Community Engagement: Tree Inventory Manual

Department of FOREST RESOURCES
UNIVERSITY OF MINNESOTA

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Letter to inventory participant

Dear Inventory Participant:

Welcome to the Community Engagement Preparedness Program (CEPP) Tree Inventory, with your assistance, your community or host community will collect valuable information on the urban tree population. This information can be used to implement urban forest management plans and provide necessary details for use for future funding opportunities.

This volunteer training manual is designed to assist you in developing the skills and background to accurately conduct a complete community tree inventory or a sample tree inventory that accurately reflects the tree composition and character of the community. This manual will also serve as a reference for data collection and data input associated with the tree inventory. You are encouraged to add your own notes to this manual throughout the training and inventory.

Our hope is that you will gain valuable experience, useful skills, and develop an enhanced appreciation of the importance of the urban forest in your community. Additionally, we hope that you will gain a better understanding of your critical role as a volunteer and steward of your community's urban forest ecosystem. People like you make communities a better place to live and work.

On behalf of everyone who has worked on this project, we would like to thank you for your effort in helping make the CEPP Tree Inventory a success!

Sincerely,

The University of Minnesota Project Team
www.mntreesource.com

Department of FOREST RESOURCES
UNIVERSITY OF MINNESOTA

Setting up an inventory

Why complete a tree inventory?

Tree inventories provide an accurate profile of the urban forest in your community. A completed inventory can be used to formulate effective management plans for tree care. The data gathered during an inventory can supply community officials with the information necessary to create an adequate budget for the care and maintenance of their urban forest. Understanding the number, diversity, and general age of trees within your community will help identify susceptibility to current and future invasive pests, catastrophic events, maintenance work needed, the monetary value, and quantify the benefits provided by the urban forest.

Detailed information obtained from an inventory is critical when applying for funding and in the development of strategic management plans. The inventory will help identify the level of risk to your community from invasive pests (like emerald ash borer) and other catastrophic events. Once your community's level of risk has been identified a timeline of tree removals and plantings can be strategically created to increase species diversify and overall health of the urban forest. Monocultured areas are highly susceptible to any current or future pests (e.g., disease, fungal, or pests) that have the potential to wipeout a monocultured planting. Inventory data can also be used to identify areas that have a lack of trees and quantify ecosystem services such as rain water interception, reduced energy demand, and carbon sequestration.

Monocultures are an area with one predominant species

Although there are many different types of inventories, the method described throughout this manual is a *stratified random sample*. This technique allows an accurate and precise estimate of total trees, species diversity, and diameter classes. Smaller communities (those with fewer than 5,000 total trees) may find it simpler to do a complete inventory versus a sample inventory.

Creating a sample

The sample inventory described in this manual is formally called a *stratified random sample*. This method is research based[1] and produces estimates of the total number trees with an error of ± 10%. In order to setup a sample area in your community three basic steps need to be followed.

[1] Jaenson, R., Bassuk, N., Schwager, S., & Headley, D. (1992). A statistical method for the accurate and rapid samping of urban street tree populations. *Journal of Arboriculture, 18*(4), 171-183.

1. Identifying zones - divide community into zones (*stratification*)
2. Pre-sample (gathering of basic information)
3. Randomly select blocks or street segments to sample

Identifying zones

Identifying zones in your community can be accomplished using aerial imagery from Google Maps, Bing Maps, or any online (or hardcopy) community level maps. As an example, a residential neighborhood built in the1950's with a grid street pattern will likely differ from a residential neighborhood built in the 1990's with curving streets and cul-de-sac's (Figure 1). The main objective is to divide the city up into similar areas. In our example, gridded streets and blocks (*rectilinear*) built in the 1950's share similar characteristics with respect to the urban forest (e.g., species or age). Zones **DO NOT** overlap and all streets or blocks in a zone should be contiguous. How the zones are used is explained later in this manual, for now simply work-on creating zones that consist of areas similar in terms of development style, time, or use. Keep in mind what you truly care about: *Where are the trees and what kind are they?*

Zones are simply categories you create to group your city into smaller similar sections. Categories should be based on

Figure 1. Zones - the red outline signifies a different zone that the blue outline. Note the difference in street patterns.

To accomplish the task of creating zones any geographic information system (GIS) can be used. Communities with a GIS department as part of the city or county government may use professional software such as ArcGIS. If professional software is not available, free software like Google Earth or paper maps can also be used. Instructions on how to use specific GIS software are outside the scope of this manual. Consider working with a local college, a university extension office, or your city public works department to help create maps of the sample blocks. Figure 2 gives an idea of how a completed zone identification map might look.

Geographic information system or GIS is a term used to describe mapping and maps. Many modern GIS are computer based, but paper maps can also be used.

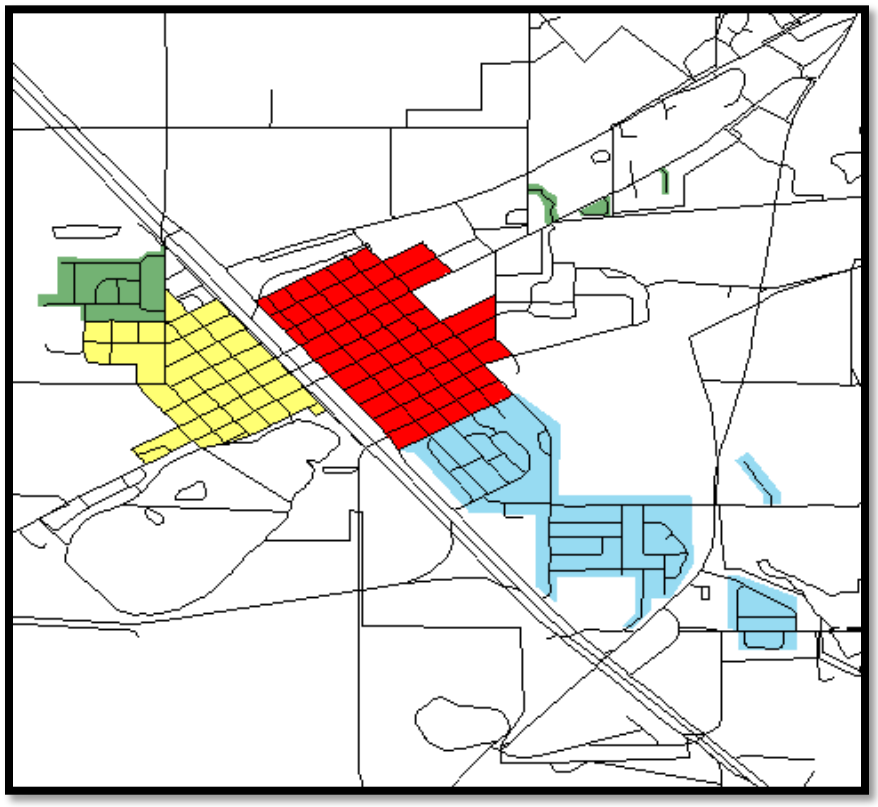


Figure 2. An example of a community with zones identified. Each zone is represented with a different color.

Curvilinear zone segments, like those colored blue in Figure 2, should be determined by taking the average street length of your community's square or rectangular block sides. Measure or estimate the block traditional block streets (colored red in Figure 2), divide by the total number of blocks measured to arrive at an average street segment length. Then divide the average by two as you will sample both sides of curvilinear streets. **Example:** 4 sides of a typical block measure 800 feet, the curvilinear zone segment would be 400 feet (800 ÷ 2).

Segments in the curvilinear zones are similar to blocks in the street grid or downtown

To create curvilinear street segments to inventory, measure out approximately 400 feet on the map for the curvilinear zones (which will included both sides of the street). The green and blue section on the map in Figure 2 represents curvilinear zones due to the curving irregular nature of the streets in those sections.

All zones should be identified and labeled on a community map. Examples of zones labels are:

- Residential 1
- Residential 2
- Downtown 3
- Curvilinear 4, etc.

Within each zone label the individual blocks or segments. If there are twenty blocks in a zone, label the blocks 1-20.

Pre-Sample

In order to determine which blocks or zone segments will be part of the inventory sample, a pre-sample must be completed. The purpose of the pre-sample is to gather basic information about where trees are located so that a final random sample within each zone can be correctly identified.

For each zone (e.g. Residential 1, Residential 2, Downtown 3, Curvilinear 4, etc.) randomly select 20% of the total number of blocks or segments. **Example:** if there are 20 blocks in zone Residential 1, then you would randomly select 4 blocks to pre-sample for that zone. Repeat for each zone in the community. The random selection of the blocks can be accomplished using computer software or by simply putting blocks numbers in a hat and drawing numbers at random.

Once you have randomly selected the blocks or segments in each zone you can begin the pre-sample. Using the list of randomly selected block or segments numbers, count all of the trees contained on the blocks or segments. During the pre-sample **DO NOT** record species, condition, or any other information. Simply count the number of trees and keep a tally of the number of trees by the zone and block or segment number. See Table 1 for an example of the pre-sample data sheet.

Example:

Table 1. Data collection example for pre-sample information

Zone	Block or Segment #	# of Trees
Residential 1	15	103
Residential 1	5	89
Curvilinear 4	7	113

Randomly select blocks or street segments to sample

Once the pre-sample has been completed and the tree counts recorded, it is time to select the blocks that will comprise the inventory sample (Table 2). To determine the number of blocks required to be sampled in each zone: 1) add up all of the trees counted in a zone, 2) divide the number tree in a zone by the number of blocks or segments in the given zone to obtain an average number of trees per block, 3) multiply the average number of trees per block for a zone by the total number of blocks or segments in that zone, that will be an estimate of the total number of trees in that zone.

Example calculations:

Table 2. Calculation examples

Zone	Total # of Blocks or Segments	# Blocks or Segments Pre-sample	# Trees counted in Pre-sample
Residential 1	20	4	331

$$A.\ \boldsymbol{Average\ trees\ per\ block} = \frac{\mathbf{331}}{\mathbf{4}} = \mathbf{82.75}\ \boldsymbol{trees\ per\ block}$$

$$B.\ \boldsymbol{Estimated\ trees\ for\ zone\ Residential}\ \mathbf{1} = \mathbf{82.75} * \mathbf{20} = \mathbf{1655}\ \boldsymbol{trees}$$

Complete these calculations for each zone and add the estimated trees for each zone to get the total estimated number of trees for you community. Make sure to organize and record all calculations as they will be used in the next steps and to analyze the data once the inventory has been completed.

The nature of the sample design requires that each zone have a different weight. To create the zone weight divide the estimated

Weight in this context refers to the percent of the entire community a specific zone contributes to the urban forest.

number of trees for a zone (calculation ***B.*** from above) by the estimated total number of trees in the community. Record the zone weight, you will need it later. In this example assume the estimated total number for trees is 8,241.

Example weight calcuation:

$$\boldsymbol{C. Weight\ for\ zone\ Residential\ 1 = \frac{1655}{8241} = 0.20}$$

Next you need to determine the number of blocks or segments that will be physically sampled during the inventory. Multiply the the zone weight (calculation ***C.*** from above) by the number 2,300 (*this number is just part of the staticaly method*) to arrive at the number of trees you need to sample inventory for each zone.

Example number of trees calculation:

$$\boldsymbol{D.\ Number\ of\ trees\ to\ sample\ in\ \ zone\ Residential\ 1 = 2,300 * 0.20 = 460\ trees}$$

Perform these calculations for each zone in your community. Once the number of sample trees required in each zone has been calculated (calculation ***D.*** from above), divide that number by the estimated number of trees per block for that zone (calculation ***A.*** from above) This will give you the approximate number of blocks or street segments in a zone to be inventoried (round up if needed).

Example number of sample blocks calculation:

$$\boldsymbol{E.\ Number\ of\ blocks\ to\ sample\ in\ \ zone\ Residential\ 1 = 460\ \div 82.75}$$
$$\boldsymbol{= 5.6\ or\ 6\ sample\ blocks}$$

Complete the calculation ***E.*** for each of the zones. Once the number of blocks or street segments to sample in each zone has been calculated, randomly select the block or street segment number for each zone (block numbers where in section **1. Identifying zones**).

Example: In zone Residential 1 there are 20 blocks numbered 1 through 20. Randomly select 4 blocks by picking 4 numbers between 1 and 20. Random selection can be done with computer software or by picking numbers out of a hat.

Once all block and street segments to be inventoried have been identified, create maps of ***each block or street segment*** that include the zone and block number as well as the street names. If possible, it is convenient to have the parcel ownership information on the maps in order to more actually identify the location of inventoried trees.

Make sure to record accurately all calculations as they will be need when you analyze your data after data collection has been completed.

Volunteer Commitment

All volunteers are asked to participate in the training program to make the inventory as consistent and accurate as possible. Volunteers are expected to establish teams and scheduled dates to inventory block or street segments typically before October. Teams should have **three** volunteers. The more groups, the less time involved for everyone. We recommend teams only inventory for 4 hours or less per time out in the field. Any gaps or lingering sections will be filled in by other teams in the community.

Equipment and material

Each team should have access to inventory t-shirts or safety vests to help identify you and your team. Other items needed include: diameter measuring tape, 50 foot tape measure, data sheets, and a clip board. Teams should arrange to pick-up and drop off of materials with local project leaders.

What to wear and bring

Wear comfortable shoes, as you will be walking and standing for considerable amounts of time. In addition we suggest you also bring the following items:

- Cell phone
- Inventory sheets
- Block maps
- Diameter measuring tapes
- Pencils
- Tree identification guides
- Dress for the weather (layers and/or rain gear)

Safety

Please be aware of personal safety during the inventory. Volunteers may be working in busy areas throughout their community. **Do not ever leave team members for any reason when in the field.** Should a team ever feel unsafe leave immediately and work with project leads or emergency personal to determine a course of action. If first aid or other emergency measures are needed, dial 911. Volunteers will be collecting data on public and private land. If a landowner requests that you do not enter his or her property, thank them for their time, make a note on the data sheet and move on.

Conducting the Block Inventory

Block Sampling

Start point

Most south-western corner and work in a counter-clockwise direction. Each tree inventoried on block will receive a number starting with 1 and continuing until all trees have been inventoried on that block or street segment. Information for each tree will be recorded an inventory sheet. Be sure to also indicate the placement of the tree on the block map with a dot and the tree number. This will allow the inventoried tree to easily be located later if needed. Tree numbers on a block do not repeat (i.e. per block there is only one tree label **1**). **DO NOT REPEAT TREE NUMBERS ON A SINGLE BLOCK!**

Public trees

Record the tree number, tree information, and complete a condition rating on **all** trees in the public right of way. To determine if a tree is a public or private tree, please verify the distance with your local city authority. If you cannot determine the public right of way use your best judgment to determine whether the tree is a public tree or a private tree. Public trees are any trees owned and maintained by the city.

Private trees

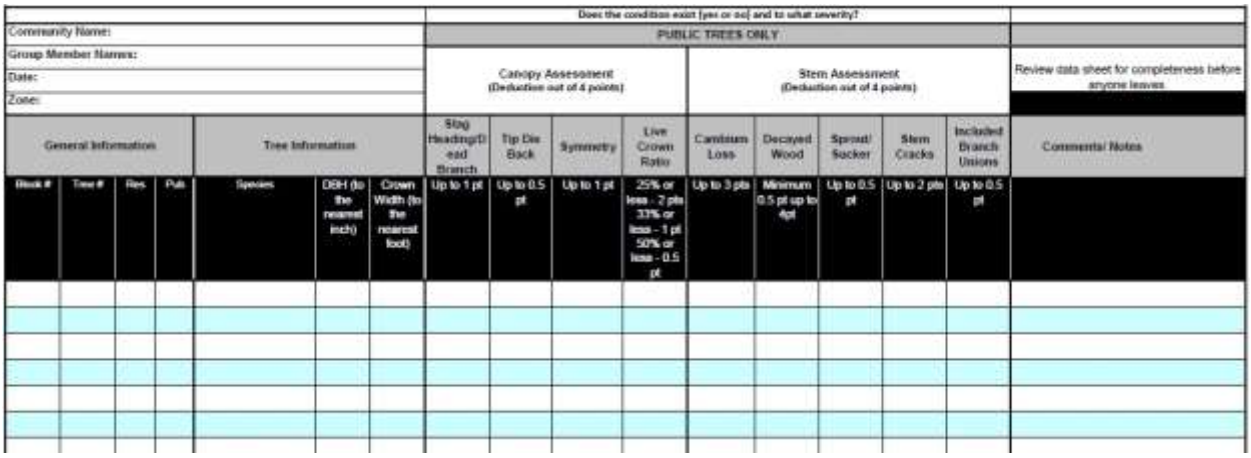
Record the tree number and tree information on the inventory sheet. **DO NOT** complete a condition rating for these trees. Private trees should include any residential trees or commercial land (any tree on land **not** owned or maintained by the city).

Rules of thumb for private trees

- Inventory conifers 6 feet or taller that are not considered part of foundation or hedge plantings.
- Inventory all deciduous trees greater than 3 inches in diameter, as measured 4.5 feet above ground.
- Only inventory trees in maintained landscapes (i.e. mowed lawns, etc.).
- Trees with multiple stems; measure the diameter of each and add them together to record a composite diameter.

Filling out the inventory datasheet

Please use this as a guide to complete the inventory datasheet. Tree identification, tree measurements, and tree condition rating will be explained in the sections that follow. Printable datasheets can be downloaded from http://www.mntreesource.com/forms.



Community Name:							Does the condition exist [yes or no] and to what severity?								
Group Member Names:							PUBLIC TREES ONLY								
Date:							Canopy Assessment (Deduction out of 4 points)				Stem Assessment (Deduction out of 4 points)				Review data sheet for completeness before anyone leaves
Zone:															
General Information				Tree Information			Stag Heading/Dead Branch	Tip Die Back	Symmetry	Live Crown Ratio	Cambium Loss	Decayed Wood	Sprout/ Sucker	Stem Cracks	Included Branch Unions	Comments/ Notes
Block #	Tree #	Res	Pub	Species	DBH (to the nearest inch)	Crown Width (to the nearest foot)	Up to 1 pt	Up to 0.5 pt	Up to 1 pt	25% or less - 2 pts 33% or less - 1 pt 50% or less - 0.5 pt	Up to 3 pts	Minimum 0.5 pt up to 4pt	Up to 0.5 pt	Up to 2 pts	Up to 0.5 pt	

Figure 3. Example of the inventory datasheet.

- ***General Information***
  - **Community Name** – Write in the name of the city being inventoried
  - **Group members** – record the names of the inventory team in case clarification is needed
  - **Date** – record the date of the inventory
  - **Zone** – record the zone where the block is located (this should be on the community map)
  - **Block #** - the block number as it appears on your inventory map
  - **Tree #** - the number of the tree, remember no repeating numbers on a single block
  - **Priv** – check the box if the tree is on private land
  - **Pub** – check the box if the tree is on public land

- ***Tree Information***
  - **Species** – enter the common or scientific name of the tree species
  - **DBH to the nearest 1" –** Using a diameter-tape (Diameter at Breast Height)
  - **Crown Width** – the diameter measurement of the spread of the branches (nearest foot)

NOTE: The maximum deductions in each column. Deductions are in quarter point increments only! Please record the deductions in decimal format.

- ***Crown Assessment (Public trees only)***
    - **Stag Heading – up to 1 point** see the Condition Rating section of the manual
    - **Tip Die Back** – **up to 0.5 point** see the Condition Rating section of the manual
    - **Symmetry – up to 1 point** see the Condition Rating section of the manual
    - **Live Crown Ratio** – **up to 2 points** see the Condition Rating section of the manual

- ***Stem Assessment (Public trees only)***
    - **Cambium** – **up to 3 points** see the Condition Rating section of the manual
    - **Exposed & Decayed Wood** - You must **deduct a minimum of 0.25 point** if exposed or decayed wood is present. There is no maximum deduction.
    - **Sprouts/Suckers** – **up to 0.5** see the Condition Rating section of the manual
    - **Stem cracks** – **up to 2 points** see the Condition Rating section of the manual

- ***Comments/Notes*** - Any observation about the tree that you feel is important to note

NOTE: Data Entry Personnel

Data from the completed inventory sheets can be entered in a Microsoft Excel spreadsheet. There are pre-set formulas in the spreadsheet to calculate the total deductions from both the Crown Assessment and the Stem Assessment. The data entry Microsoft Excel file can be downloaded from http://www.mntreesource.com/forms.

Identifying Tree Species

Leaves

When using the tree ID cards or a tree identification book pay close attention to the following characteristics of the leaves or needles. If there is terminology with which you are unfamiliar, please check the glossary of common tree terminology in the Appendix. **Tree ID cards** can be found at http://www.mntreesource.com/resources.

Leaf Types - Are the leaves compound or simple? If they are compound, are they pinnately compound or palmately compound?

Leaf Margin - The leaf margin refers to the edge of the leaf. Some basic types are:

- Entire(smooth)
- Serrate (jagged pointing towards the tip)
- Lobed (think of maple or oak)
- dentate (jagged pointing outward)

Branch, Leaf, or Bud Arrangement - How are the branches, leaves, or buds connected?

- Opposite – branch, leaf, or bud will be directly opposite, 2 at a connection point
- Alternate – branch, leaf, or bud will be staggered
- Whorled - branch, leaf, or bud will be opposite, typically at least 3 at a connection point

Fruits/Seeds

If you need to narrow down the species try using the fruit or cone. Botanically, any part of the tree that contains a seed or seeds is often referred to as a fruit, which means not only the apples and cherries, but also the little "helicopters" of the maples. Things to look for:

What type of fruit and what size is it? Samaras (maples, ashes, elms) or acorns or apples, etc.

Bark

Bark can be helpful as some tree species have very distinctive bark from other tree species.

- Smooth or Rough or Corky
- Ridges or Flakes

Buds

Terminal buds are at the very tips of the twigs and can be a great diagnostic tool.

Terminal buds

- Absent or Present
- Sharply Pointed or Rounded
- Singular or Grouped
- Sticky or Dry

Tree Measurements

Measuring Diameter at Breast Height (DBH)

Overview

DBH stands for diameter at breast height which is a standardized point on the trunk 4.5 feet from the base for the tree. DBH can be measured using a diameter tape (D-Tape). Circumference can be measured using a standard measuring tape, and then converted to a diameter measurement by dividing the circumference by pi, 3.14.

Procedure

Using a D-Tape

1. Measure 4.5 feet from the ground to a point on each volunteer, this will be your personal "breast height". Remember your "breast height" location
2. While standing next to the tree, wrap the D-tape around the tree (at the point determined in step 1). If the tree is on a slope, take this measurement on the up-hill side of the tree. (Figure 4).
3. There are 2 sides on most D-tapes:
    a. One side measures distances in feet, similar to a standard measuring tape.
    b. The other side has been converted to measure diameter**. Make sure to use the diameter side of the tape when measuring DBH!**
4. To read the measurement, wrap the DBH tape completely around the tree at breast height. Record the number where the zero meets the tape. This is the tree's diameter (Figure 4).

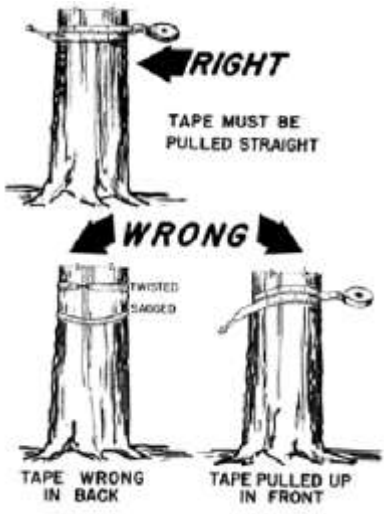


Figure 4. Measure DBH with a D-tape

Measuring Crown Width

Overview

Crown width refers to the average diameter of a tree's crown (the spread of the branches) and is used to calculated information regarding tree canopy cover and rain water interception. A tree's crown diameter can be approximated by measuring radial measurements (Figure 5).

Measurement Method 1

1. One volunteer should stand under the edge of the canopy holding one end of the tape measure.
2. A second volunteer should walk with the opposite end of the tape measure to the center of the tree's trunk, remember or jot-down the distance (in feet). **HOLD the TAPE TIGHT!**
3. Select a side of the tree is approximately 90 degrees from the location in step 1.
4. Repeat Steps 1 & 2
5. To determine crown width, add the two radii measurements together and record diameter on your inventory sheet.

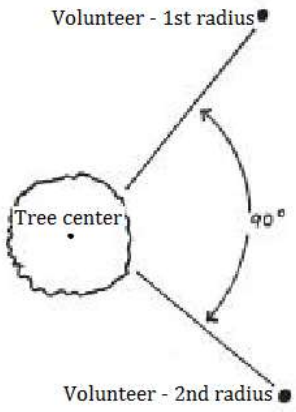


Figure 5. Measuring crown width with a tape measure

Measurement Method 2 (requires a flexible tape at least 50 feet long)

1. One volunteer should stand under the edge of the canopy holding the beginning of the tape.
2. A second volunteer should walk with the opposite end of the tape measure and wrap the tape around the trunk at approximately 90 degrees and walk to the edge of the canopy (Figure 5).
3. Read and record the total feet (rounding to the nearest foot) from the tape.

Note: Both methods should record the same measurement. Method 1 requires two measurements, whereas Method 2 only requires one measurement.

Condition Rating

Condition ratings are assessed in teams of two or three volunteers. Each individual should evaluate the tree independently. Then team members should discuss their ratings. If the condition rating differs greatly between team members, discuss the merit/fault of each rating to resolve the differences.

Each tree will have two separate condition ratings: **Crown Assessment** and **Stem Assessment**. Numeric values for a tree's crown and stem are not averaged. Both are rated on a zero to four point scale. Each tree starts with 4 points from the Crown and 4 points from the Stem. The points recorded on the inventory sheet are deductions in quarter point increments. While in the field, record only the deductions from each section, the total deductions will be done automatically when the data is entered into the computer. Foliage (leaves) are not evaluated in this system.

Crown Assessment

The crown includes everything from the first set of major branches to the top of the tree.

Stag Heading (Figure 6)

A condition where an entire main branch is dead from the tip all the way back to the main stem or another major branch. **Up to 1 point** may be deducted based on the size of the dead branch and the percentage of the crown affected.

Figure 6. Stag heading

Tip Die Back (Figure 7)

A condition where there is significant death at the tips of branches. Only the outer branch tips are affected. **Up to 0.5 point** can be deducted as a result of this condition.

Figure 7. Tip Die Back in the crown

Symmetry (Figure 8)

This condition factor addresses of crown symmetry. Compared to a perfectly symmetrical crown, **up to 1 point** can be deducted if a portion of the crown is missing.

Figure 8. An asymmetrical crown

Live Crown Ratio (LCR)

LCR is a measure of the total photosynthetic potential of a tree. LCR is the ratio of the height of the crown to the total height of the tree. **Remember the crown does not necessarily begin where foliage begins on the tree; the crown starts at where the first main branch(s) attach to the trunk and goes to the top of the tree**. To get a reading of the LCR, hold a tape measure (or ruler) at arm's length standing far enough from the tree to view the entire tree between 0 and 10 inches on the tape. Line up the top of the tree with 0 and the base of the tree with 10 on tape (Figure 9). Standards for LCR with **NO deductions are 60% for deciduous and 75% for coniferous**. As a general rule, deciduous trees with less than 25% LCR should lose 2 points, LCR of 33% would lose 1 point, and 50% LCR could lose up to 0.5 point.

Example: If the top of the tree is at 0" and the bottom of the crown is at 6", then the tree would have a 60% Live Crown Ratio and no deductions would be recorded.

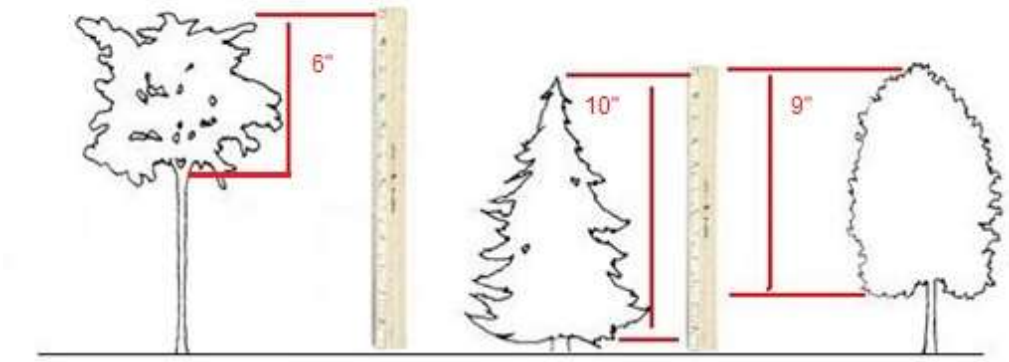


Figure 9. Live Crown Ratio: Standing far from the tree, line up your ruler or tape measure with the height of the tree. Find the height of the crown, and express it as a percentage of total height. The trees above would have LCR's of 60% (6 inches ÷10 inches),

Stem Condition

The stem (or trunk) is the portion of the tree from the ground line up to the first set of major branches.

Cambium Loss (Figure 10)

Cambium is living tissue that creates the systems for moving water and nutrients throughout the tree. Generally, there has been cambium loss where there is missing or loose bark. Points are deducted for any loss of cambium due to pruning wounds, accidental damage, vandalism, and winter injury. **Up to 3 points can be deducted if 50% or more** of the stem's circumference is girdled. Use this recommendation to calculate lower rates of girdling **(e.g. a tree that is missing 25% of its cambium would have a 1.5 point deduction)**. Don't add vertical cambial loss, only add up circumferential loss.

Figure 10. Cambium loss

Decayed Wood (Figure 11)

Decayed wood requires a **deduction of 0.25 point minimum** or more if it shows obvious signs of decay (i.e. "punky" or soft wood). Points should be deducted based on the significance, location and amount. There is no maximum point deduction; however, any point deduction of 4 points or more will result in a final stem condition rating equal to zero (the worse possible score).

Figure 11. Exposed and decayed wood

Sprouts/Suckers

Deduct up to 0.5 point for excessive sprouts or suckers. Sprouts can also be referred to as water sprouts and are excess growth off the main stem of the tree. Suckers are growth located at or around the base of the tree.

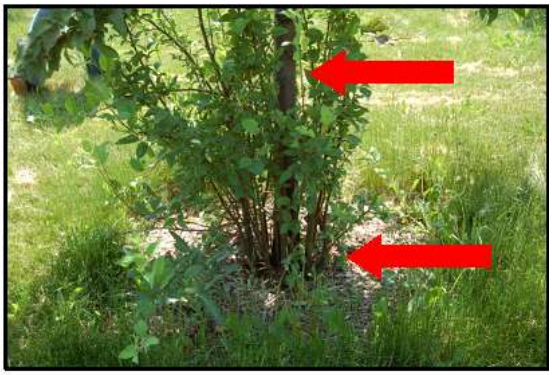


Figure 12. Sprouts and suckers

Stem Cracks

Depending on the severity, **up to 2 points can be deducted** for stem cracks. Severity increases with multiple cracks, size and extent of the crack.

Figure 13. Stem crack

Included Branch Unions

Point deduction is a function of the number and severity of inclusions. **A maximum of 0.5 point can be deducted**. Only the first main branches can be considered when deducting points for this category. Anything further up in the crown of the tree is **NOT** considered for stem condition rating.

Figure 14. Included branch unions

Data Entry

Appendix

Glossary

alternate (leaf)	Leaves are attached to the branch in an alternating pattern.
cambium loss	Covers any loss of cambium due to pruning wounds, accidental damage, vandalism, issues of stem girdling, and winter injury.
cambium	The thin layer of living wood tissue between the bark and the inner wood of the tree.
codominant leaders	Two or more top branches of a tree that compete to direct the upward growth of the tree.
condition	A quantitative assessment of a tree's specific likelihood of structural failure.
coniferous	A tree that has needles or scale-like leaves and cones. Examples are pines, spruces, firs, and cedars.
crown	The part of the tree including the leaves and branches, but excluding the trunk.
crown symmetry	The general shape and condition of the crown is the same from all visible angles.
decay	See wood decay
deciduous	Trees that shed their leaves in autumn. Examples include maple, oak, basswood, and aspen.
dentate	Leaf has sharp teeth that point straight out from the leaf.
diameter at breast height (D.B.H.)	The diameter of the tree trunk at 4.5 feet above the ground. Can be measured by dividing the circumference at 4.5 ft off the ground by 3.14(pi).
die-back	See Tip die-back
doubly serrate	Leaf has larger serrations and smaller serrations
ellipitical	Leaf is widest at the center
emerald ash borer (EAB)	An invasive species of beetle in the United States, originally from Asia
entire	Leaf has a smooth margin (edge)
epicormic shoots	See water sprouts
included bark	Bark that has grown in between the join of a branch and stem or two branches, creating a weak attachment.
live crown ratio (LCR)	The ratio of living branches to total tree height, usually expressed as a percentage.
oblong	Leaf is longer than it is wide.
opposite (leaf)	Leaves are attached to the branch directly opposite each other.
ovate	Leaf is egg shaped.

palmately compound (leaf)	There are multiple leaflets attached to the end of the rachis in a ‘palm’ formation.
pinnately compound (leaf)	There are multiple leaflets attached laterally to the leaf stem (rachis).
samara	A type of fruit with wings found on maples and ashes.
serrate	Leaf has sharp teeth pointing towards the leaf tip.
simple (leaf)	There is only one leaf attached to the leaf stem (petiole).
species tree code	The four letter code used by the US Forest Service to designate trees by their genus and species.
stag heading	The complete death and defoliation of main scaffold branches, so called because of antler-like appearance of branches.
stem	The trunk of the tree, excluding the branches and leaves.
stem circumference	The circular measurement around the stem of the tree at 4.5 feet above the ground.
stem girdling roots	Roots that encircle or run tangential to a tree’s stem, eventually compressing the woody and non-woody tissues of the stem.
suckers	A shoot originating from the roots of a tree, under the soil.
terminal bud	The bud located at the very tip of the twig. Not all species have true terminal buds.
tip die-back	The progressive death of twigs and branches starting from the tip and working “back” towards the stem.
transplant shock	A period of time the tree takes to recover from root loss. Generally the larger caliper the tree, the longer the transplant shock.
tree defects	Any condition such as decay, cavities, weak branch attachments (included bark), cracks or cankers that occur anywhere on the tree and may cause the structural failure of part or of the entire tree.
water sprouts	An upright shoot arising from dormant buds on the trunk or a branch of a tree, above the soil line. Also known as epicormic shoots/sprouts.
whorled	Three or more leaves are attached to the branch opposite each other. Examples of trees with whorled branches are pines, spruces, firs, and catalpa.
winter injury	Injury caused by a freezing following a period of warmer weather.
wood decay	Wood that is rotting or missing due to decomposition by fungus or bacteria.