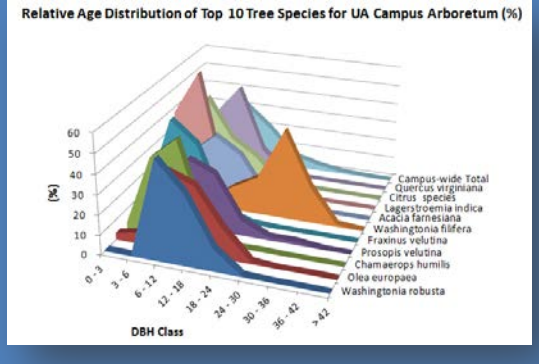
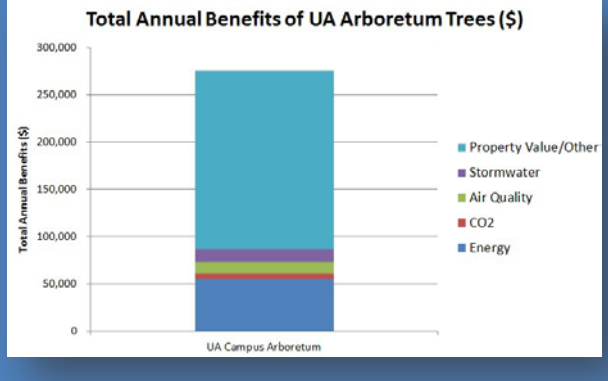
Arizona Urban Tree Map

Understanding Your Reports

A Guide to Understanding Your i-Tree Streets Report





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I. Introduction

The materials presented in this urban tree inventory report guide are part of the Arizona Urban Tree Map (AZUTM www.azsf.gov/azutm) project, a collaboration of Arizona State Forestry, University of Arizona School of Natural Resources and the Environment (SNRE) and USDA Forest Service (USDA-FS). Products created for this project include three urban tree identification field guides specific to the climate regions found in Arizona; a guide to the common insects and diseases found in Arizona's urban trees; a paper-based tree data collection form template; an instruction guide for collecting and uploading tree inventory data; and a web tool for information upload and data analysis. These products have been created to facilitate the collection of urban tree inventory data for Arizona's communities and Arizona State Forestry.

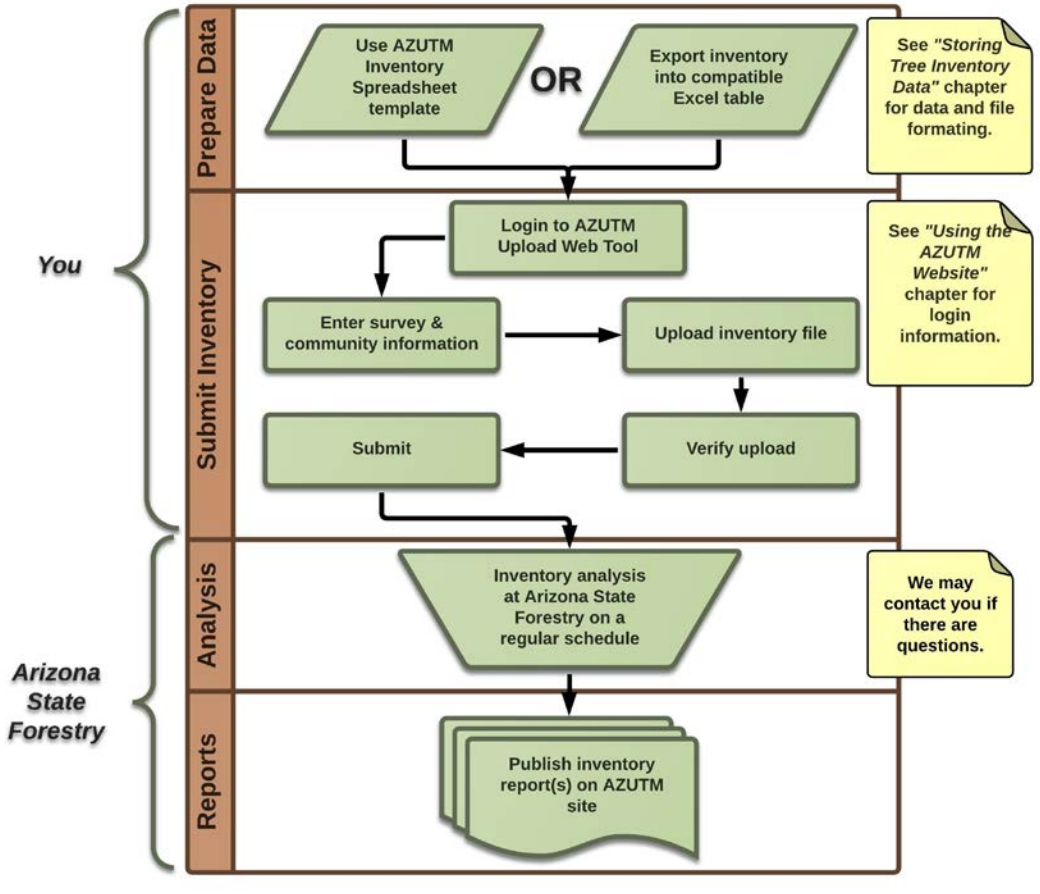

Figure 1. Flowchart of urban tree inventory report generation steps taken from the AZUTM Tree Inventory Instruction Guide at www.azsf.gov/azutm. See the Tree Inventory Instruction Guide for how to create and submit an urban tree inventory for analysis.

The primary objective of the AZUTM project is to develop an accessible tool that can be used to compile statewide urban forest information in a single, integrated location. This information will be used to determine the economic and environmental value of Arizona's urban forests (see Figure 1). A clear understanding of existing conditions will allow Arizona State Forestry, the USDA-FS, and local entities to identify the strengths and weaknesses of our forestry resources, and develop long-term goals for urban forests. Because the database can be easily updated, it will be of great benefit to urban forest managers in both the short and long-term.

II. i-Tree Streets Analysis

Once an urban tree inventory has been completed and submitted to the AZUTM website, Arizona State Forestry will process and analyze the submitted data with customized i-Tree Streets software. i-Tree Streets is an "analysis tool for urban forest managers that uses tree inventory data to quantify the dollar value of annual environmental and aesthetic benefits: energy conservation, air quality improvement, CO^2 reduction, stormwater control, and property value increase" (i-Tree). This free tool was developed and is maintained with the support of USDA-FS and can be downloaded at www.itreetools.org.

Figure 2. i-Tree logo

We chose i-Tree Streets to generate urban tree inventory and benefit reports because it is supported by USDA-FS, it is relatively easy to use, and it is widely used by state and local communities nationwide. We used the localized tree benefit and cost factors - such as electricity costs and average home resale value – provided by i-Tree Streets for most major towns and cities in Arizona.

The i-Tree Streets program analyzes tree data by STRATUM Climate Zones and has assigned three Climate Zones for Arizona: Southwest Desert, North and Interior West (see Figure 3. i-Tree Streets Climate Zones). The program includes a standard tree species listing for each Climate Zone in the country. In order to aid in efficiency, the creators of i-Tree Streets also developed generic tree categories (for example broad-leaved deciduous-small) that could be used for species less common in urban areas. It is also possible to customize the list to meet localized needs. Because of missing species and hybrids commonly planted in Arizona, we modified the i-Tree Streets species lists and parameters to improve data collection and benefit analysis. For each of Arizona's i-Tree Streets climate zones (STRATUM Climate Zone), we added and modified species using i-Tree Streets' existing species as functional equivalents with the help of industry professionals from southern and northern Arizona. Without modifications, i-Tree Streets will lump missing species together into generic tree categories with generic benefit estimates.

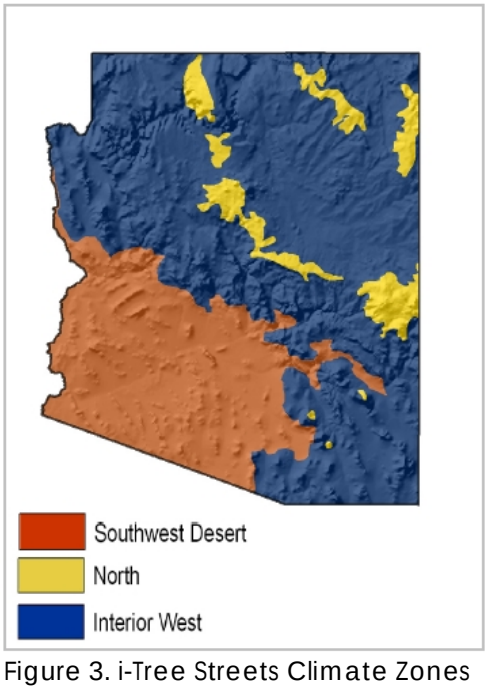

Figure 3. i-Tree Streets Climate Zones

For a list of modified or added species, see the LU_SPCODE tab in the *AZUTM Tree Inventory Spreadsheet Template* file (Excel 97 or newer) found on the AZUTM Resources page at www.azsf.gov/azutm. The LU_SPCODE tab contains a full list of: 1) all i-Tree Streets species; 2) modified existing species highlighted in yellow; and 3) newly added species and hybrids for Arizona's Climate Zones highlighted in red. A detailed description of the spreadsheet, its content, and functionality can be found in section V "Storing Tree Inventory Data" of the *AZUTM Instruction Guide* (PDF). The instruction guide can also be found on the AZUTM Resources page at www.azsf.gov/azutm.

III. AZUTM Tree Benefit Reports

i-Tree Streets' tree benefits related reports can be found in the following Excel 2007 or newer file which contains report tables and graphs on multiple spreadsheet tabs:

- BenefitOutputPublic.xlsx
  - AverageAnnualBenefitsPublic
  - NetAnnualEnergyPublic
  - NetAnnualStormwaterPublic

AZUTM relies on the estimated tree benefit factors provided by i-Tree Streets for most major cities and towns in Arizona. Parts of i-Tree Streets' definitions for the report sections are included in the *italicized* part of the Description sections below. The official description of the i-Tree Streets reports can be found in the i-Tree Streets Manual v5 PDF starting on page 46 (www.itreetools.org/resources/manuals.php).

Note: While AZUTM's Benefits reports are complete, the Cost and Cost Benefit Ratio analysis are incomplete because they require additional information specific to local horticultural practices and maintenance expenses - information that is not included in the AZUTM tree inventory upload.

A. Average and Total Annual Benefits

Description: *The Summary report presents the annual total energy, stormwater, air quality, carbon dioxide, and aesthetic/other [or property value] benefits.* It is a snapshot of the current benefits provided by the trees in your community. Values are dollars per tree or total dollars.
The annual benefits provided by your trees can be used to help justify your maintenance costs, support your tree planting plans, galvanize support from city council and/or board members, and show your community how trees work on their behalf.

Report Titles: "*Average Annual Benefits of Public Trees by Species ($/tree)*" and "*Average Annual Benefits of Public Trees by Species*"

Related Files and Tabs:

- BenefitOutputPublic.xlsx
  - AverageAnnualBenefitsPublic

B. Annual Energy Benefits

Description: *The Energy report presents the contribution of the urban forest toward conserving energy in terms of reduced natural gas use in winter (measured in therms or gigajoules) and reduced electricity use for air conditioning in summer (measured in kilowatt-hours or gigajoules).* This report will help justify the amount of energy saved by the trees in your community. It can be used to support strategic tree planting around energy-using structures and encourage increased tree care of existing trees.

Report Titles: "*Annual Energy Benefits of Public Trees by Species*" and "*Annual Energy Benefits of Public Trees by Zone*"

Related Files and Tabs:

- BenefitOutputPublic.xlsx
  - NetAnnualEnergyPublic

C. Annual Stormwater Retention Benefits

Description: This represents the amount of water not entering the storm water system, saving money with reduced flow due to infiltration of water and interception of rain by the trees. Chemicals and debris from impervious surface (roads, walkways, rooftops) will wash away into streams, wetlands, rivers, and oceans during a rain event. Trees reduce the amount of chemicals and debris entering our waterways by intercepting rainfall with their leaves and branches and increasing water infiltration into the ground with their root system. This report includes tables showing the estimated annual Stormwater retention benefits per species and inventory area (Zone). Measured in gallons or cubic meters.

Report Titles: "*Annual Stormwater Benefits of Public Trees by Species*" and "*Annual Stormwater Benefits of Public Trees by Zone*"

Related Files and Tabs:

- BenefitOutputPublic.xlsx
  - NetAnnualStormwaterPublic

D. Total CO_2 Storage Benefits

Description: These tables show the estimated current net carbon dioxide storage benefits of reported trees per species and inventory area (Zone). Carbon storage refers to the amount of CO_2 trees store in woody biomass over the life of the tree or products made from that biomass (for example furniture or lumber) as a result of sequestration (in pounds). *It should not be added to the [Net Annual CO_2 Sequestration Benefits] value or double-counting will occur.*

> **Note**: The total carbon dioxide storage benefits estimates may be less accurate and useful in supporting your management needs compared to the net annual carbon dioxide sequestration benefit estimates described below..

Report Titles: "*Stored CO2 Benefits of Public Trees by Species*" and "*Stored CO2 Benefits of Public Trees by Zone*"

Related Files and Tabs:

- BenefitOutputPublic.xlsx
  - CarbonStoragePublic

E. Net Annual CO_2 Sequestration Benefits

Description: *As opposed to the Carbon Storage Report above, net annual carbon sequestration refers to the amount of CO_2 actually removed from the atmosphere annually.* An example of a use of benefits would be an offset of vehicle and/or power plant emissions. *This report includes*

tables showing the estimated net annual atmospheric carbon dioxide reduction benefits per species and by inventory area (Zone). According to i-Tree, *[t]he model accounts for CO_2 released as trees die and decompose and CO_2 released during the care and maintenance of trees.* The annual carbon dioxide sequestration benefit estimates are helpful for estimating the amount of greenhouse gases removed by your inventoried trees.

Note: On average a passenger vehicle (car or truck) produces 10,471 pounds of CO_2 per year (http://www.epa.gov/cleanenergy/energy-resources/refs.html). Divide the Net Annual CO_2 Sequestration (pounds) your trees provide by 10,471 to estimate how many passenger vehicles they offset.

Report Titles: "*Annual CO2 Benefits of Public Trees by Species*" and "*Annual CO2 Benefits of Public Trees by Zone*"

Related Files and Tabs:

- BenefitOutputPublic.xlsx
  - NetAnnualCO2BenefitsPublic

F. Annual Air Quality Benefits

Description: The figures show estimated benefits and costs provided by trees by species and inventory area (Zone). *The Air Quality report quantifies the air pollutants (O_3, NO_2, SO_2, PM_{10}) deposited on tree surfaces and reduced emissions from power plants (NO_2, PM_{10}, VOCs, SO_2) due to reduced electricity use (measured in pounds or kilograms). Also reported are the potential negative effects of trees on air quality due to BVOC emissions.* This report will help you show how trees assist in mitigating the health effects of pollution.

Report Titles: "*Annual Air Quality Benefits of Public Trees by Species*" and "*Annual Air Quality Benefits of Public Trees by Zone*"

Related Files and Tabs:

- BenefitOutputPublic.xlsx
  - NetAnnualAirQualityPublic

G. Annual Property Value Benefits

Description: The tables demonstrate estimated property value benefits of trees per species and inventory area (Zone). *The Aesthetic/Other report presents the tangible and intangible benefits of trees reflected in increases in property values (in dollars).* This report can show how trees positively affect property value based solely on the presence, type, and DBH of the tree. This can be used support increased planting within the residential and commercial areas of your community.

Report Titles: "*Annual Aesthetic/Other Benefit of Public Trees by Species*" and "*Annual Aesthetic/Other Benefit of Public Trees by Zone*"

Related Files and Tabs:

- BenefitOutputPublic.xlsx
  - AverageAnnualBenefitsPublic

H. Miscellaneous Reports

The spreadsheets may contain additional automatically generated tabs with reports that are not relevant because tree cost estimates were not included in the initial analysis. These tree cost and cost-benefit ratio reports use place-holder cost values without regard to local conditions and should be disregarded.

IV. AZUTM Tree Structure Reports

i-Tree Streets tree structure related reports can be found in the following Excel 2007 or newer file which contain report tables and graphs on multiple spreadsheet tabs:

- PopulationSummaryPublic.xlsx
  - PopSummaryPublic
  - PopSummaryPublicZone
- StructuturalPublic.xlsx
  - SpeciesDistPublic
  - SpeciesDistPublicZone

AZUTM relies on the estimated tree benefit factors provided by i-Tree Streets for most major cities and towns in Arizona. Parts of i-Tree Streets' definitions for the report sections are included in the *italicized* part of the Description sections below. A full description of the i-Tree Streets reports can be found in the i-Tree Streets Manual v5 PDF starting on page 46 (www.itreetools.org/resources/manuals.php).

I. Population Summary

Description: Tree count by species, DBH class, and tree type. In some cases, the population count will be summarized by inventory area (also called Zones in i-Tree Streets) on separate tabs. These reports provide a basic understanding of species frequencies citywide, by management zone and by DBH size class. *The Population Summary reports include summary tables and complete lists of inventoried species, their total numbers, numbers by tree type, and numbers by default DBH size classes. These reports provide a basic understanding of species frequencies citywide, by management zone and by DBH size class.*

Note: Trees whose species codes have not been recognized by i-Tree Streets will appear at the bottom of the reports in the Unmatched summary category.

Report Titles: "*Population Summary of Public Trees*"

Related Files and Tabs:

- PopulationSummaryPublic.xlsx
  - PopSummaryPublic
  - PopSummaryPublicZone

J. Distribution of Top 10 Species

Description: *The Species Distribution reports present data on species composition in the form of pie charts and tables for the 10 most common species, displayed in percentage of total numbers. These reports are helpful for understanding species dominance.* Additional Excel tabs for each inventory area, called Zones in i-Tree Streets, may be also present.
High tree species diversity in your community will help prevent the possibility of large-scale damage or mortality of trees from native and introduced insects or disease. A good guideline for tree diversity is no more than 10% of any species, no more than 20% of any genus and no more than 30% of any family. This report will help you visualize your current species diversity and help you identify where there may be a surplus or lack of certain tree species.

Report Titles: "*Species Distribution of Public Trees*"

Related Files and Tabs:

- StructuralPublic.xlsx
  - SpeciesDistPublic
  - SpeciesDistPublicZone

K. Relative DBH Class Distribution of Top 10 Species

Description: This report helps you to understand the size distribution, and, in turn, the age distribution of the trees in your inventory. It helps you plan for the future to understand when trees may begin to decline, and new trees should be planted. This report also includes tables and an area chart of the top most abundant tree species relative to count within each DBH Class.

> **Note**: Diameter at Breast Height is used by i-Tree Streets as a stand-in for relative tree age which may be appropriate for some species but not for all.

Report Titles: "*Relative Age Distribution of Top 10 Public Tree Species (%)*"

Related Files and Tabs:

- StructuralPublic.xlsx
  - RelativeAgeDistTop10Public
  - RelativeDistByZonePublic

L. Canopy Cover

Description: Table of all species that make up more than 1% of the total population relative to % Total Canopy Cover and other measures. % Total Canopy Cover is an estimate of how much shade is provided relative to tree species, size, and number of trees.
[Importance Values (IV)] are displayed in table form for all species that make up more than 1% of the population. The Streets IV is the mean of three relative values (percentage of total trees, percentage of total leaf area, and percentage of canopy cover) and can range from 0 to 100 with an IV of 100 suggesting total reliance on one species. IVs offer valuable information about a community's reliance on certain species to provide functional benefits. For example, a species might represent 10% of a population, but have an IV of 25% because of its great size, indicating that the loss of those trees due to pests or disease would be more significant than their numbers suggest.
Canopy cover = shade. In warm environments like the desert Southwest, knowing the amount of shade provided by your trees is very beneficial. If your community has canopy cover/shade goals, this report will give you an accurate snapshot of the canopy cover/shade that trees are currently providing.

> **Note**: There are several ways of calculating Importance Values for urban trees. i-Tree Streets' method may overestimate Importance Values in Arizona.

Report Titles: "*Importance Values for Most Abundant Public Trees*"

Related Files and Tabs:

- StructuralPublic.xlsx
  - ImpValueBySpeciesPublic
  - CanopyCoverByZonePublic

M. Canopy Condition

Description: The tree Canopy Condition observation is a custom AZUTM measure of overall tree health and is determined using the percent of canopy cover that is healthy. In general, it is a measure of how much of the canopy is in leaf versus how much deadwood is present.
This report will provide you with a current snapshot of the condition of trees in your community. It can also assist in maintenance planning and forecasting new tree plantings, pruning and removals. The following scale was developed for the AZUTM project to evaluate tree condition:

Good: >75% healthy tree cover. The leafy canopy is mostly healthy; there are few dead branches.
Fair: 50-75% healthy tree cover. The leafy canopy is more than half of the volume of the total canopy; there are dead branches but they are less than half the total canopy.
Poor: 25-50% healthy tree cover. The leafy canopy is less than half of the total canopy; the dead branches are more numerous than live branches.
Dead/Dying: <25% healthy tree cover. The leafy canopy is a small portion of the total canopy; dead branches substantially outnumber live branches.

Note: Do not confuse AZUTM's custom Canopy Condition observations with i-Tree Streets' Condition Categories. The latter describes four similarly named classes (Dead/ Dying, Poor, Fair, Good) of woody or foliage Replacement Factor Percent (RFP) – a more involved measurement or observation. According to i-Tree: *RFP values are used in calculating the replacement values of the trees using the Council of Tree and Landscape Appraisers (CTLA) method and reflect the relative structural integrity and health of a typical tree in the given condition.*

Report Titles: "*Canopy Condition for Public Trees by Zone*" and "*Canopy Condition for Public Trees by Species*"

Related Files and Tabs:

- StructuralPublic.xlsx
  - CanopyConditionByZone
  - CanopyConditionBySpecies

N. Insect Observations

Description: Custom AZUTM observation of insect presence or absence on each tree. The report includes a count summary of reported insect infested trees per species.
While most insects cause no harm and are beneficial to the trees in your community, some can cause serious damage. Understanding what types of insects, and where they are located within the trees in your community can help you prevent and prepare for potential mitigation.

Note: Early detection is the best way to prevent insect and disease outbreaks in your urban forest. Therefore, the AZUTM project includes a guide to aid in insect and disease identification. The AZUTM Insect and Disease Field Guide can be found under the Resources webpage at www.azsf.gov/azutm

Report Titles: "*Insects for Public Trees by Zone*" and "*Insects for Public Trees by Species*"

Related Files and Tabs:

- StructuralPublic.xlsx
  - InsectsByZone
  - InsectsBySpecies

O. Disease Observations

Description: Custom AZUTM observation of disease agent presence or absence on each tree. The report includes a count summary of reported diseased trees per species.
Disease can spread rapidly throughout a community of trees if the conditions are suitable. Understanding what type of disease and where it is located within the trees in your community can help you prevent and prepare for potential mitigation.

Note: Early detection is the best way to prevent insect and disease outbreaks in your urban forest. Therefore, the AZUTM project includes a guide to aid in insect and disease identification. The AZUTM Insect and Disease Field Guide can be found under the Resources webpage at www.azsf.gov/azutm

Report Titles: "*Diseases for Public Trees by Zone*" and "*Diseases for Public Trees by Species*"

Related Files and Tabs:

- StructuralPublic.xlsx
  - DiseasesByZone
  - DiseasesBySpecies

V. Appendix A: How to open a ZIP archive file

In order to reduce file size for emailing and archival, digital files and folders can be compressed into a single archival file (also known as a "compressed folder"). Various compression formats exist of which ZIP, 7z, and RAR are some of the most commonly used. Windows has built-in support for ZIP compression and decompression. All AZUTM urban tree inventory reports will be published in ZIP archival format on the "AZUTM Community Inventories" page at: www.azsf.gov/azutm

Windows 98 and Windows ME

1. Click Start, point to Programs, and then click Windows Explorer.
2. In Windows Explorer, right-click the .zip file, and then click Extract.
3. Follow the instructions on the screen to finish the unzipping process.

Windows Vista, 7, 8, and 8.1

1. Locate the compressed folder (or .zip file) that you want to extract files or folders from.
2. Do one of the following:
   - To extract a single file or folder, double-click the compressed folder (or .zip file) to open it. Then, drag the file or folder from the compressed folder to a new location.
   - To extract the entire contents of the compressed folder (or .zip file), right-click the folder, click Extract All, and then follow the instructions.

VI. Terms and Definitions

Term	Definition
AZUTM	Arizona Urban Tree Map, an Arizona State Forestry project in support of urban forest inventories hosted at www.azsf.gov/azutm
BVOC	Biogenic Volatile Organic Compounds in contrast to man-made or anthropogenic VOCs – air pollutants produced by trees and other living organisms or biological processes
Climate Zone	STRATUM Climate Zones developed by USDA-FS and used by i-Tree Streets
CO_2	Carbon dioxide – a greenhouse gas
DBH	Diameter at Breast Height – a standard tree measurement required for AZUTM analysis.
NO_2	Nitrogen dioxide – an air pollutant
O_3	Ozone – an air pollutant
PM_{10}	Atmospheric particulate matter of 10 micrometer or less –air pollutants
SO_2	Sulfur dioxide – an air pollutant
STRATUM	i-Tree Street precursor developed by USDA-FS's "Urban Ecosystems and Processes" team
tab	Worksheet within an Excel spreadsheet file; also called "sheet," "sheet tab," or "worksheet tab"
USDA	United States Department of Agriculture
USDA-FS	USDA Forest Service
VOCs,	Volatile organic compounds – air pollutants
Zone	i-Tree Streets' term for a tree inventory area within a community

VII. Credits and References

Photo and Figure Credits

Figure 2: i-Tree logo, USDA-FS. i-Tree
"Tab" icon created by Hrag Chanchanian from the Noun Project.
"Excel" icon created by Jose Campos from the Noun Project.

References

USDA-FS. i-Tree web page, www.itreetools.org
USDA-FS. i-Tree Streets v5 User's Manual, www.itreetools.org

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