at risk besides those illustrated indude:

- Hispanic population
- Individuals that had strokes
- Children younger than 5
- Adults older than 65
- Individuals exposed through daily commuted (walking or public transportation)
- Individuals living in areas with hazard risk like sewage overflows



% Non-White (2020 ACS)



% Households with Annual Income < $25,000 (2020 ACS)

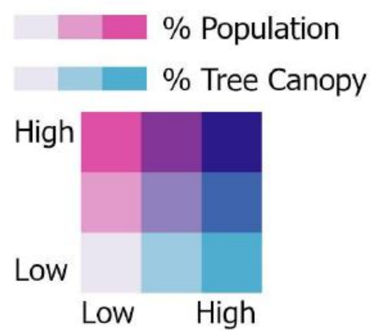


Figure 4: These maps show percent existing tree canopy cover in relation to two demographic groups that are highly interrelated and typically within the most susceptible groups against environmental challenges. Shades of pink indicate tree canopy percentage by block group, with the darkest shade indicating higher percentages. Meanwhile, shades of blue indicate percentage of residents within each of the demographic groups, with the darkest shade indicating higher percentages.

COMMUNITY RESILIENCE

Environmental Stressors & Neighborhood Prioritization

With an increase in severe storms and extreme weather across the country, flooding and rising temperatures are two environmental challenges that impact the city of Burlington. Using both the Urban Flood Risk Mitigation and the Urban Cooling modules of the Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) tool, we were able to identify census block groups that are more at risk of flooding and high temperatures with current tree canopy.

The maps below can be used to determine tree planting allocation to strengthen community resilience against flooding and rising temperatures.

Mitigation Capacity by Local Vegetation

Flooding is of great concern for Burlignton. Trees can be critical in bank stabilization, water quality protection, and absorbing water during high precipitation events. Surface runoff retention **(a)**, as mapped with the Urban Flood Risk Mitigation module of the InVEST tool, represents the capacity for the current vegetation and soil to retain water during rain events. Areas with low runoff retention may benefit from increased tree plantings due to the capacity of vegetation acting as riparian buffers filtering runoff and absorbing precipitation into the soil. The heat island effect has a considerable impact on cities, and rising temperatures can result in fatalities (particularly among the elderly and those with cardiovascular diseases). The capacity of local vegetation to mitigate rising temperatures **(b)** varies throughout Burlington's urban landscape.

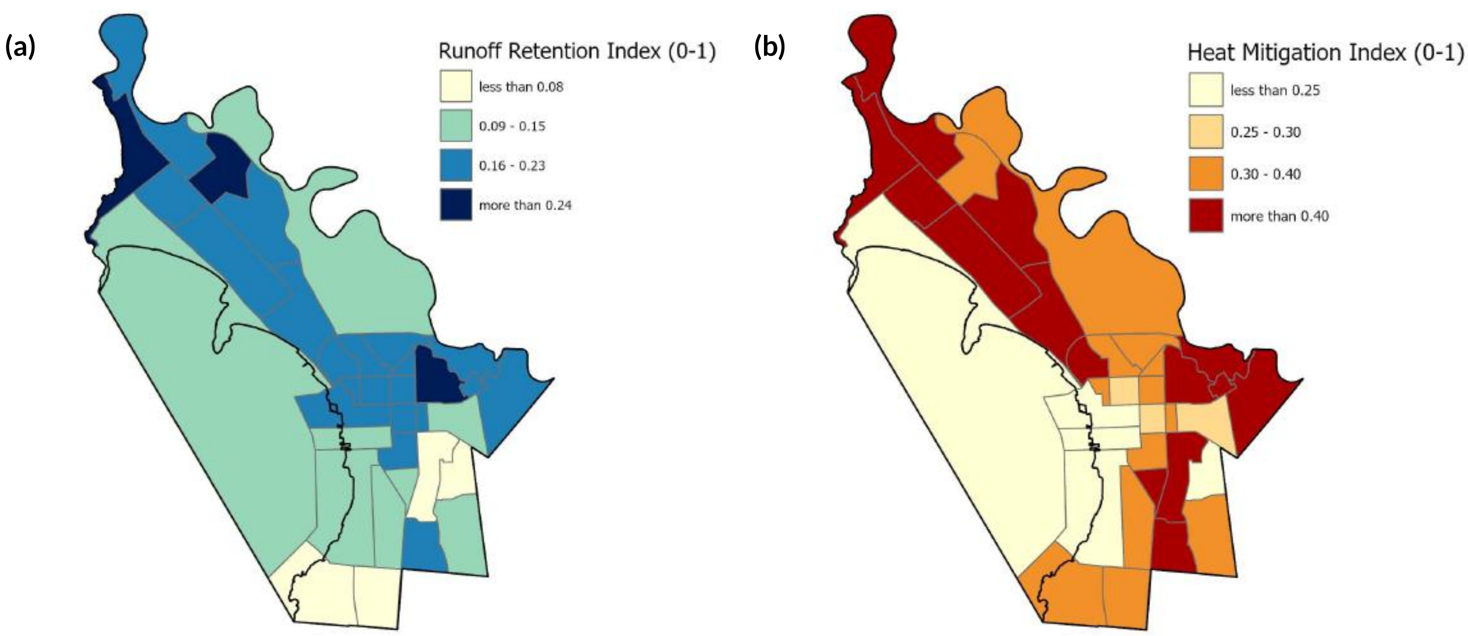


*Figure 5: **(a)** The runoff retention index indicates retention of surface runoff as mapped. The map ranges from zero (indicating low retention of runoff) to one (indicating high retention of runoff). **(b)** The heat mitigation index ranges from zero (low mitigation capacity) to one (high mitigation capacity) and was modeled with InVEST.*

LANDCOVER

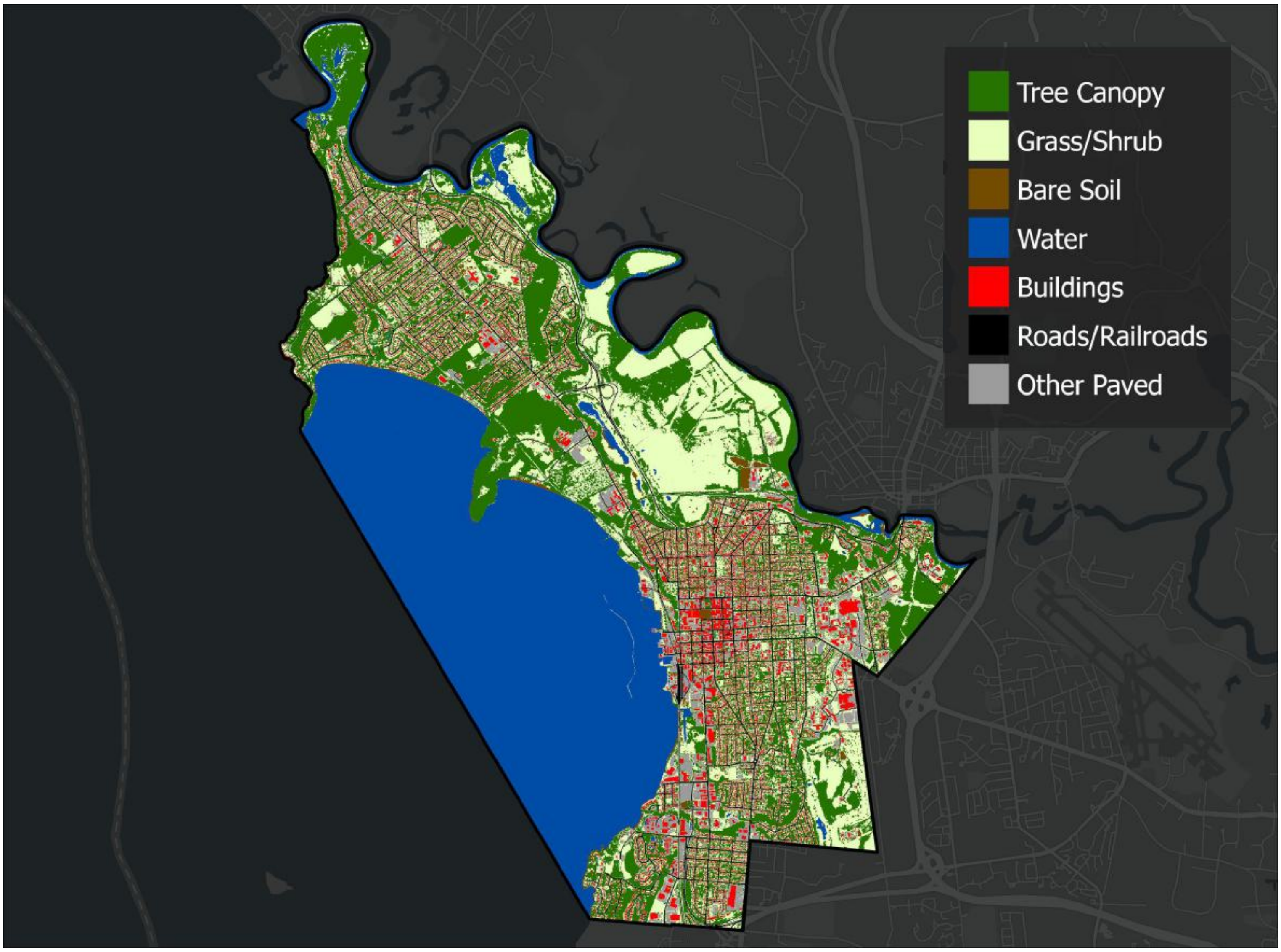


Figure 6. The new 2023 landcover for Burlington *was used in this assessment to quantify existing tree canopy, possible tree canopy - vegetated, possible tree canopy - impervious, and not suitable. The following terminology is used throughout this report.*

Key Terms

Existing Tree Canopy - The amount of tree canopy present when viewed from above using aerial or satellite imagery.

Possible Tree Canopy - Vegetated: Grass or shrub area that is theoretically available for **the** establishment of tree canopy.

Possible Tree Canopy - Impervious: Asphalt, **concrete** or bare soil surfaces, excluding roads and buildings, that are theoretically available for the establishment of tree canopy

Not Suitable - Areas where it is highly unlikely that new tree canopy could be established (primarily buildings and roads).

Measuring Tree Canopy Change

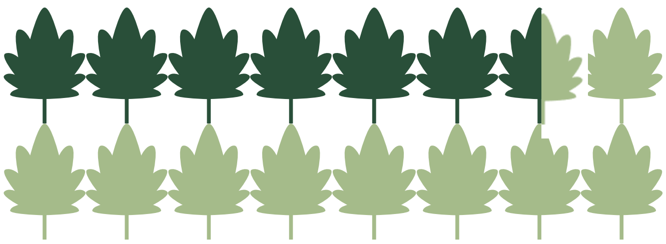
Area Change - the change in the **area of** tree canopy between the two time periods.

Relative % Change - the magnitude of change in tree canopy based on the amount of tree canopy in 2014.

Absolute % Change - the percentage point change between the two time periods.

TREE CANOPY METRICS

40% *of Burlington's land is covered by tree canopy*



Tree canopy and tree canopy change were summarized at various geographical units of analysis, ranging from tax parcels to watersheds. These tree canopy metrics provide information on the area of Existing and Possible Tree Canopy for each geographical unit.

Existing Tree Canopy

Cities commonly have uneven distribution of tree canopy, a pattern that applies to Burlington. There are some 10-acre hexagons with less than 5% tree canopy and others with nearly 100% tree canopy (Figure 7). This unequal distribution can be traced back to Burlington's history of development patterns and open space planning. Those residents who live and work in more treed areas (darker green hexagons) benefit disproportionately from the ecosystem services that trees provide. Conversely, the more urbanized regions of the Burlington have lower amounts of tree canopy and therefore receive fewer ecosystem services from trees.

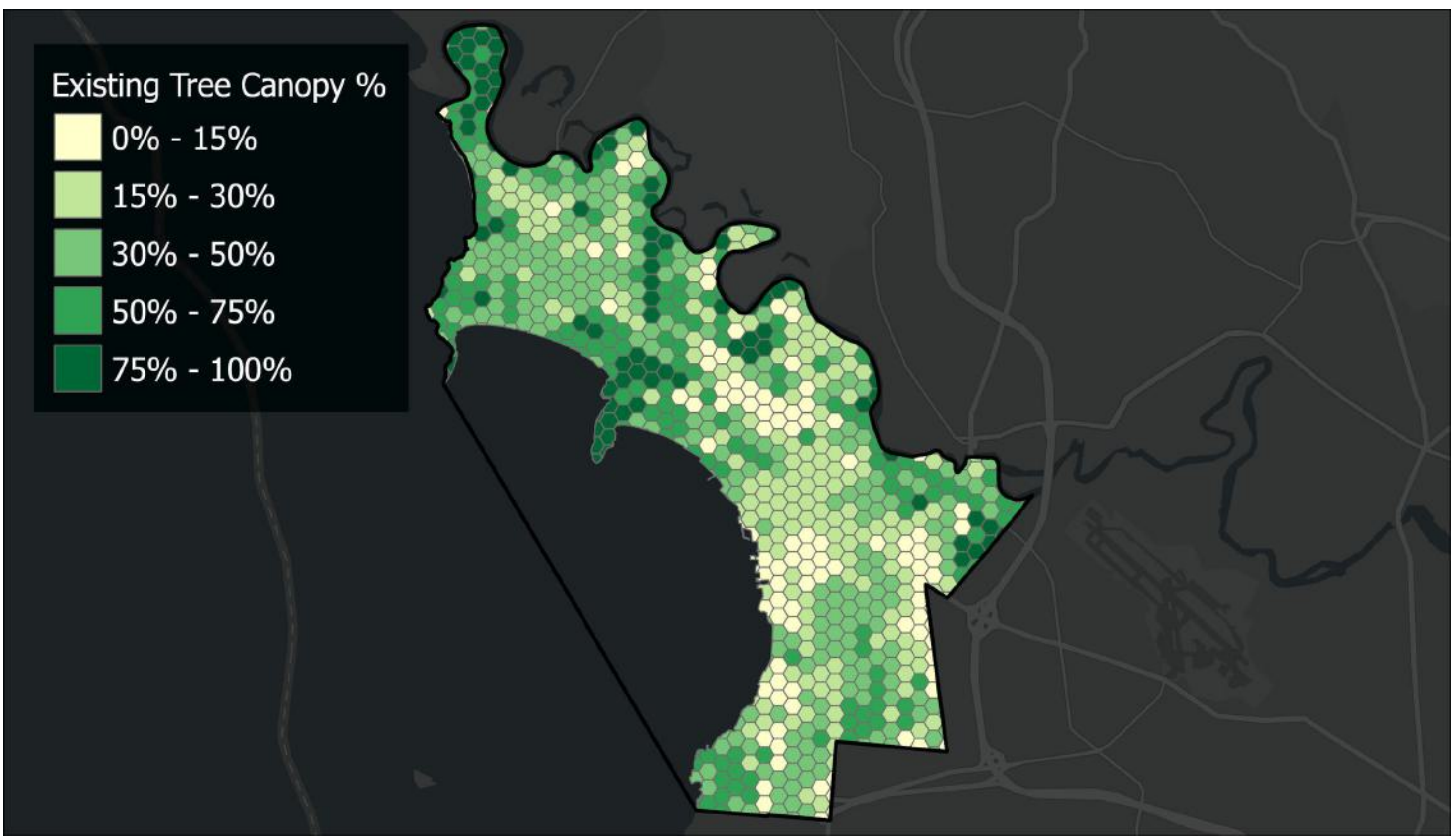


Figure 7. Existing tree canopy percentage for 2023 conditions summarized using 10-acre hexagons. For each of the hexagons, the percent tree canopy was calculated by dividing the amount of tree canopy by the land area, which excludes water. Using hexagons as the unit of analysis provides a standard mechanism for visualizing the distribution of tree canopy without the constraints of other geographies that have unequal area (e.g., zip codes).

Possible New Tree Canopy

There is available space in Burlington to plant more trees. In this assessment, any areas with no trees, buildings, roads, or bodies of water are considered Possible-Vegetation and represent locations in which trees could theoretically be established without having to remove hard surfaces. Many factors go into deciding where a tree can be planted with the necessary conditions to flourish, including land use, landscape conditions, social attitudes towards trees, and financial considerations. Examples include golf courses and recreational fields. While there is open space to plant trees, there is a direct conflict in use; thus, the Possible-Vegetation category should serve as a guide for further field analysis, not a prescription of where to plant trees. With 2,181 acres of land (comprising 33% of the the city's land area) falling into the Possible-Vegetation category, there remain significant opportunities for planting trees and preserving canopy that will improve the city's total tree canopy in the long term.

In Burlington's most densely urbanized areas, significantly increasing the tree canopy will be difficult; nevertheless, it remains vitally important to strive for canopy gains. In the Burlington's residential areas, healthy natural regeneration of the existing tree canopy and planting new trees will be important. There is often a "plant and forget" cycle in residential areas, where trees are generally planted when homes are built, without the follow-up to replace trees as they decline to establish the next generation of canopy.

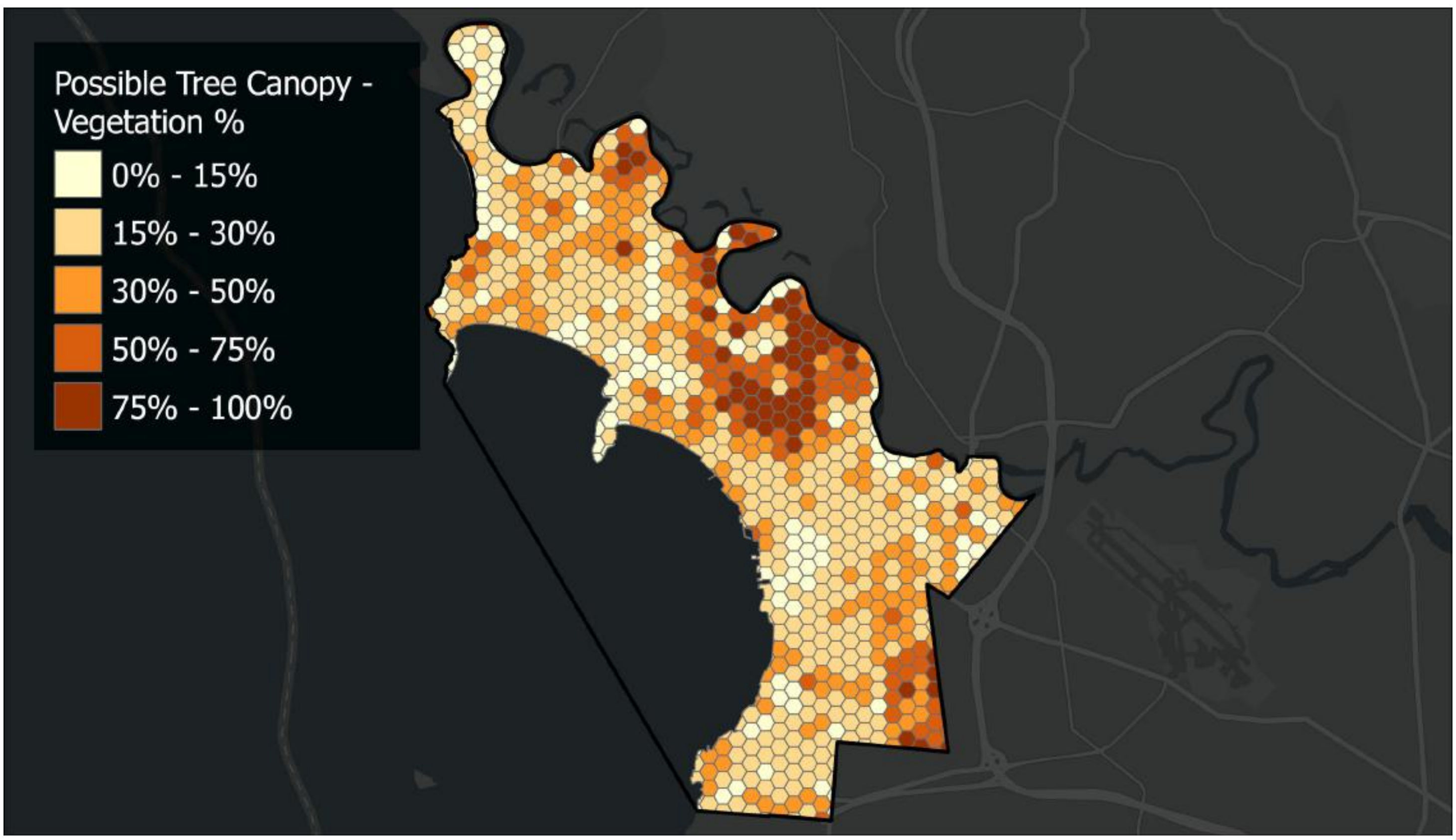


Figure 8. Possible Tree Canopy consisting of non-treed vegetated surfaces summarized by 10-acre hexagons. These vegetated surfaces that are not currently covered by tree canopy represent areas where it is biophysically feasible to establish new tree canopy. It may be financially challenging or socially undesirable to establish new tree canopy on much of this land. Examples include golf courses, recreational and agricultural fields. Maps of the Possible Tree Canopy can assist in strategic planning, but decisions on where to plant trees should be made based on field verification. Surface, underground, and above surface factors ranging from sidewalks to utilities can affect the suitability of a site for tree canopy planting.

Canopy Change Distribution — Absolute % Change

Burlington has experienced a net decrease in tree canopy over the 2014 to 2023 time period, but the story of change is more nuanced, with a mix of loss and gain. All areas of the city experienced both gains and losses of tree canopy, though some areas saw a net increase and others a net decrease. Removal and die off of mature trees resulted in the loss of large patches of tree canopy. Mature trees with large crowns contribute substantially to tree canopy and take decades to grow, so their loss creates large, localized declines in tree canopy. Even though there was evidence of tree loss throughout the Burlington, planting efforts, preservation programs, and natural growth helped offset losses and stem decline. Canopy begets canopy as almost all trees gain canopy on an annual basis. Trees, when properly cared for, can mitigate environmental risks challenges relating to the urban environment such as flooding, air quality, and urban heat island. This makes tree canopy an important part of a the city's infrastructure.

The trajectory of Burlington's tree canopy in the future is uncertain. There are both environmental and anthropogenic risks facing canopy cover. Invasive species could pose a serious threat if not identified and controlled early. Natural events such as storms can have a mixed impact on the canopy. In conserved areas, tree canopy will return through natural growth, but in urbanized areas, trees lost to storms will need to be replanted. Climate change may cause trees to grow more quickly but could also result in inhospitable conditions for native species. Anthropogenic factors include preservation and conservation efforts and the strength of tree ordinances. Managing these risks will be key to achieving sustained canopy growth.

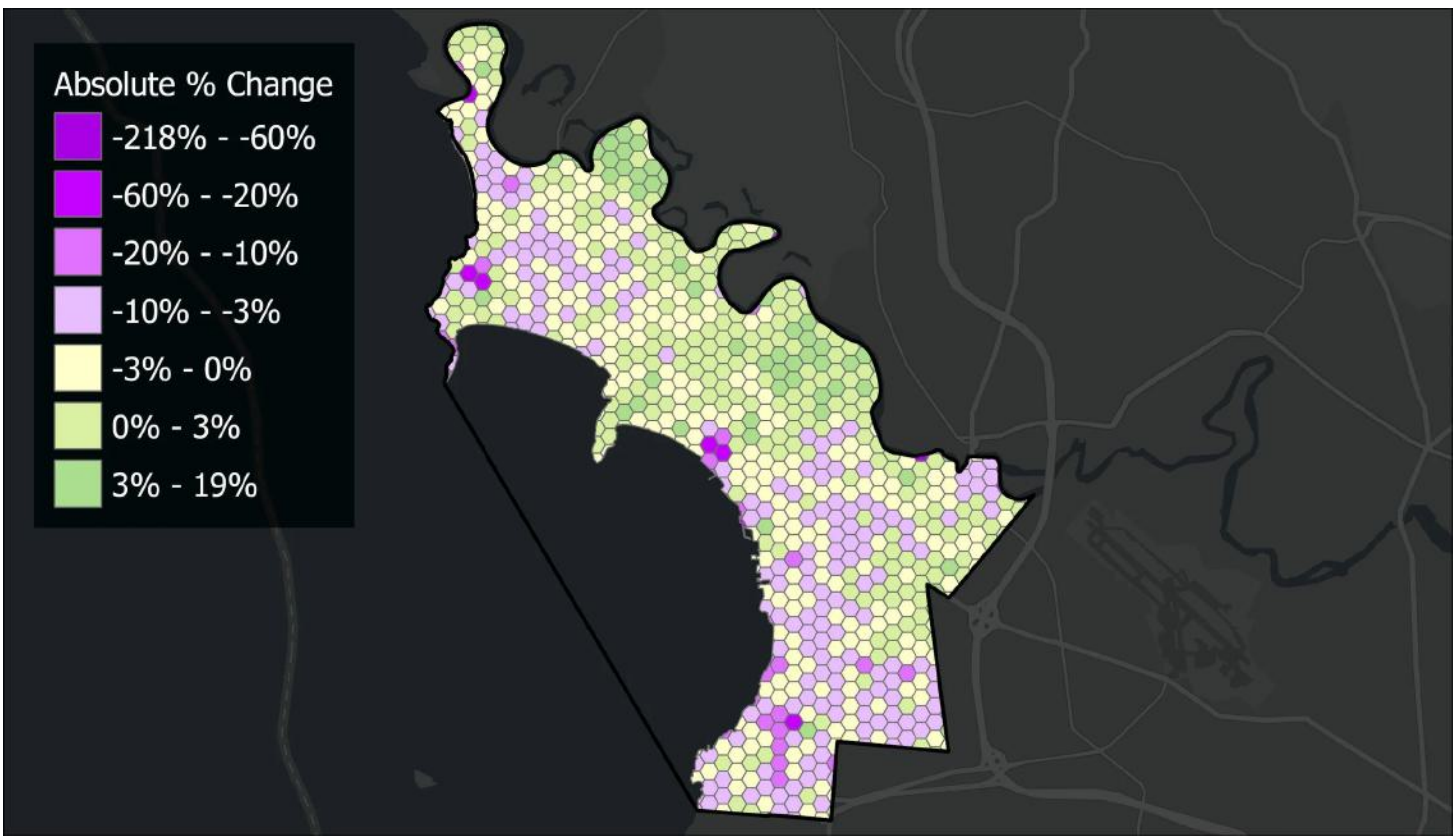


Figure 9: Tree canopy change summarized by 10-acre hexagons. Darker greens indicate greater gain, while darker purple reflects higher amounts of loss.

Canopy Change Distribution - Relative % Change

The magnitude of tree canopy change across Burlington can be measured by the relative tree canopy change over the 2014 - 2023 period. The relative change is calculated by taking the tree canopy area in 2014, subtracting the tree canopy area in 2023, then dividing this number by the area of tree canopy in 2014. Areas with the greatest change indicate that the canopy is markedly different in 2023 as compared to 2014. In some of the commercial and urbanized areas with little tree canopy in 2014, the growth of street trees resulted in a sizeable relative gain. Conversely, the removal of trees as a result of construction in sparsely treed areas resulted in substantial relative reductions in tree canopy.

The greatest relative gains in tree canopy were in locations where new plantings were carried out on areas with little tree canopy to begin with. Just as forest patches provide valuable ecosystem services, such as wildlife habitat, so do individual trees. In areas with low tree canopy, an individual tree can have an outsized impact, through ecosystem services such as providing a refuge from the sun while watching a baseball game, shading cars in a parking lot or helping to reduce homeowner air conditioning costs. Though growing conditions in Right of Way (ROW) areas can be tough, they are a tool to increase canopy in low coverage, often impervious surface dominated areas. Natural growth can provide gains in areas with robust canopy, but in areas with low canopy, such as commercial spaces, tree plantings are an important part a long-term plan to increase tree canopy and resulting ecosystem services.

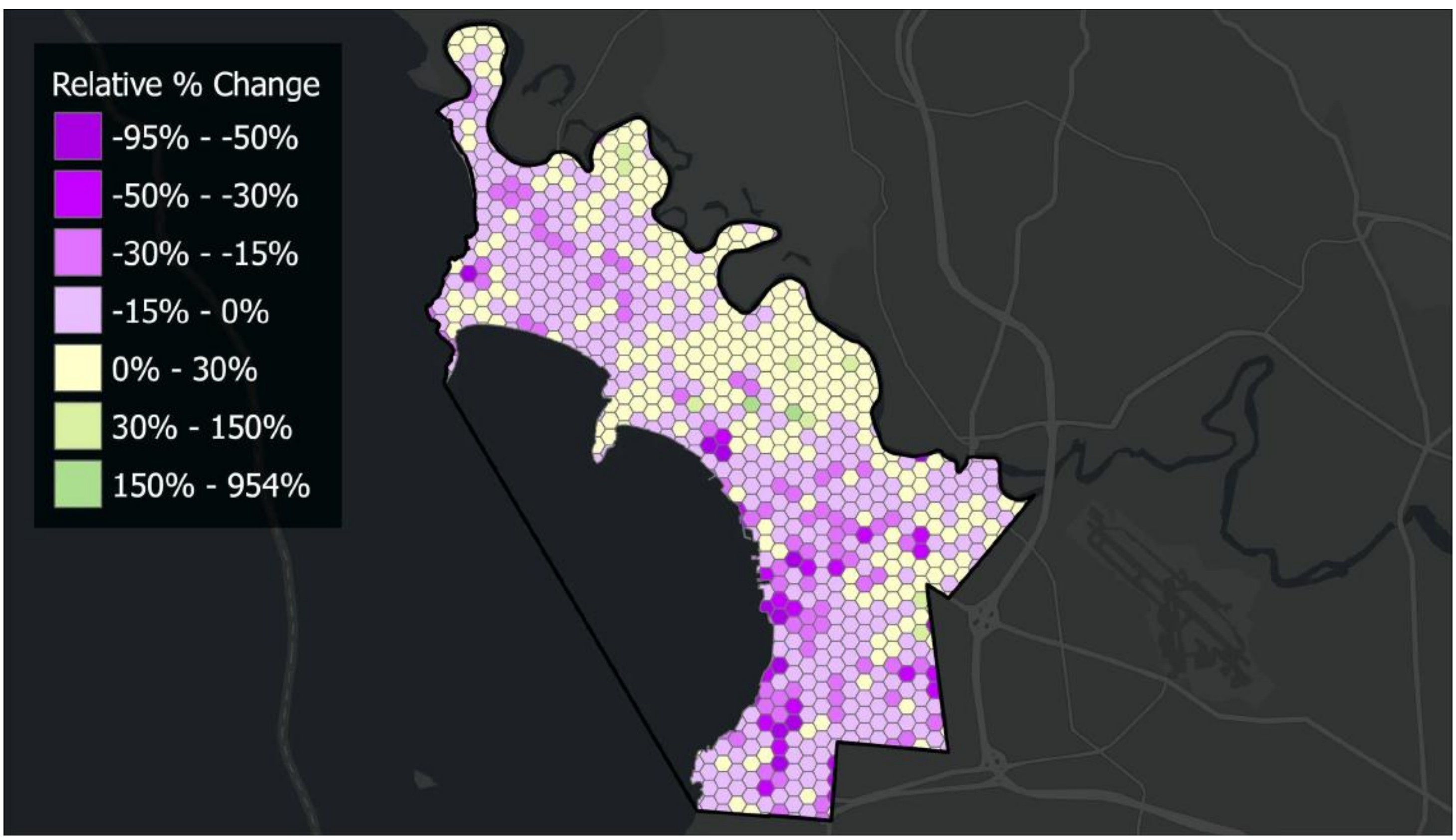


Figure 10: Tree canopy change metrics summarized by 10-acre hexagons. Relative tree canopy is calculated by using the formula (2014-2023)/2023. Colors are categorized by data quantiles. Darker greens indicate greater relative gain, while darker purple reflects a higher magnitude of loss.

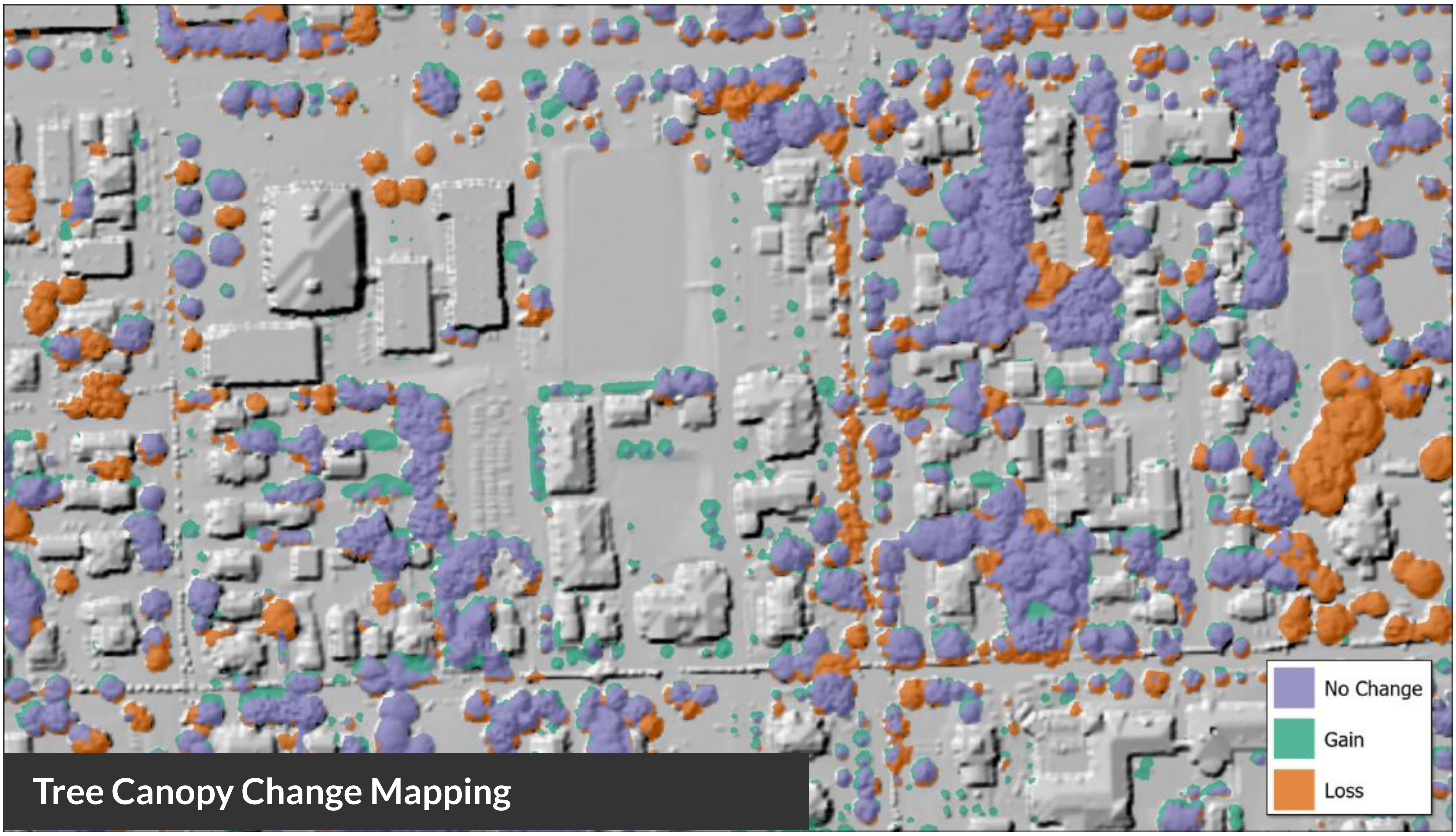


Figure 11: Tree canopy change mapping for the area surrounding S Willard St overlaid on 2014 LiDAR. This area experienced a mix of gain and loss.

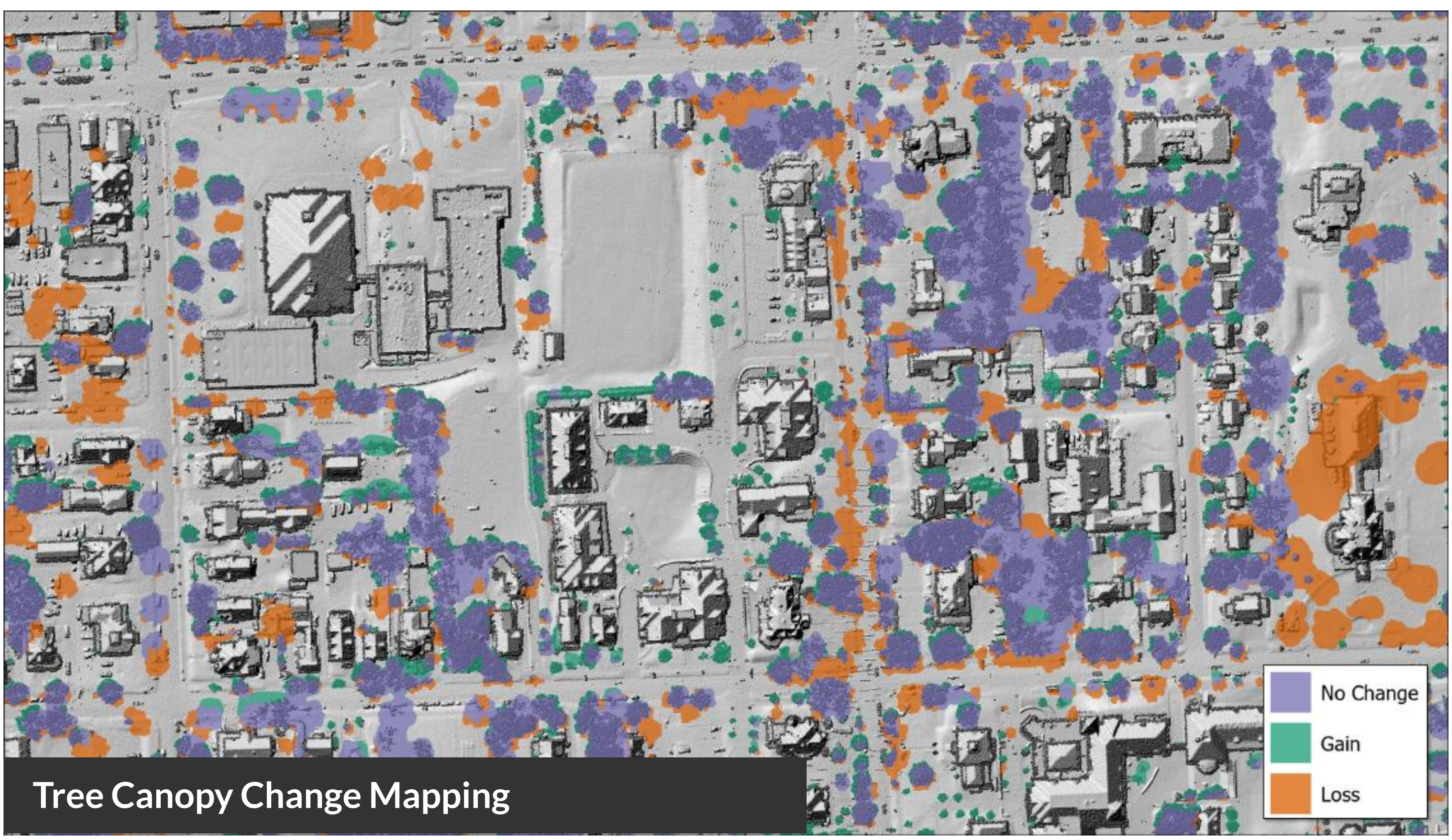


Figure 12: Tree canopy change for the same area above but overlaid on the 2023 LiDAR. The areas of gain appear rough now that tree canopy is present, and the areas of loss appear smooth due to the absence of tree canopy.

PATTERNS OF CHANGE

Numerous factors contribute to the wide range of tree canopy change patterns of Burlington. These include zoning, land use history, urban density, and landowner decisions. The examples that follow illustrate how these factors influence canopy change. Examining patterns and processes over the past decade can provide insights into how the canopy may change in the future.

Natural Succession Drives Growth

Growth of already existing canopy was the largest driver of Burlington's tree canopy gains. Tree planting and natural succession are slow but important processes for increasing urban tree canopy.

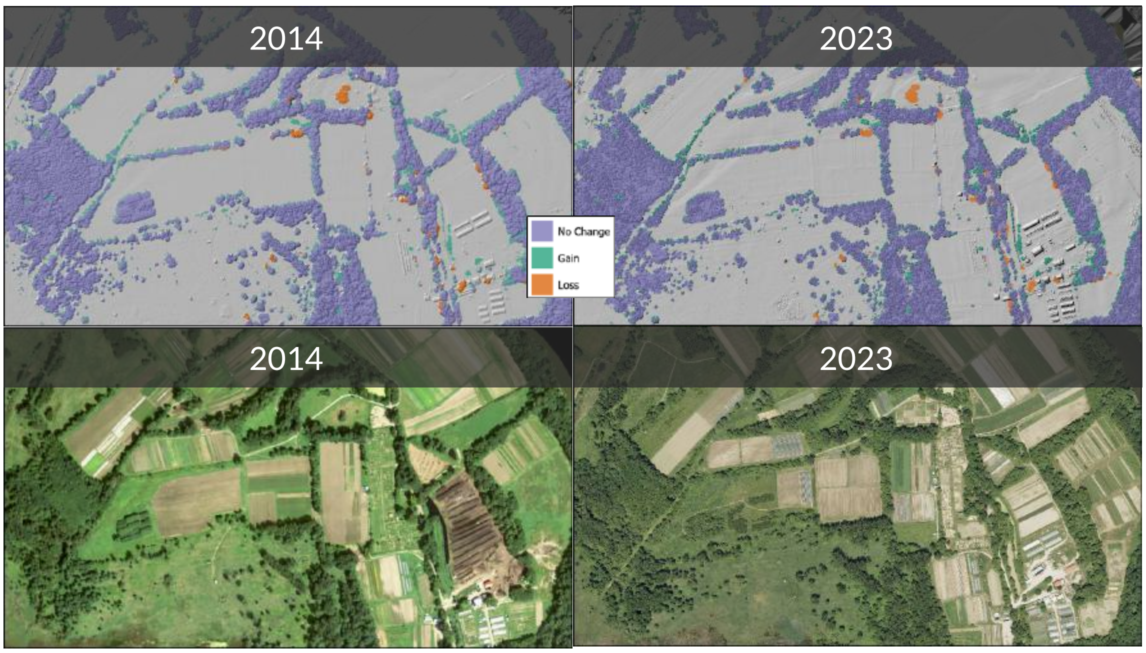


Figure 13. Natural growth in the Burlington Intervale created a net increase in tree canopy in the area.

Tree canopy gain

Agricultural Area

Natural Sucession

Natural Areas Provide Ecosystem Services

Forested areas provide important wildlife habitat, pollution mitigation, and outdoor recreation opportunites.

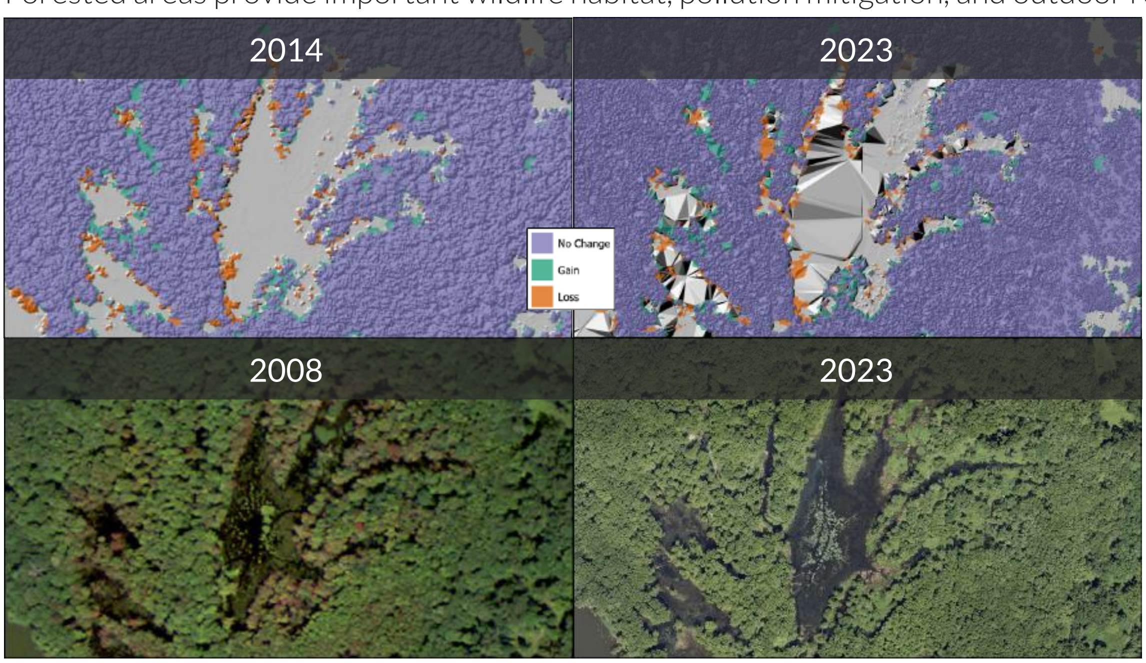


Figure 14. In the Derway Island Nature Preserve natural processes like storms result in downed branches and trees, which are quickly filled in with canopy from surrounding trees.

Stable Canopy

Protected Area

Wildlife Habitat

Residents are Key

Trees continue to grow and contribute canopy in established neighborhoods, but age, disease, invasive species, storms, and changing landowner preferences all contribute to removals. As a result, losses may outpace gains over time if replacement trees are not planted.

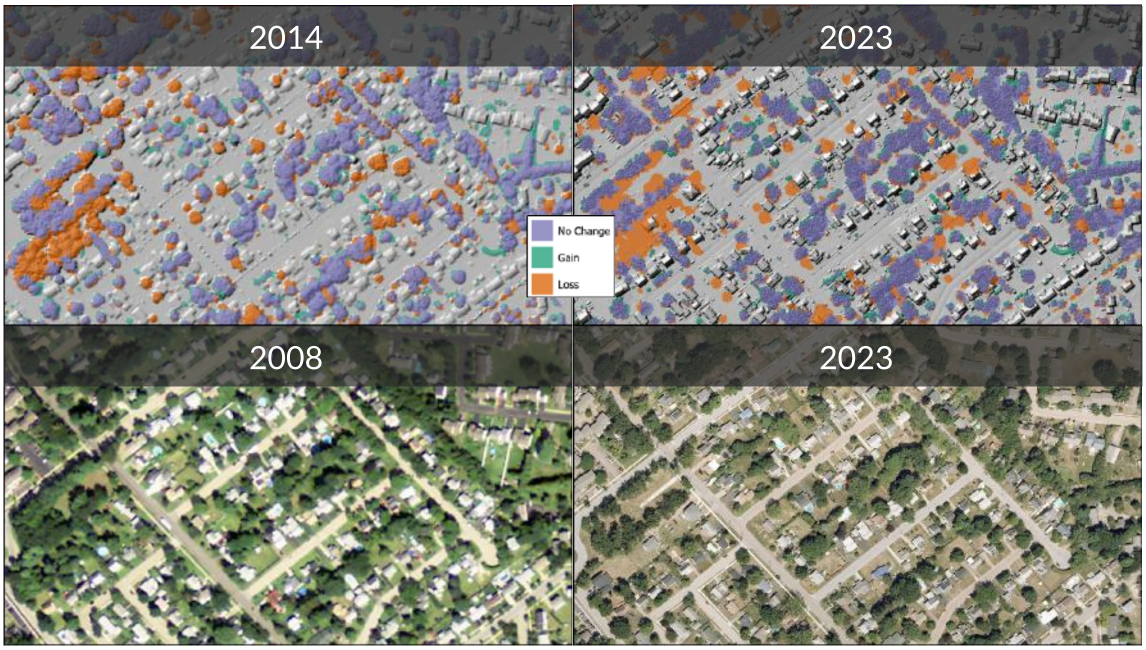


Figure 15. Natural growth of existing tree canopy helped to mitigate losses in this residential area off North Ave

Mix of Loss and Gains

Neighborhood

Widespread Tree Removal

Construction Associated with Tree Canopy Losses

Redevelopment is a natural part of a city's lifecycle and often needed to revitalize communities, create opportunities, and enhance quality of life for residents. But care should be taken to balance development needs with the essential ecosystem services that urban forest patches provide. Trees are often removed to provide space for new construction but new tree planting can help offset losses.

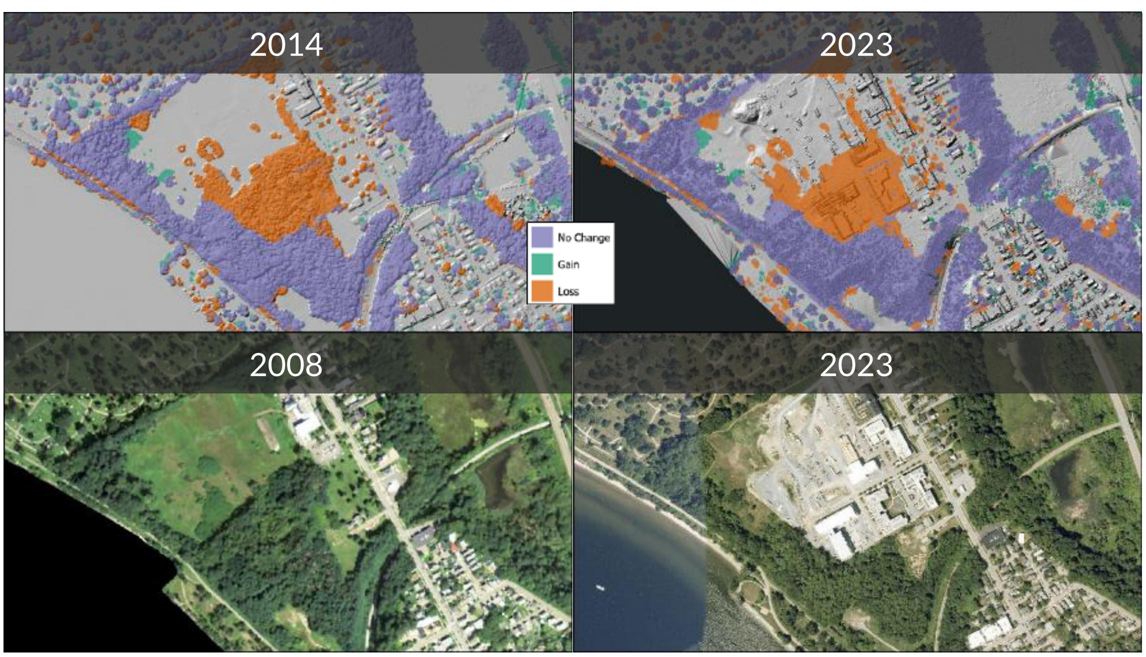


Figure 16. Construction for the redevelopment of the former Burlington College into housing, resulted in tree canopy loss.

Forest Patch Loss

Multi-Family Residential Area

New Construction

Wards

The city's official geographic boundaries are a useful way to summarize tree canopy and draw comparisons between parts of the city and allow communities to make informed decisions about their tree canopy. The differences in canopy between Burlington's wards is the result of land use history and changes to the built environment. Areas with large parks and open space or those that have lower density development tend to have more canopy, while areas that are more dense with commercial or industrial use tend to have less tree canopy. Ward 4 had the highest tree canopy coverage at 53% followed by Ward 1 at 47% and Ward 7 at 46% . Ward 3, which contains the downtown area, had the lowest tree canopy coverage at 17. Ward 7 had the largest area of tree canopy with 784 acres, representing 30% of the city's total tree canopy area. Each ward experienced both gain and loss of tree canopy within their boundaries, but overall losses outpaced gains in all but one of the city's wards. Only Ward 2, saw a net increase, gaining 6 acres of tree canopy between 2014 and 2023. Ward 5 saw the largest declines, losing 38 acres of tree canopy, followed by Ward 4 which lost 26 acres.

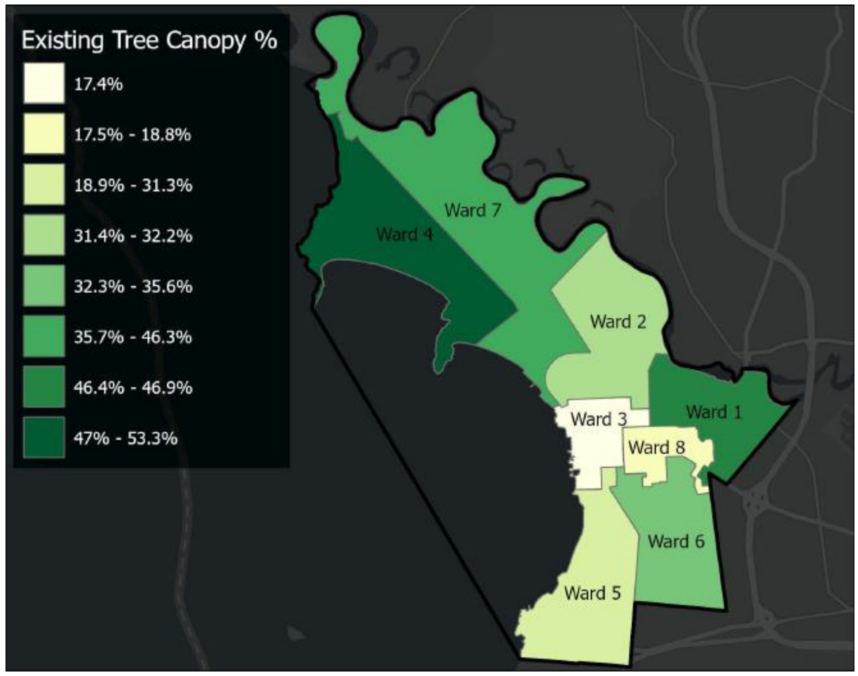


Figure 17: Existing tree canopy percentage for 2023 conditions summarized by Ward.

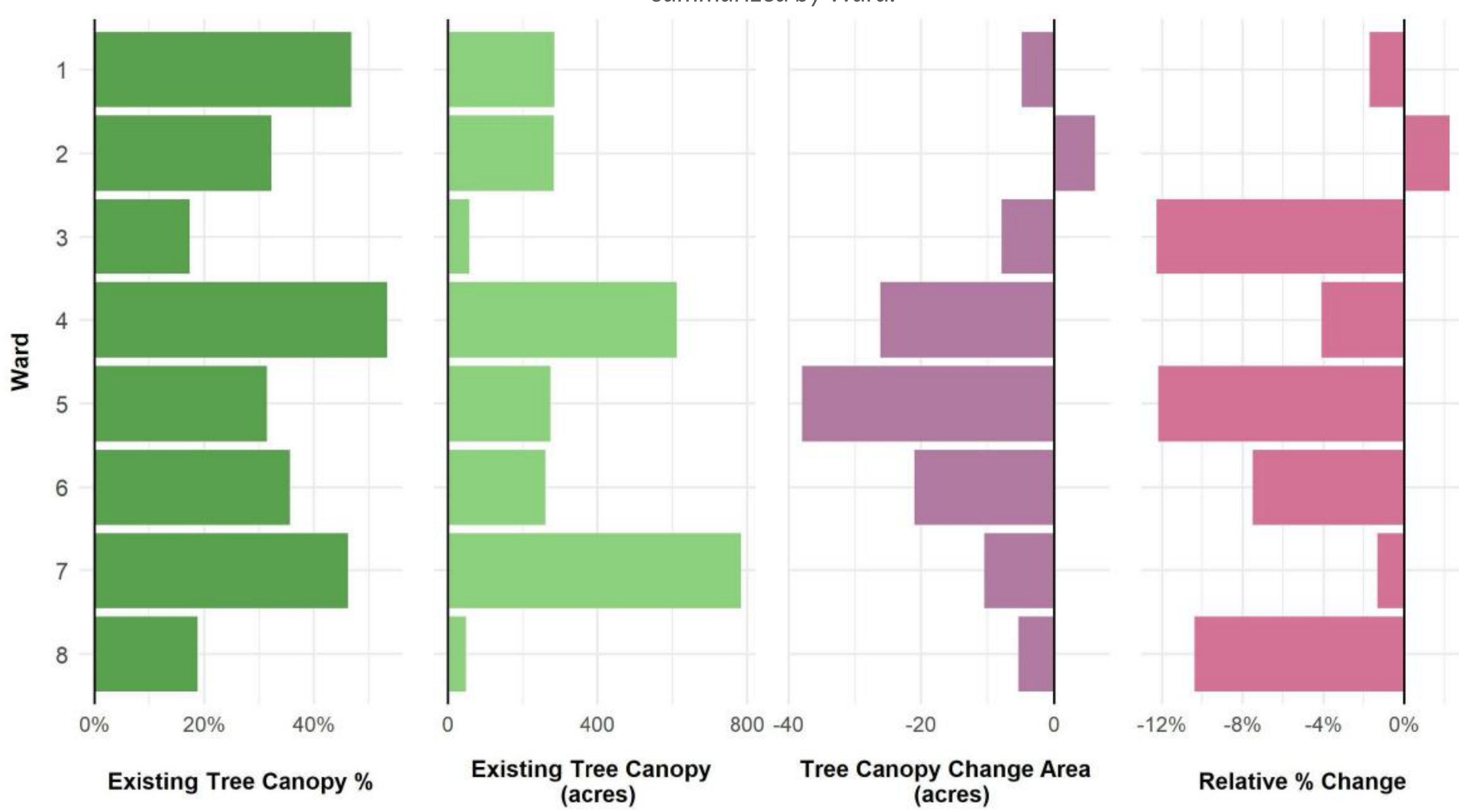


Figure 18: Tree canopy and change metrics summarized by Ward.

Parcel Land Use

Land use is how humans make use of the land including the economic and cultural activities (e.g., agricultural, residential, and commercial) practiced in the city. Land use is not to be mistaken by land cover which refers to landscape features, such as trees, buildings, water and other classes mapped as part of this study. Understanding the location and land-use types that tree canopy falls into is important information for coordination and planning purposes. Tree canopy cover was calculated in terms of percent of the land area within each district (Figure 20) to understand the proportion of canopy coverage for each, and as a percent of city-wide total tree canopy area (Figure 19) to determine contribution to Burlington's overall tree canopy.

The largest share (978 acres or 37.5%) of Burlington's tree canopy falls within residential parcels. Residential parcels also saw the largest decrease in tree canopy over the T1-T2 period with a net loss of 66.5 acres. The next largest share, 627 acres or 24% of the city's tree canopy exists on city property parcels. This land use saw the second largest losses with a decrease of 35 acres of tree canopy. The largest gains in tree canopy was seen on farmland parcels which saw a net increase of 9.7 acres of tree canopy.

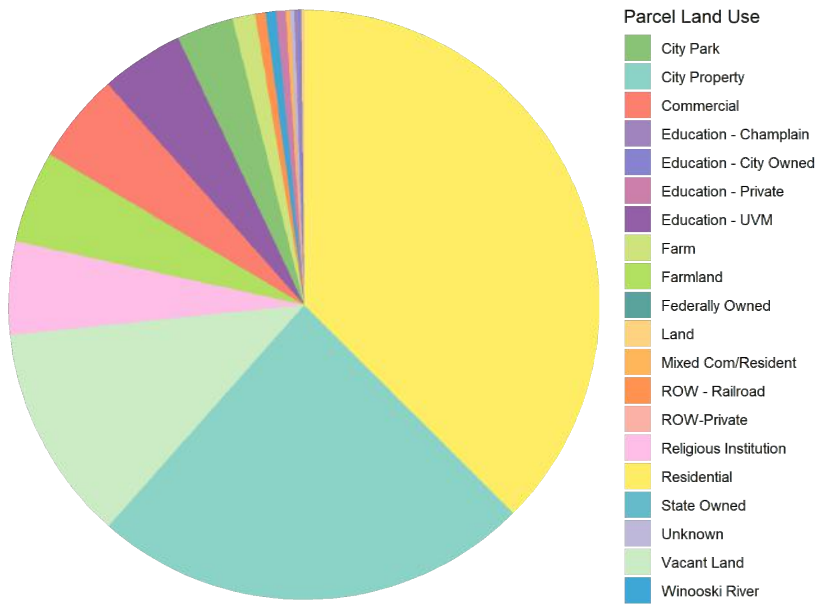


Figure 19: Burlington Tree Canopy Distribution by parcel land use.

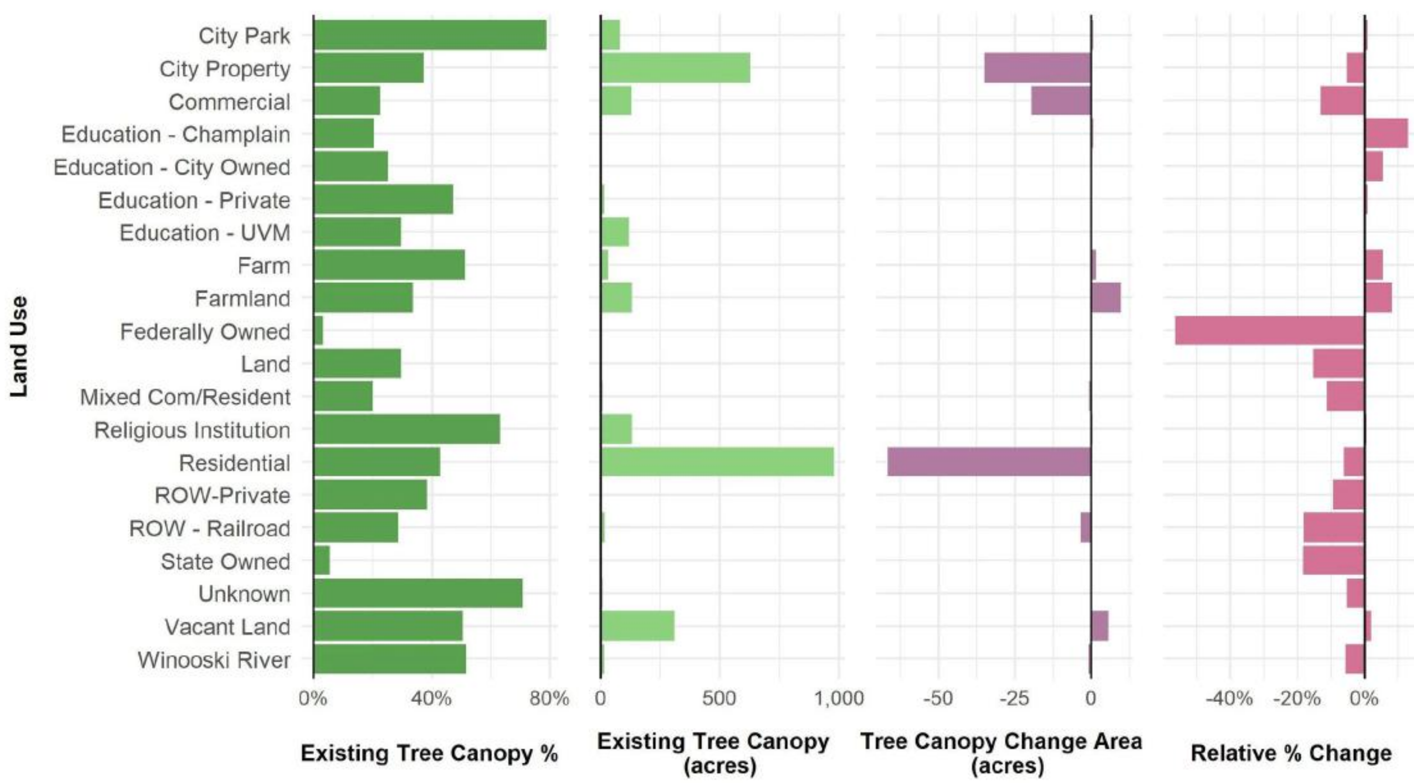


Figure 20: Tree canopy and change metrics summarized by parcel land use.

Watersheds

Watersheds represent areas in which water moves and drains in order to reach streams, lakes, and other waterbodies. Burlington's tree canopy is an important factor in managing the health of the city's three watersheds. The land use within a watershed can have large impacts on its health, including water quality and flood risk. Maintaining robust tree canopy can mitigate problems associated with impervious surfaces within a watershed by managing stormwater runoff, filtering pollution, and stabilizing the banks of streams and rivers. Existing tree canopy coverage within each watershed ranged from 37.5% in Burlington Direct Land Drainage, to 42% in the Tributaries to Lower Winooski watershed, to 50% in Shelburne Bay Direct Drainage. In the Burlington Direct Land Drainage watershed, 106 acres of tree canopy were lost between 2014 and 2023. The Shelburne Bay Direct Drainage watershed lost 12 acres, though this resulted in a higher magnitude of loss with a relative percent change of -8.3%. The Tributaries to Lower Winooski watershed is the only one to see a net increase in tree canopy, with an 11 acre increase over the 2014-2023 time period.

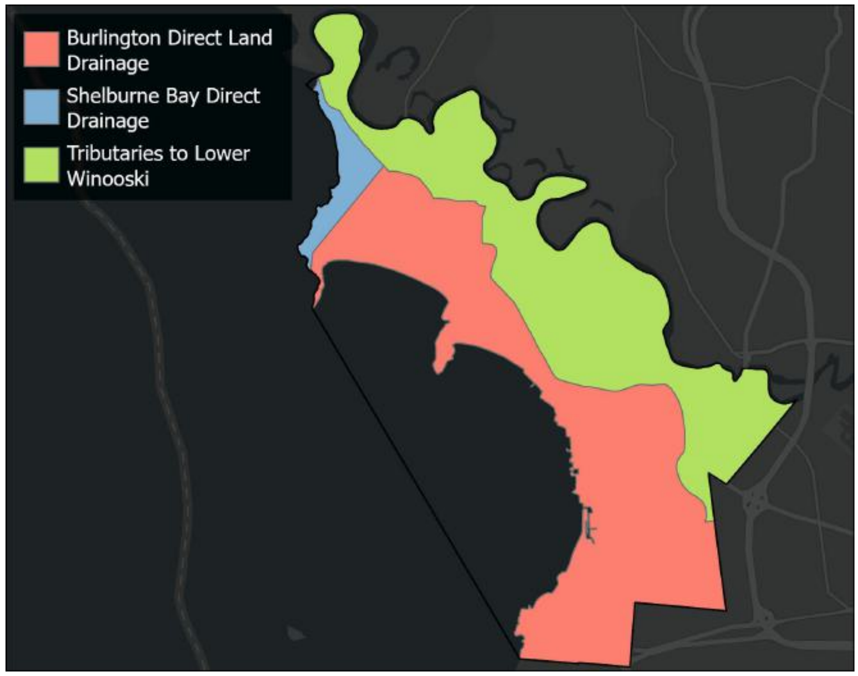


Figure 21: Burlington watersheds by which tree canopy metrics were summarized.

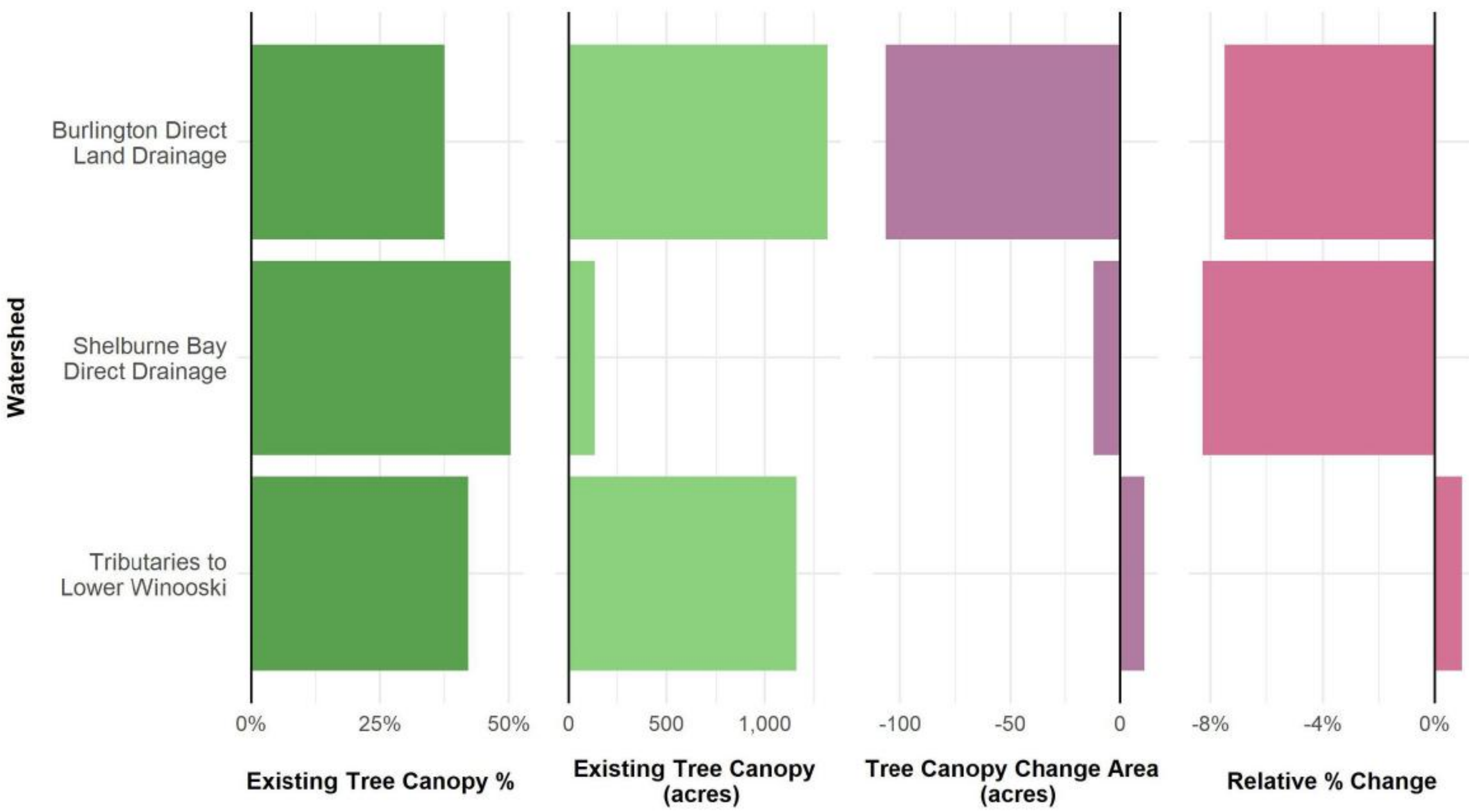


Figure 22: Tree canopy and change metrics summarized by watershed.

TREE HEIGHT DISTRIBUTION

Tree height is a useful proxy for tree age. Diverse height structure indicates a healthy and varied tree age distribution. Even-aged urban tree canopy results when trees were planted around the same time and can lead to a sudden and widespread loss in canopy when many mature trees reach the end of their lifespan at the same time. Age diversity supports a more resilient canopy over time, ensuring that that not all trees reach maturity at the same time.

In Burlington, the most prevalent height of trees is 40-50 feet, with the number of trees in each height class dropping dramatically as the height of trees increases past 60ft tall (Figure 23). There are few trees greater than 110ft tall, which can be expected in an urbanized area.

Mature trees have greater capacity to offer ecosystem services to urban residents. Loss of taller, more mature trees results in loss of those benefits and potential impacts to the overall canopy cover. It will be important to preserve trees in the 50-80 foot height range, while planting a variety of new trees to continue the lifecycle. Proper care and monitoring will help to develop the next generation of trees that reach maturity and balance the distribution. Having trees with a broad age distribution, as well as a variety of species, will ensure that a robust and healthy tree canopy is possible over time. Specific information on individual trees is collected via on-the-ground field inventories and was not captured in this assessment.

Tree Height Distribution

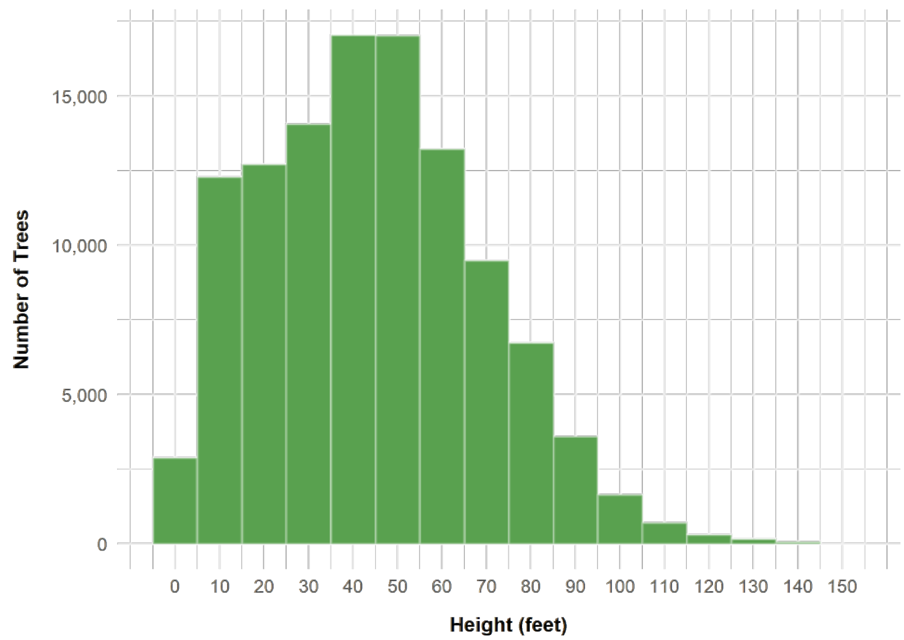


Figure 23: Histogram of the tree canopy height displaying the number of trees in each 10-foor bin.

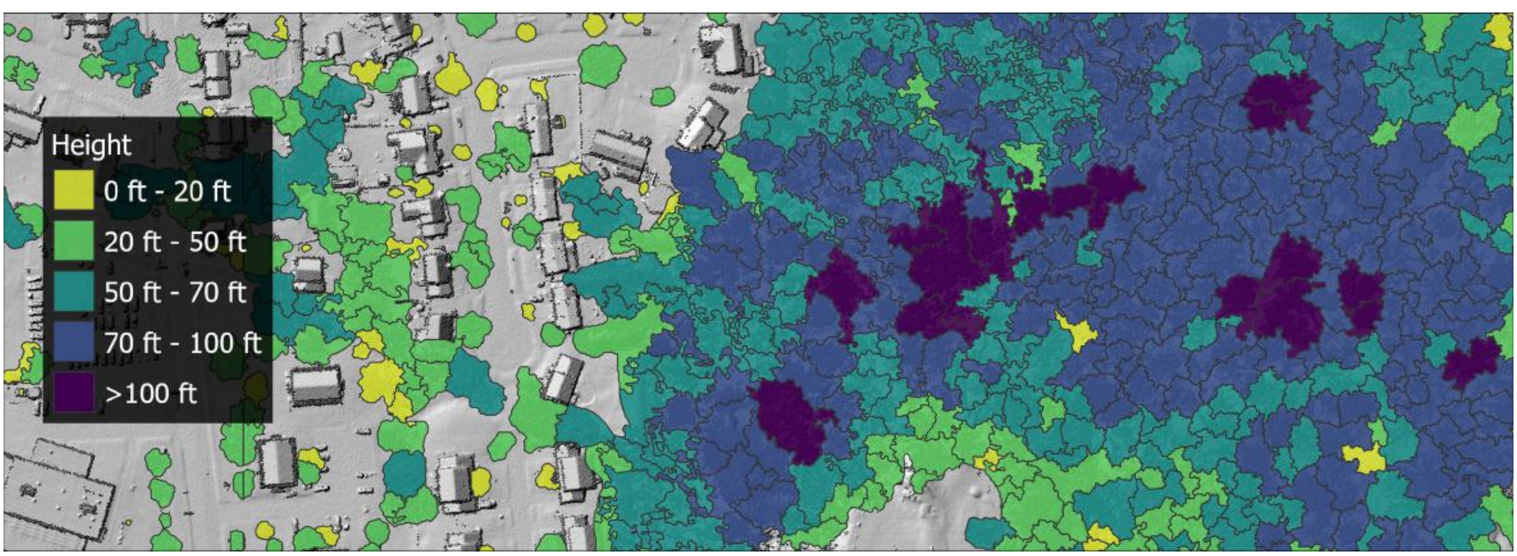


Figure 24: Example of the height classification with darker green representing taller canopy. Burlington's tree canopy was segmented into polygons approximating individual trees. Each of these polygons was then attributed with the height from the 2023 LiDAR.

FOREST PATCH SIZE

Along with the size, distribution, and diversity of urban forests, structure is another key factor to consider in management decisions. Urban forests are made up of patches of tree canopy interspersed throughout the landscape. This project used an algorithm to divide Burlington's tree canopy into five forest patch classes based on their morphology.

Forest patches, large and small, serve important roles in urban landscapes. Small patches and individual trees can provide access to natural areas and associated benefits in urban settings and can serve as stepping stones for wildlife traveling between larger forest patches. It is critical to maintain large patches of forest since they are necessary for certain ecosystem services that smaller patches cannot provide. In addition to producing outsized benefits like pollution mitigation and cooling, large forest patches can accommodate species with larger home ranges and species that rely on interior forest. This supports biodiversity by providing habitat for a wider variety of species than small patches alone can support.

The largest share of Burlington's tree canopy exists in small patches, with the total area of that size class adding up to 1,055 acres (Figure 26). Very large patches (438 acres), large patches (433 acres), and medium patch (427 acres) total areas were relatively consistent, though their locations in Burlington are concentrated in the northern portion of the city (Figure 25). Isolated trees made up the smallest total area of the five size categories covering a total of 266 acres throughout the city.

Forest Patch Size Classes

Figure 25: Overview of Burlington forest patches by size (left). Example close-up of forest patch size classification (right). Forest patches are groups of trees surrounded by other, non-forested, land cover types.

Forest Patch Total Area

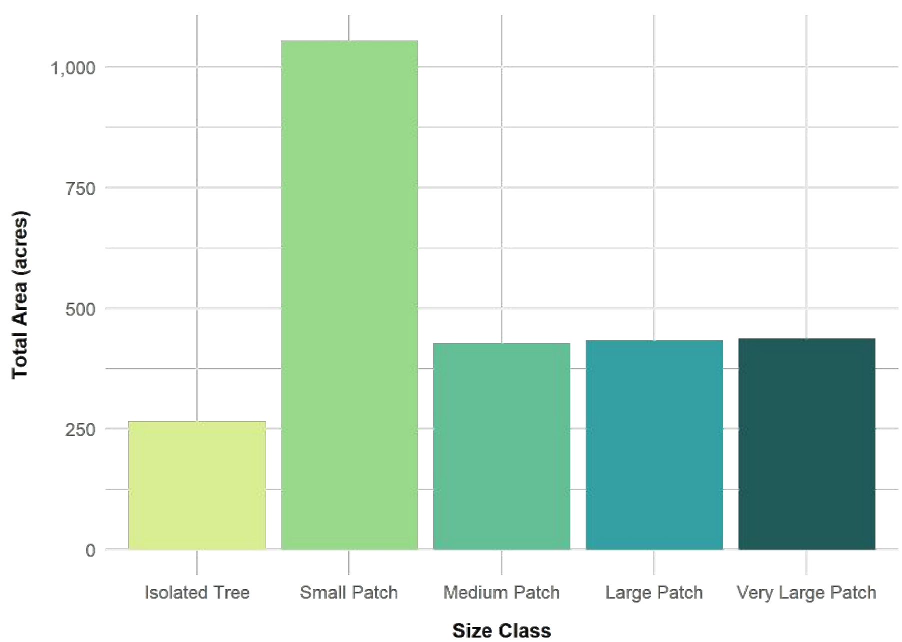
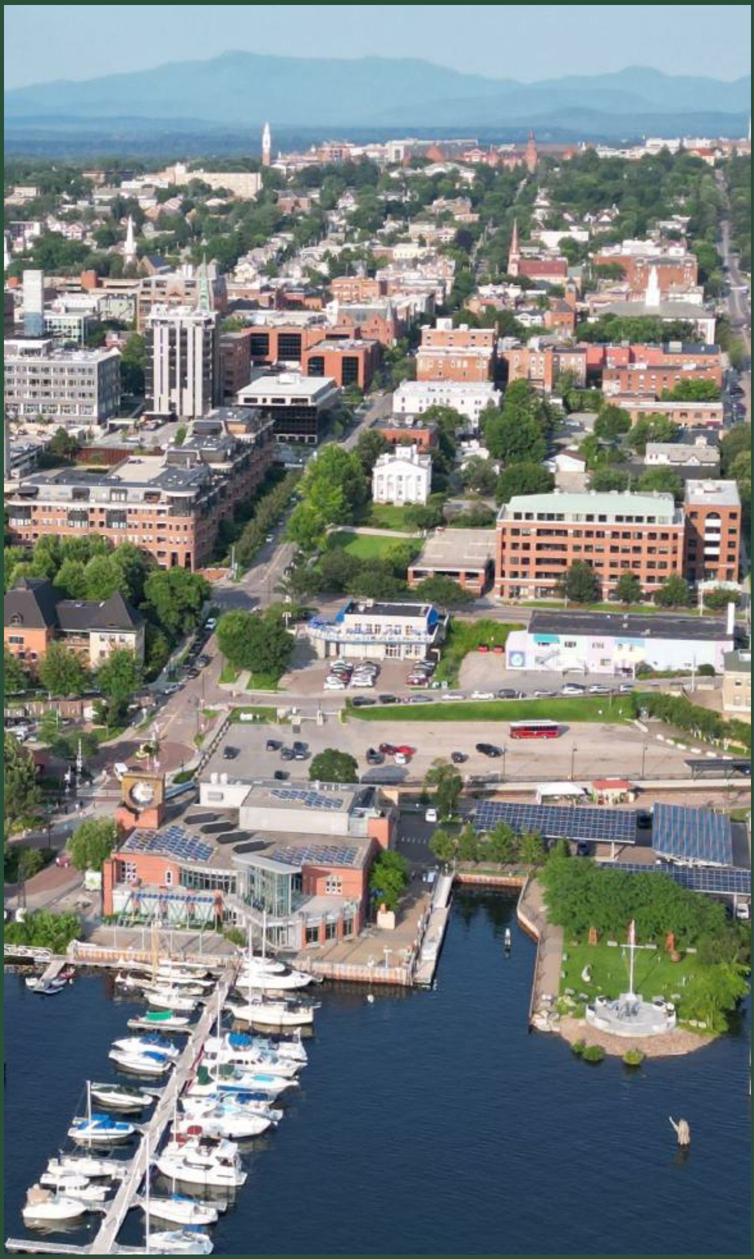


Figure 26: Total area of each forest patch size class.

This assessment was carried out by the University of Vermont Spatial Analysis Lab in collaboration with Burlington, Vermont. The methods and tools used for this assessment were developed in partnership with the USDA Forest Service. The source data used for the mapping came from the City of Burlington, the State of Vermont, and the USDA. The project was funded by the City of Burlington Additional support for this project was provided by the Gund Institute for Environment at the University of Vermont. Computations were performed on the Vermont Advanced Computing Core supported in part by NSF award No. OAC-1827314.



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