URBAN GREENING EXPLORER

An Interactive Dashboard for Exploring Vancouver’s Public Trees

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# Introduction

## Background

Urban trees are critical green infrastructure. They clean the air, capture carbon, absorb rainwater, providing habitat, improving our health and well-being, protect the city from storms, extreme heat, and the impacts of climate change (City of Vancouver, 2025a). Vancouver maintains extensive open datasets on its public trees and neighbourhoods, yet this information is distributed across portals and is not packaged for interactive, neighborhood-level exploration by students, community groups, or planners. An interactive dashboard can address this gap by combining point-level exploration of individual trees with neighborhood summaries and density-based comparisons.

## Problem Statement

While the datasets exist, they are not designed for everyday exploration. For example, a resident may wish to know which trees are in their local area, what species are most common, or how their neighborhood compares to others in terms of greenery. Existing static reports do not support this kind of place-based inquiry. The proposed Urban Greening Explorer will respond to this need through three interactive views: a point map of trees (Explore Trees), neighborhood-level choropleths and rankings (Neighbourhood Overview), and a simple density-based lens (Green Comfort Zones) that highlights where greenery is most concentrated.

## Research Gap

Previous work on Vancouver’s canopy tends to present citywide summaries or high-level targets but rarely connects individual tree records to neighborhood polygons for analysis. There is also limited effort to present these insights in a public-friendly, interactive format. This project fills the gap by building a reproducible workflow that joins tree points to Local Areas, computes density and basic indicators, and visualizes them through choropleths, rankings, and quantile-based comfort zones. This approach is intentionally descriptive, offering transparency into current patterns without making prescriptive planting recommendations.

## Assumptions

This project assumes that only public trees are included in the dataset, since private trees are excluded from the City of Vancouver’s inventory. Records without valid geographic coordinates are assumed unusable and therefore excluded from analysis. It is also assumed that the Local Area Boundaries provided by the city are accurate representations of Vancouver’s neighborhoods and can be treated as consistent spatial units for comparison. Although the public tree dataset refreshes monthly, some attributes such as planting date or diameter may not reflect the most current field conditions. For the purposes of this research, the dataset is treated as sufficiently accurate and representative to support exploratory neighborhood-level analysis.

## Potential Benefits

The Urban Greening Explorer will make Vancouver’s open data more accessible and interpretable to a broad audience by transforming raw records into interactive maps and comparisons. For community members, it offers an intuitive way to explore their local trees and better understand patterns of greenery in their neighborhoods. For planners and students, it provides a reproducible workflow for spatial analysis that highlights disparities in tree density across the city. The inclusion of Green Comfort Zones encourages public discussion about environmental equity, livability, and resilience to urban heat. By framing the tool as exploratory and research-oriented, the project contributes to civic data literacy and fosters new opportunities for public engagement with environmental sustainability.

# Proposed Research Project

## Objectives

The overarching objective of this project is to create an interactive, research-oriented dashboard that allows the exploration of Vancouver’s public tree dataset in ways that are both scientifically meaningful and publicly accessible. The first objective is to develop an interactive map interface (Explore Trees) that enables users to view individual tree records, filter by attributes such as species, planting year, and average diameter, and understand micro-level patterns in the city’s tree distribution. The second objective is to conduct spatial joins between tree locations and Local Area boundaries in order to compute neighborhood-level indicators such as total trees, unique species and density (trees per km²). These will be presented through choropleth maps, rankings, and comparative tables to provide a meso-level lens on urban greening (Neighbourhood Overview). The third objective is to define and visualize Green Comfort Zones by identifying neighborhoods in the top quantile of tree density. This perspective offers a macro-level understanding of where greenery is most concentrated, providing insights into potential environmental and social benefits associated with higher tree density.

## Methodology and Justification

The app follows a clear spatial data analysis process. First, the tree dataset is read in a way that correctly identifies location information, even if it is stored under different column names. Second, neighborhood boundaries are loaded from a digital map file and converted into a standard format so they can be displayed and measured accurately. Third, each tree is matched to the neighborhood it falls within. Fourth, neighborhood-level statistics are calculated, including the total number of trees, the number of different species (by scientific name), the average trunk diameter, and the earliest and most recent planting years. Finally, tree density is calculated as:

**trees per km² = tree count ÷ neighbourhood area (km²).**

This is a standard, interpretable metric in urban forestry and spatial planning for comparing green presence across bounded areas.

The “Green Comfort Zones” concept is intentionally simple and descriptive: neighborhoods at or above the 80th percentile of tree density are highlighted as relatively greener places under current conditions. The approach is grounded in common cartographic and exploratory data analysis practice using quantiles to make density differences legible without asserting health causality or recommending interventions. This design is justified by Vancouver’s Urban Forest Strategy emphasis on public understanding of tree benefits (City of Vancouver, 2025a), and established GIS practice for neighborhood comparisons using polygon areas, spatial joins, and choropleth visualization (Longley et al., 2015).

# Data Sources

This project uses local files only which are:

1. Public Trees (CSV)
2. Local Area Boundaries (GeoJSON)

both from the City of Vancouver Open Data Portal (City of Vancouver, 2025b; 2025c). No external APIs are used while all computations occur on the workstation, improving reproducibility and avoiding rate limits or schema drift.

# Data Analytics

The data processing begins by ensuring that only tree records with valid geographic coordinates are included, since some records in the City of Vancouver’s inventory may be incomplete. Each tree is then assigned to a Local Area Boundary, which allows the data to be aggregated and compared across neighborhoods. To ensure that density calculations are accurate, neighborhood areas are measured using a consistent projection that converts boundaries into square kilometers. From this foundation, summary tables are generated that show the total number of trees, the diversity of species, the average diameter, and the range of planting years for each area. These processed results provide the basis for the dashboard’s maps, rankings, and comfort zone visualizations.

## Indicators and “Green Comfort Zones”

Neighborhood indicators in this project include total trees, unique species, average diameter (inches), and planting year range. Tree density, defined as trees per square kilometer, is the central metric for comparing greenery across neighborhoods in a standardized way. Building on this, the app computes “Green Comfort Zones,” which highlight neighborhoods at or above the 80th percentile of tree density. While this measure does not directly capture oxygen levels or air quality, these zones can be understood as areas with relatively higher concentrations of trees that are likely to provide more shade, localized cooling, and stormwater absorption. They also serve as an intuitive way for residents to recognize greener spaces that may contribute to community well-being, aesthetic value, and resilience against urban heat.

From a research perspective, the comfort zones provide a transparent, reproducible lens for interpreting current patterns of tree distribution. They reveal disparities across neighborhoods, making it easier to reflect on questions of environmental equity without engaging in prescriptive planning or recommending specific planting actions. This framing encourages discussion about the role of greenery in urban environments while remaining exploratory and data-driven.

# Technology Stack

The application is written in Python using Streamlit for the user interface, Pandas/NumPy for tabular operations, GeoPandas/Shapely for spatial processing, pyproj for projections, Folium (with streamlit-folium) for interactive maps, and Altair for charts. This stack was chosen to maximize productivity for a single developer while producing publication-quality, browser-based outputs that are easy to reproduce and share.

# Expected Results

The project will deliver a functioning Explore Trees dashboard with three tabs. The Interactive Tree Map tab will render point markers with tooltips for species, planting date, and diameter and allow filtering by local area, species, common name, planting year, and minimum diameter. The Neighbourhood Overview tab will present a density choropleth and a sortable ranking table of local areas by trees per km² (with totals and unique species). The Green Comfort Zones tab will highlight neighborhoods in the top density quantile and list them in a table, alongside a shaded map. Beyond the software deliverable, the project contributes a reproducible workflow for transforming open civic data into interpretable neighborhood comparisons, advancing applied research on urban sustainability and public data use. The tool not only demonstrates applied spatial analysis but also contributes to broader discussions on how open data can be transformed into accessible, research-grade insights for the public.

# Project Planning and Timeline

The timeline for this project is structured across distinct phases, beginning with the proposal drafting and revision, and progressing through data wrangling, exploratory analysis, dashboard development, and final reporting. Table 1 summarizes these phases, their timing, milestones, and expected deliverables.

**Table 1. Summary of Project Phases, Milestones, and Deliverables**

|  |  |  |  |
| --- | --- | --- | --- |
| **Phase** | **Dates** | **Milestones** | **Deliverables** |
| Proposal Phase (Initial) | Sept 6 – Sept 17, 2025 | Brainstorm project ideas, explore and review datasets, drafted proposal according to the requirements and submitted. | Initial version of proposal submitted. |
| Proposal Revision | Sept 20 – Sept 27, 2025 | Incorporated professor’s feedback and removed bullet points, improved citations, removed “Tree Planning,” expanded “Explore Trees.” | Final revised proposal submitted. |
| Data Wrangling & Spatial Join | Sept 28 – Oct 2, 2025 | Robust CSV parsing, polygon normalization, projections, spatial join. | Cleaned tree & boundary datasets. |
| Exploratory Analysis & Visualizations | Oct 3 – Oct 10, 2025 | Species counts, planting years, initial charts, sanity checks. | Summary visualizations. |
| Dashboard Explore Trees Tab | Oct 11 – Oct 19, 2025 | Point map and filters/tooltips, stats panels, distributions, sampling logic. | Prototype Explore tab. |
| Midterm Report & Demo | Oct 20 – Oct 25, 2025 | Submit midterm report, present Explore Trees tab with preliminary neighbourhood table, record a midterm video demo showcasing the implementation so far. | Midterm report, demo, and midterm video submission |
| Neighbourhood Choropleth & Ranks | Oct 26 – Nov 5, 2025 | Area-based density, choropleth, sortable ranking table. | Draft Neighbourhood Overview tab. |
| Green Comfort Zones | Nov 6 – Nov 12, 2025 | Implement ≥80th percentile threshold, shaded map, supporting list/table. | Comfort Zones tab. |
| Testing & Usability | Nov 13 – Nov 20, 2025 | Debug, UI polish, performance, legends/accessibility, reproducibility check. | Refined dashboard. |
| Result Synthesis | Nov 21 – Nov 28, 2025 | Summarize insights and limitations, draft findings narrative. | Draft findings & rankings. |
| Final Report Writing | Nov 29 – Dec 7, 2025 | Methods, results, discussion, screenshots, and reproducibility notes. | Completed final report. |
| Defense Preparation | Dec 8 – Dec 15, 2025 | Slides, final app polish, rehearsal of live demo narrative. | Final defense presentation and working app. |

**Figure 1. Gantt Chart**

**A graph with green squares

AI-generated content may be incorrect.**

# Project Contract

As the sole project developer, I commit to delivering a functional web application as outlined, writing all reports (proposal, midterm, final), upholding academic integrity by citing all sources and datasets.

# Work Log Table

The work log records the hours spent and the specific activities completed throughout the project. It provides transparency into the effort distribution, ensures accountability, and demonstrates how the project progressed across key milestones. Table 2 summarizes the daily contributions, highlighting tasks such as scoping, data wrangling, writing, revisions, and final submission.

**Table 2. Summary of Logged Hours and Tasks Completed**

|  |  |  |
| --- | --- | --- |
| **Date** | **Hours** | **Work Done** |
| Sept 6, 2025 | 1.5 | Reviewed project requirements and brainstormed initial ideas. |
| Sept 9, 2025 | 2.0 | Explored Vancouver Open Data portal. Identified Public Trees dataset and Local Area Boundaries as suitable sources. |
| Sept 12, 2025 | 2.0 | Conducted background research on urban greening benefits and Vancouver’s Urban Forest Strategy. Drafted background section. |
| Sept 15, 2025 | 2.5 | Developed objectives and methodology outline. Created project timeline and Gantt chart. |
| Sept 17, 2025 | 3.0 | Proofread and finalized the proposal. Completed references and formatted work log. Submitted proposal. |
| Sept 20, 2025 | 1.5 | Received professor’s feedback; outlined required revisions (remove bullet points, improve citations, expand “Explore Trees,” remove “Tree Planning”). |
| Sept 22, 2025 | 4.0 | Rewrote proposal sections: expanded “Explore Trees,” removed “Tree Planning,” added new “Green Comfort Zones” component, and introduced explicit indicators (total trees, unique species, average diameter, planting years, density). Revised Problem Statement and Research Gap with stronger citations. |
| Sept 24, 2025 | 1.5 | Final proofreading, polished formatting, ensured consistency with feedback. |
| Sept 27, 2025 | 0.5 | Submitted revised proposal with updates reflecting professor’s feedback. |

# Closing and References

## Closing

This project transforms Vancouver’s open data into an interactive neighborhood explorer that clarifies where trees are and how distributions differ across the city. By keeping the scope strictly exploratory and methodologically transparent, it complements city strategy materials and supports public understanding without making recommendations about tree placement. The final dashboard will not only serve as a tool for exploration but also as an example of how civic datasets can be transformed into accessible, research-grade insights.

## Acknowledgement

I gratefully acknowledge the City of Vancouver for providing the open datasets that make this project possible. Their commitment to transparency and open access to civic information enables students, researchers, and the public to engage with data in meaningful and impactful ways.

## References

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