

## List of Variables

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## Tree & Tree Area Characteristics

### Identifying Information

V1

V4

**Tree ID#, Location, Species, and Planting Season & Year**

The *Tree ID#* is a unique identification number assigned by the organization to each planted tree. The *Tree ID#* is already provided and will be used to correctly identify specific trees on site.

Tree *location* is identifying information about the physical location of the tree. This information is retained in the form of geographic coordinates (also called a map point). *Location* is already provided.

*Species* is the biological name for the type of tree that was planted. Both the scientific name (the Latin genus and species, e.g., *Acer rubrum*) and the local common name (e.g., red maple) have been recorded. This information has been provided, however not to the cultivar level.

*Planting Season and Year* are the season (Spring or Fall) and the year that the tree was planted. This information is provided.

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<sup>1</sup> “Resolution” as used in the Protocol refers to the scale in which numerical measurements are recorded. For instance, “to the nearest 0.1 cm” means that if a measurement of 10.55 cm is indicated on a DBH tape, 10.6 should be recorded in the DBH field of a data sheet or electronic data collection device. If recording “to the nearest 0.5 m” is called for, a measurement of 4.6 m obtained from a hypsometer should be written as 4.5 m, while a measurement of 4.8 should be recorded as 5.0 m.

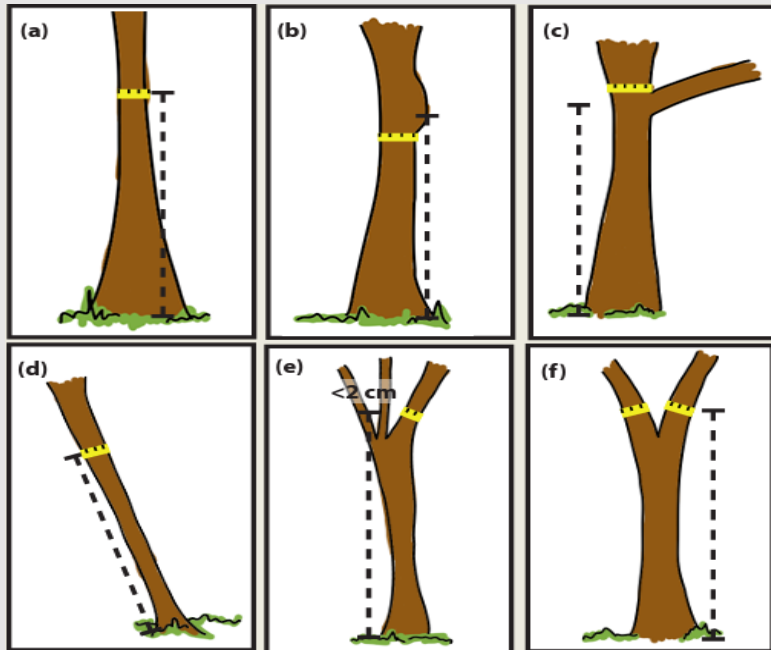
### Size

#### DBH

V5

Diameter at breast height (*DBH*) is the diameter, or width, of the main trunk of the tree at breast height. *DBH* is one of the most common, consistent and accurate measures of the size of a tree. *DBH* can be used to calculate a variety of benefits provided by urban trees, including stored carbon. Change in *DBH* over time is also a common way to measure the growth of a tree.

*DBH* is measured at “breast height,” which is officially 1.37 m or 4.5 ft from ground level (the base of the tree). It can be helpful to measure exactly where this height is on your own body, or even pin a safety pin at this spot, to ensure that *DBH* is measured at the same point on every tree. Measure *DBH* using a *DBH* tape, which is a special measuring tape in a scale that converts circumference to diameter automatically. Wrap the *DBH* tape around the trunk of the tree perpendicular to the trunk (panel a in **Figure V5**), taking care that the tape is not twisted or crooked. *DBH* should be recorded to the nearest 0.1 cm or 0.1” (depending on the unit system used, see box below), which is usually the finest resolution<sup>1</sup> provided on *DBH* tapes.



**Figure V5. Where to measure *DBH* (yellow ruler).** On all diagrams, “breast height” (1.37 m, 4.5 ft) is indicated by the dashed line. (a) *DBH* on most trees should be measured at 1.37 m (4.5 ft) above ground level (dashed line in all panels). (b) Where the tree has a bulge, measure *DBH* as close as possible to 1.37 m above or below the bulge. (c) Where the tree has a branch at 1.37 m, measure just above the branch point. (d) For trees that lean, measure *DBH* at a distance of 1.37 m along the trunk, or where 1.37 m would be were the tree standing straight up. (e)-(f) For trees with multiple trunks, measure the *DBH* of all trunks greater than 2 cm (3/4”), recording the *DBH* of the largest trunk in the *DBH* field and the *DBH* of all secondary trunks in the *Additional Notes* field.

*DBH* can be tricky to measure if the tree has a bulge or branch at breast height (panels b and c in *Figure V5*), leans one way (panel d in *Figure V5*), has multiple trunks greater than 2 cm (3/4”) in diameter (panels e and f in *Figure V5*). For trees on uneven or sloped ground, measure breast height from the base of the tree on the upper side of the slope.

#### A Note on Units:

##### Metric versus English

Most of the world uses the metric system (kilometers, meters, centimeters). However, the U.S. and a few other countries use English units (miles, feet, inches). Since science is typically conducted using the International System of Units (metric), this Protocol recommends using metric units, although the sample data sheet does allow the data collector to specify the units used for each variable, and wherever units are used in variable descriptions, we provide an English conversion of metric measurements.

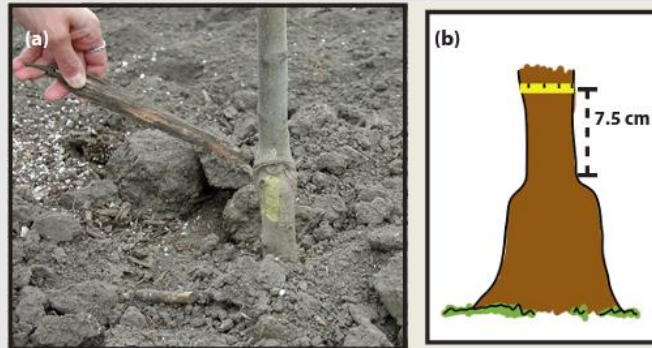
#### V6

##### Caliper

*Caliper* refers to the diameter of the trunk of the tree at 15 cm (6”) above the first lateral root. The first lateral root is the root nearest to the soil surface that reaches out horizontally or roughly parallel to the soil surface. Caliper is a commonly used measure of size for small trees, right out of the nursery, that are not yet tall enough to measure *DBH*. Because trees are

often sold from the nursery by caliper size, caliper-at-planting is often part of nursery and planting records kept by a tree planting organization. We can measure the caliper of recently planted trees and calculate the annual growth rate as the change in caliper divided by the number of growing seasons that have elapsed since planting.

*Caliper* should be measured using the DBH tape and recorded to the nearest 0.1 cm (or 0.1"). The plain units side of the DBH tape can be used to measure up 15 cm (or 6") along the trunk of the tree. For a tree that is not planted too deeply, 15 cm above



**Figure V6. Where to measure *Caliper* on irregular trees.** (a) Some trees display a prominent grafting union, recognizable by a bulge on one or more sides of the tree and possibly different textured bark. (b) Where the tree has a grafting union visible, measure *Caliper* at 7.5 cm (3") above the graft (yellow ruler).

Image (a) obtained from University of Minnesota Extension.  
Citation: Doug Foulk, "Apples and Pears in Minnesota Home Gardens,"  
<http://www.extension.umn.edu/distribution/horticulture/M1157.html>.

the first lateral root is the same as 15 cm above ground level. For trees with mulch at the base of the tree, you may need to dig down into the mulch to find the soil line at the base of the tree. If digging into mulch does not reveal a first lateral root, measure caliper 15 cm above the soil line. For trees that display a visible grafting union above soil level (see panel a in **Figure V6**), measure Caliper 7.5 cm (3") above the graft bulge (panel b in **Figure V6**).

Note that if a tree was planted too deeply, it may be difficult or impossible to find a first lateral root in order to accurately measure *Caliper*. If this is the case, make a note, so that you know that calculating change in caliper since planting may not be a completely accurate measure of tree growth.

## **V7** Total Height

*Total Height* is the height of a tree from the base of the tree (ground) to the tops of its branches. *Total Height* is another important measure of size. Height can tell us about the ability of a tree to provide benefits (e.g., shade or stored carbon) and potential future interference with overhead infrastructure or with other trees. It can also be used in combination with *Height to Crown* (see V8 below) to give us an approximate measure of canopy volume and potential for photosynthesis and growth. *Total Height* can be measured with a clinometer or digital hypsometer/range finder. Since these devices are used very differently, please refer to the instructions provided with purchase of your clinometer or hypsometer. *Total Height* is measured as the distance from the ground to the top of the tree, including any dead branches at

the top of the tree. Record *Total Height* to the nearest 0.5 m (or nearest foot if using English units). For severely leaning trees, height is considered the distance along the main trunk from the ground to the top of the tree.

**V8**

### Height to Crown

*Height to Crown* is the distance along a tree's main trunk between the ground and the beginning of the canopy or crown. The crown, or canopy, of a tree is the leaves and branches of a tree that make up the green leafy tops of deciduous trees (trees that lose their leaves in fall) or coniferous trees (trees with needles). *Height to Crown* can be subtracted from the *Total Height* (see V7 above) of the tree to get a rough measure of the size of the tree's canopy. For trees close to pedestrian or vehicular right-of-ways, *Height to Crown* can help urban forest managers anticipate when a recently planted tree may need to be pruned up.

*Height to Crown* is measured using a clinometer or hypsometer, and record to the nearest 0.5 m (or to the nearest foot if using English units). Measure *Height to Crown* as the distance between the ground and the lowest hanging part of the live crown. Live branches that are less than 3 cm (1 3/16") in diameter and more than 1.5 m (4.9 ft) below the main crown can be excluded.

## Tree Condition

**V9**

### Crown Dieback

#### *Crown*

*Dieback* is the amount of dead branches on the top and outsides of the tree canopy (**Figure V9**). Dieback occurs from the top down and from the outside inward. Dead branches within the live canopy of the tree or underneath other live branches on the underside of the canopy are not part of crown dieback because these branches might naturally die off due to self-shading and self-pruning. *Crown Dieback* serves as a measure of tree health. Dieback is often one of the early symptoms of root zone stress and in severe cases can be a precursor



**Figure V9. Example of Crown Dieback.** A red maple (*Acer rubrum*) exhibiting crown dieback. This tree would receive a Crown Dieback rating of 3, corresponding to 40-60% dieback.

Images obtained from  
ForestryImages.org. Citation: Jason  
Sharman, Vitalitree, Bugwood.org.

**Table V9. Explanation of *Crown Dieback* values.** Observers should look at tree from more than one angle and imagine drawing a line around the outermost visible branches and determining the percent of missing canopy within.

Crown Dieback Rating	Visually estimated percent dieback
0	0% (no dieback)
1	1-20% Dieback
2	21-40% dieback
3	41-60% dieback
4	61-80% dieback
5	81-99% dieback (very few living branches)
6	100% dieback (complete dieback, no living canopy)

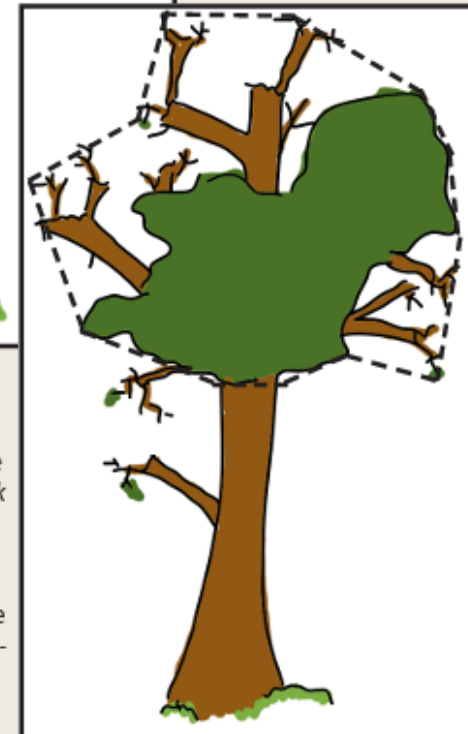
to the death of the entire tree. Trees exhibiting dieback symptoms are also likely to have depressed growth rates.

*Crown Dieback* is a categorical, visually-assessed variable that should be determined by at least two observers looking at the tree from multiple angles. Observers should mentally draw an outline around the outermost branches or crown perimeter visible from that angle and estimate the percent of the canopy area (including dieback area) that is missing (see box to right) This is most easily done if one can look at the tree with a clear patch of sky as background (e.g., **Figure V9**). Observers should only include in the visually-estimated percent of dieback those dead branches that are on the tops and outside of the tree. Exclude any dead branches on the underside of the

### Estimating Crown Dieback v9



The tree at the left has approximately 15% dieback in the canopy, and would be given a *Crown Dieback* rating of 1.



The tree at the right has approximately 50% dieback in the canopy, and would be given a *Crown Dieback* rating of 3. Note that the dead branch underneath the canopy and the branch off the main trunk are excluded from the total crown area.

canopy of within the live canopy. The visually-estimated percent dieback is transformed into a categorical rating and recorded in categories of 20% intervals according to the values in *Table V9*.

If two observers looking at the tree from different angles obtain different *Crown Dieback* ratings, the observers should average their individual estimates of percent dieback and record the *Crown Dieback* rating corresponding to the average percent die-back.

**V10 Lower Trunk Damage**

*Lower Trunk Damage* is damage near the base of the tree in the form of peeling or broken bark or damaged wood. Damage can be caused by lawn mowers, weed-whackers, vehicles, or even animals. Substantial lower trunk damage can increase risk of tree infection by fungus or disease, and repeated damage over time on all sides of the lower trunk, as from a lawn mower, can girdle and eventually kill a tree by severing the vascular tissue.

*Lower Trunk Damage* is recorded as a presence/absence variable, where 1 indicates the presence of damage and 0 the absence of damage (*Table V10*). Look for damage on the lower

**Table V10. Explanation of *Lower Trunk Damage* values.**

Lower Trunk Damage value	Explanation
0	Absence; no evidence of damage is visible on lower 45 cm (18") of trunk.
1	Presence of damage on lower trunk

trunk (<45 cm or 18" from ground). Examine the base of the tree and look for any evidence of damage by a lawn mower, weed-whacker, car, animal, etc. in the form of scars or missing bark. The most common damage occurs about 15-20 cm (6-8") above the ground, the approximate height of a lawn mower, and looks like a horizontal strip of broken outer bark. Damage should be very visible, and more than a single minor scrape, such as broken outer bark. Evidence of wound occlusion (healing) may be apparent, but healing *Lower Trunk Damage* should still be recorded "present."

**V11 Other Damage**

*Other Damage* is damage on parts of the tree (upper trunk, branches, canopy) aside from the lower trunk. Damage on a tree can affect the overall health and growth of the tree. Any damage that strips a tree of bark or leaves an open wound opens the tree to infection by a fungus or disease. Damage such

**Table V11. Explanation of *Other Damage* values.**

Other Damage value	Explanation
0	Absence; no evidence of damage is visible on the tree excluding any Lower Trunk Damage (V9).
1	Presence of damage on the tree above any Lower Trunk Damage (V9), such as snapped branches or vandalism, car damage, tec.

as a snapped branch that removes leaves can also decrease photosynthesis and growth potential.

*Other Damage* is recorded as a presence/absence variable, where 1 indicates the presence of damage elsewhere than the lower trunk and 0 the absence of damage (**Table VII**). Examine the whole tree and look for evidence of vandalism or other human-initiated damage (or negligence). This may include, but is not limited to: a dog rope tied to the tree, broken branches left unpruned, leaves stripped off branches (usually at pedestrian height), bark peeled off the tree, something choking or girdling the tree, car damage, or even a tree pulled out of the ground.

## V12

### Mortality Status

*Mortality Status* is a record of whether the tree is alive, standing dead, removed, or in some other status (**Table VI2**).

Mortality status is an essential outcome of many monitoring studies, to report on mortality and survival rates as performance metrics, and to understand population change.

Throughout this protocol, we define “mortality” to include trees that die in place and those that are removed while still alive. This is consistent with recent urban tree mortality research (Hilbert et al. 2019, Roman et al. 2016). Trees classified as standing dead, stump, and removed will all be included when calculating mortality rates. Furthermore, it is generally difficult, or even impossible, for field crews to infer whether trees observed as removed were dead or alive at the

**Table VI2. Explanation of *Mortality Status* values.**

Category	Description
Alive	The tree has green leaves and/or buds and green tissue under the bark. Extremely unhealthy trees, such as those with no leaves but live buds, are included in this category.
Standing Dead	Tree is dead and above 12 inches (30.5cm) in height. Trees classified as standing dead must be completely dead above-ground, with no green leaves, no live buds, and no green tissue under the bark. Trees that have the trunk and branches dead but have live basal sprouts should be recorded as standing dead.
Stump	Tree is dead and under 12 inches in height.
Resprouted, No Central Leader	Main body of tree is dead or is a stump and sprouts have begun to grow. One sprout in particular is taller and/or seems to be growing to be the main trunk of the tree.
Resprouted, Central Leader	Main body of tree is dead or is a stump and sprouts have begun to grow. No single sprout appears to be growing more than the others.
Removed*	Tree has been removed since the previous observation. No sign of a stump.
Replaced	Original tree has been replaced with that of a different species.
Never Planted*	Tree was never planted. This category is only relevant to monitoring planting programs and giveaway programs in circumstances for which the program staff cannot be certain that every tree distributed was actually planted. When this category is relevant, be very careful in distinguishing “removed” from “never planted” trees. Confirm with the resident or planting program manager as to whether the tree was indeed planted.
Unknown*	Tree has unknown status (possibly due to issues in accessing the property or confusion about tree location). Note: If unknown status, explain the situation in the notes.

*\* Indicates some portion of the protocol will be skipped after this data collection*

time they were removed. For repeat monitoring, field crews should confirm that the tree is indeed the same tree from prior data (i.e., not a replacement planting).

Data is collected for all live trees, including those that are replaced. If the tree is obviously replaced but is standing dead, *Mortality Status* would be Replaced and *Overall Tree Condition* would be standing dead.

If a tree is recorded as Removed, Never Planted, or Unknown, the protocol will end and no further data should be collected.

### V13

#### Pests & Diseases

The *Pests & Diseases* variable is a checkbox-style measure of the presence or absence of certain common tree-harming pests and diseases. Pests are listed in *Table V13.1* and *V13.2* and diseases are listed in *Table V13.3*. This variable includes a photo field.

*Pests* is divided into “nonthreatening pests” and “threatening pests” on this document to fit formatting but is not necessary for data collection. All diseases have been grouped into one category. The descriptions of the pests and diseases are taken from *The Morton Arboretum’s Tree Care Quick Facts* article or from the Morton Arboretum website.

**Table V13.1. Explanation of nonthreatening *Pests*.**

Pest	Description
Scales	Generally feeds on plant sap and some species produce a sticky substance called honeydew that drip onto below foliage. Heavy infestations cause branch dieback.
Japanese Beetles	Common in Chicago; shiny metallic green; can damage lawns by feeding on grass roots and once emerged from soil eat leaves and may skeletonize leaves leaving veins.
Caterpillars	Eastern tent caterpillar and fall webworm are common pests of deciduous trees. Tent caterpillars feed on leaves of ornamental trees and may defoliate some of the tree. Fall webworm may cause cosmetic issues from its tentlike structure on the tree.
Pine Sawflies	Feeds in groups on pine trees. Can cause significant defoliation to host plants.
Bagworm	Creates a bag-like silk case made from the host plant, usually conifers and deciduous trees.

**Table V13.2. Explanation of threatening *Pests*.**

<b>Pest</b>	<b>Description</b>
Emerald Ash Borer	Major invasive species that are metallic green and significantly cause mortality to ash trees. Feed on water-conducting tree tissue just under the bark, creating distinctive serpentine tunnels. Tunnels will girdle a tree in one to three years.
Two-Lined Chestnut Borer	Attacks oak trees, especially those that are stressed, injured, or weakened. Feeds under bark and destroys water-conducting tissue, causing branch dieback, eventually killing the tree.
Zimmerman Pine Moth	Generally attacks Douglas-fir and Scots, Austrian and red pines. Larvae tunnel under bark, girdling the trunk or large branches and cutting off supply of water and nutrients. Masses of sap are apparent on affected areas, usually near branch whorls.
Bronze Birch Borer	Similar to emerald ash borer in shape and size. Stresses birches. Larvae bore tunnels beneath the bark, cutting off the water supply and nutrients.
Gypsy Moth	Major invasive species. Feed on many types of trees but favor oaks. Causes severe defoliation.
Asian Long-horned Beetle	Major invasive species. Feeds on more than 14 species, especially maple. Larvae tunnel in water and nutrient carrying tissues, but also in inner heartwood, undermining the trees structure

**Table V13.3 Explanation of common and threatening *Diseases***

<b>Disease</b>	<b>Description</b>
Apple Scab	Caused by fungus as new leaves emerge. Mostly observed on leaves, blossoms, and fruit. Appear like small velvety brown to olive green spots that enlarge and darken.
Rust Fungus	Caused by fungus. Cedar-apple rust most common, which needs a juniper and a deciduous tree as hosts. Appear to have orange, yellow, or brown spots on leaves of deciduous tree, and bright orange tendrils on junipers.
Dutch Elm Disease	Caused by fungus. Spread through elm bark beetles but also through grafted elm root tissue. Noticed when leaves on upper branches curl and turn gray-green, then yellow, then brown.
Oak Wilt	Caused by fungus that invades water-conducting tissues. Leaves on infected branches curl and turn yellow or bronze in color. Red oak most susceptible.
Cankers	Appear as sunken or discolored lesions on the bark of trunks and branches or as injured areas on smaller twigs.
Bur Oak Blight	Involves tissue death of leaf and spore producing pustules found where the leaf attaches to the twig.
Tar Spot	Caused by fungus. Appearance of black spots on leaves. Cosmetic issue.

## Planting Area

### V14

#### Planting Area Type

*The Planting Area Type* (sometimes called the planting space or planting spot) is a name for the contiguous, permeable physical place within which the tree is planted. In other words, it is a description of the tree's immediate location.

The tree may be planted in an area filled with soil or a soil-substitute. Urban trees are usually planted in a space covered with a permeable substrate, such as grass or mulch. The type of planting area can tell us about the available growing space and soil conditions for the tree. Planting area may also give a clue as to who may be responsible for maintaining the tree, although this is not always the case.

*Planting Area Type* is recorded as a categorical variable, picking from the options in **Table V14.1-V14.3**. Types of planting areas are separated into three categories: those within hardscape environments (Tree Lawn, Median, Shoulder, Tree Grate, Tree Pit, Bumpout, Planter Box, Other Hardscape)(**Table V14.1**), those within maintained, non-hardscape environments (Front Yard, Side Yard, Back Yard, Maintained Park, Golf Course, Other Maintained Landscape Area)(**Table V14.2**), and non-maintained or natural areas (Vacant Lot, Vacant Residential Property, Natural Area, Other Non-Maintained Area)(**Table 14.3**). See **Figure V14** for diagrams of a few types of hardscape planting area types.

**Table V14.1. Explanation of *Planting Area Types* within hardscape environments.**

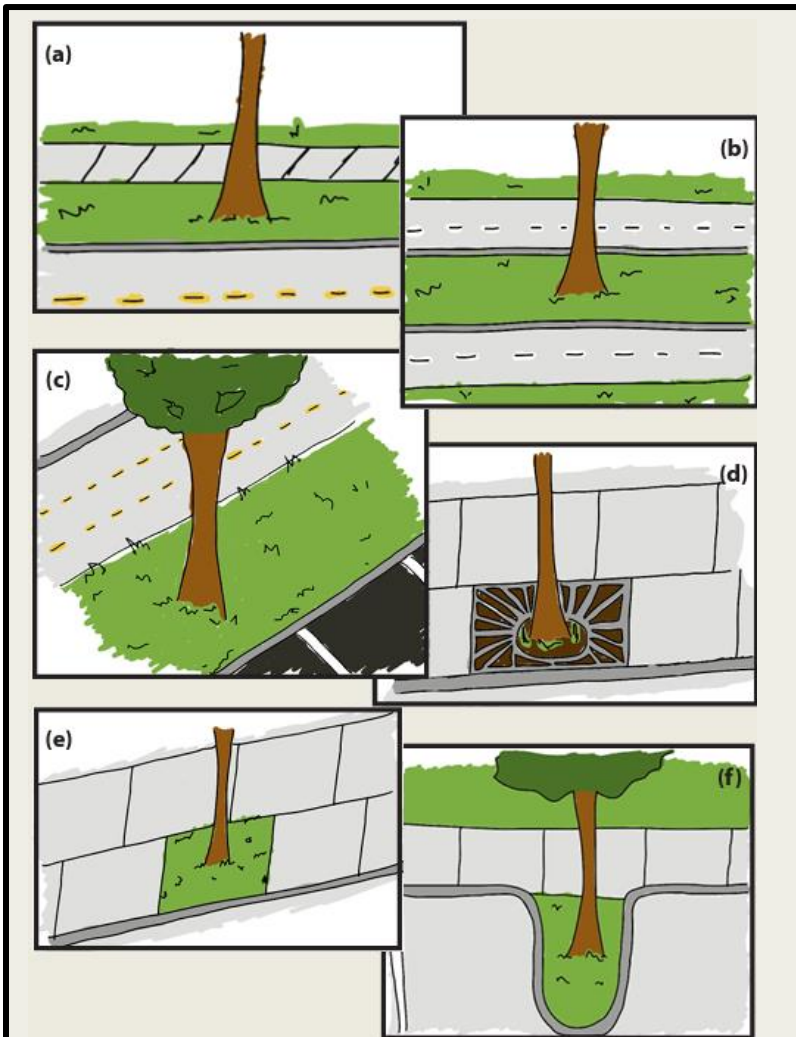
Planting Area Type	Explanation
Tree Lawn	Tree is planted in the strip of permeable surface (usually grass) between the sidewalk and the street
Median	Tree is planted in a median, or strip of land between two or more lanes of traffic.
Shoulder	Tree is planted in a large road shoulder, either sloping up or down from street level; generally for trees planted in the right-of-way of wide, busy streets or roads in more rural areas.
Tree Grate	Tree is planted in a pit along a street or sidewalk and planting area is covered by a metal tree grate.
Tree Pit	Tree is planted in a relatively small pit-like area, bordered by pavement or similar in close proximity on all four sides, but without a tree grate accompanying the pit.
Bumpout	Tree is located in a bumpout or cutout along the sidewalk or street, bordered by pavement or similar in close proximity on three sides; common where on-street parking occurs.
Planter Box	Tree is located in a raised planter box with a solid base (i.e., the tree roots are not connected to ground soil). The planter box could be anywhere on or adjacent to a property (e.g., sidewalk, yard).
Other Hardscape	Tree is located in a hardscape other than a sidewalk or median, such as cutouts or narrow planting strips in a plaza or parking lot.

**V14.2 Explanation of *Planting Area Types* within maintained, non-hardscape landscapes.**

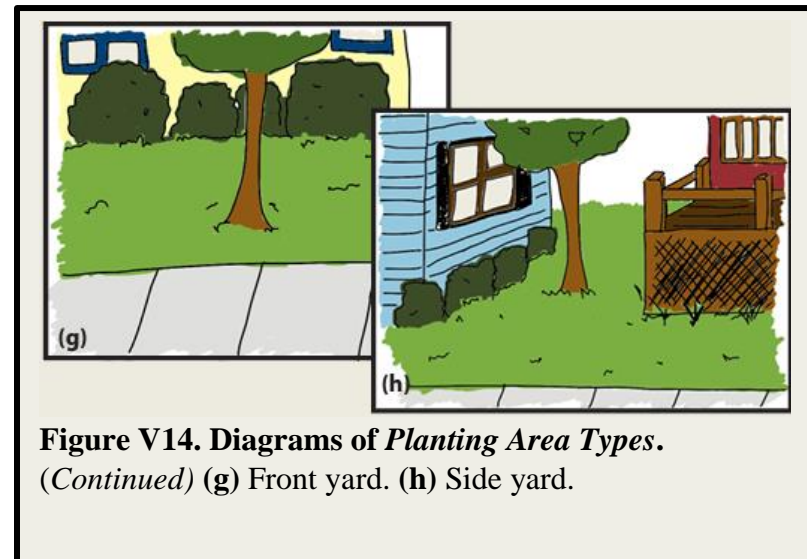
<b>Planting Area Type</b>	<b>Explanation</b>
Front Yard	Tree is located in the front yard of a house or building, between the building and the sidewalk or street.
Side Yard	Tree is located on the side of a house or building, between two buildings.
Back Yard	Tree is located in the yard behind a building. Back yards are typically associated with residential properties but may also be in back of other land use types.
Maintained Park	Tree is located in a maintained park or park-like setting, such as a city park, school campus, or cemetery. This category is specifically for trees in lawns and other landscaped areas with pervious ground cover. Park trees located in hardscapes such as plazas belong in the other hardscape category. Note: maintained park is both a site type and land use.
Pedestrian Trail or Bike Path	Tree is located along a pedestrian trail or bike path that runs through a natural area. Trees that are near a trail but not alongside it belong in Natural Area.
Golf Course	Tree is located within a golf course. Specific to trees immediately within a golf course; trees located within a small patch of forest within the golf course would belong in Natural Area.
Other Maintained Landscape Area	Tree is located in a landscaped area not described by the yard and maintained park categories. For vacant lots with land use category vacant, field crews need to use their own judgment in the field to classify a tree as located in site type other maintained landscapes area (e.g., if the lot appears mowed and nominally maintained) or natural area (e.g., if the lot appears to have no maintenance and is overgrown).

**V14.3. Explanation of *Planting Area Types* within non-maintained or natural areas**

<b>Planting Area Type</b>	<b>Explanation</b>
Vacant Lot	Tree is located in a vacant lot with no evidence of maintenance.
Vacant Residential Property	Tree is located in a vacant residential property that would receive minimal human intervention.
Natural Area	Tree is located within a natural park, including remnant forest patches, patches of forest within a golf course, or forested areas within residential property or institutional property.
Other Non-Maintained Area	Tree is located in a non-maintained area not described by the previously mentioned categories



**Figure V14. Diagrams of *Planting Area Types*.** (a) Tree lawn. (b) Median. (c) Shoulder. (d) Tree grate. (e) Tree pit. (f) Bumpout. (Continued on right)



**Figure V14. Diagrams of *Planting Area Types*.** (Continued) (g) Front yard. (h) Side yard.

## Maintenance & Community

V15

### Notable Maintenance Needs

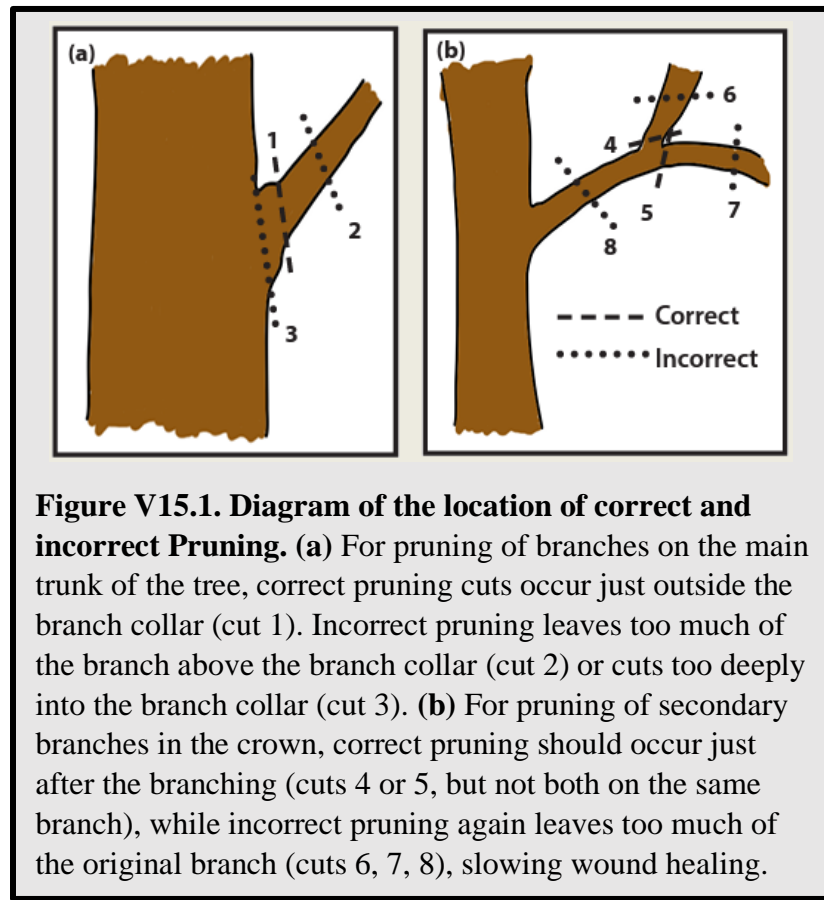
*Notable Maintenance Needs* describes any evidence of unprovided or incorrect maintenance done to the tree. Maintenance includes pruning, mulching, or staking, explained individually below. This area is a check box field, where it is checked if the field crew determines the maintenance to be substantially significant to tree care or tree health.

#### Pruning

Pruning is defined as a visible effort made by a human to remove branches from the canopy or trunk of a tree. Pruning or trimming the branches of a tree can improve the overall growth form, structure, stability, and appearance of a tree. Pruning is usually a well-intentioned effort to care for a tree, whether or not the pruning is done correctly. Still, by definition, pruning reduces the amount of leaves on the tree and thus reduces the tree's capacity for photosynthesis and growth. Pruning also leaves a wound on the tree, leaving the tree open to disease and pathogens. Evidence of pruning and whether pruning was done correctly may be an important indicator of future health of the tree as well as an indicator of whether or not the tree is being actively maintained and cared for by someone.

Examine the trunk and main branches of the tree and look for signs of pruning that has occurred since planting. Evidence of pruning (correct or incorrect) consists of a flat cut, as if done with a handsaw, knife or other implement that would yield a

flat tip of a branch. Broken-off branches do not count as pruning because it is impossible to determine whether these were intentionally or unintentionally broken by a human or other animal. "Correct" Pruning occurs just outside the branch collar, a slight bulge of differently-textured bark where the smaller branch diverges from a larger branch. Look for cut branches with the lighter color of the inner wood visible, pruning scars, open wounds, a branch collar not completely



**Figure V15.1. Diagram of the location of correct and incorrect Pruning.** (a) For pruning of branches on the main trunk of the tree, correct pruning cuts occur just outside the branch collar (cut 1). Incorrect pruning leaves too much of the branch above the branch collar (cut 2) or cuts too deeply into the branch collar (cut 3). (b) For pruning of secondary branches in the crown, correct pruning should occur just after the branching (cuts 4 or 5, but not both on the same branch), while incorrect pruning again leaves too much of the original branch (cuts 6, 7, 8), slowing wound healing.

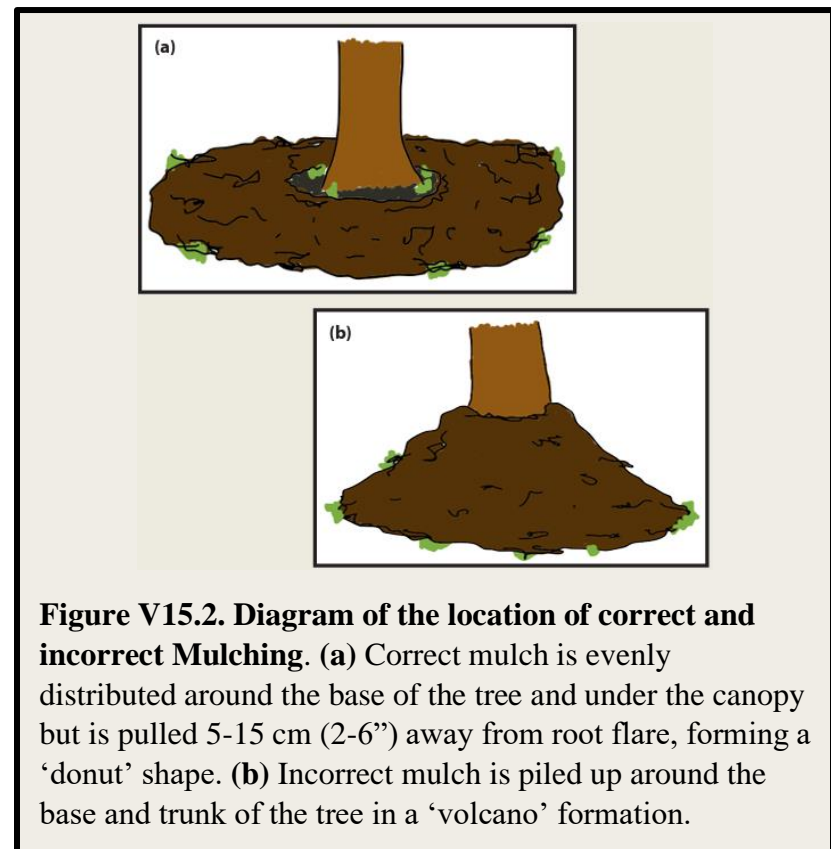
healed over, etc. Any pruning scars that are mostly or completely healed over do not count as recent pruning because such pruning is likely to have occurred at the nursery and to not have been performed by an individual responsible for the recently planted tree.

### **Mulching**

Mulching is defined as any effort to place organic or inorganic materials around the base of the tree to prevent weed growth or water loss. Mulch is usually an organic material made of shredded or chipped tree or shrub trimmings, such as wood chips or shredded bark. Inorganic mulching materials such as rubber or plastic pellets are also sometimes used. Correctly mulched trees may better withstand drought because moisture is retained in the mulched soil. Mulch also provides protection from mower damage that might otherwise occur during cutting the grass surrounding the base of the tree. Mulching, like pruning, is usually a well-intentioned effort to care for the tree, whether or not it is done correctly. Evidence of mulching and whether any mulching appears to have been done correctly may be an important indicator that the tree is being actively maintained and cared for by someone.

Examine the base of the trunk and ground underneath the tree and look for organic mulch (e.g., wood chips, shredded bark, and even saw dust or intentionally placed leaves or pine needles) and inorganic mulch (e.g., plastic or rubber pellets). “Correct” Mulching is defined as no more than 5 cm (2”) of mulch distributed in a ‘donut’ shape within the dripline, pulled 5-15 cm (2-6”) away from the base of the trunk so as not to suffocate the tree and encourage adventitious roots growing

into the mulch from the aboveground portion of the trunk (**Figure V15.2**). “Incorrect” Mulching is defined as mulch piled up around the base of the trunk in a ‘volcano’ formation (**Figure V15.2**) or excess depth of mulch (i.e., over 5 cm or 2”). Note that correct versus incorrect mulching does not consider the type of mulch used (this is captured by V16, *Ground Cover At Base*) but simply the amount and placement of mulch. Mulch so old that only a few pieces of larger bark shreds or wood chips remain visible is considered to be no mulch.



**Figure V15.2. Diagram of the location of correct and incorrect Mulching.** (a) Correct mulch is evenly distributed around the base of the tree and under the canopy but is pulled 5-15 cm (2-6”) away from root flare, forming a ‘donut’ shape. (b) Incorrect mulch is piled up around the base and trunk of the tree in a ‘volcano’ formation.

## *Staking*

Staking is defined as an effort to hold a tree in place and keep it from being knocked down or blown over. There are many methods of staking, including some that only use ropes to hold the tree upright and no stakes at all. Staking, like mulching and pruning, is usually a well-intentioned effort to care for the tree, whether or not it is done correctly. Correct staking on a recently planted tree may be an indicator that the tree is being cared for and maintained. Incorrect staking, however, such as a stake not removed at the proper time, may be an indicator that the tree is not actively being cared for.

Look for one or more stakes holding the tree upright. Correct staking implies that the stake or ropes are not pulling the tree over in one direction or the other and the stake line is not girdling the tree because it is tied too tight or the tree has out-grown the line. Incorrect staking occurs when stake line is girdling the tree, a stake is pulling the tree over, the stake is placed too close to the trunk of the tree (the tree may be growing into the stake), the staking line is snapped but still tied to the tree, or when other staking methods harm the tree. Note that a stake with nothing tying it to the tree (and nothing around the tree that might have been tied to the stake) should be noted, but is considered “none” for staking.

## **V16**

### **Ground Cover at Base of Tree**

*Ground Cover At Base of Tree* captures the dominant ground cover type at the base of the trunk and under the canopy of the tree. The type of ground cover tells us the potential for competition with other plants for water and nutrients, the permeability of the area immediately surrounding the tree, the amount of organic material potentially decomposing and providing nutrients to the tree, or even the likelihood of soil disturbance in the tree root zone (e.g., due to planting and replanting of annual plants). All of these factors can influence the growth and survival of a recently planted tree.

The ground cover variables is recorded as the representative type of ground cover adjacent to where the trunk of the tree enters the ground. Where more than one type of ground cover exists, assign the type of *Ground Cover* that constitutes the largest proportion of the area under the canopy or adjacent to the base of the tree. To assess *Ground Cover At Base*, imagine a small ring with a 15 cm (6”) width adjacent to the base of trunk where the tree enters the ground and determine the predominant ground cover type within this ring. For a tree in a tree grate, look under the grate if possible. See **Table V16** for possible values for *Ground Cover At Base*.

**Table V16. Explanation of *Ground Cover at base of Tree and Under Canopy* values.**

Type of Ground Cover	Explanation
Soil	Bare soil, exposed dirt; includes very old mulch where so few mulch pieces are visible that it no longer serves a purpose as mulch.
Organic Mulch	Organic (biodegradable in the short term) mulching material, such as bark or wood chips, shredded wood waste, even saw dust or intentionally placed leaves or pine needles.
Inorganic Mulch	Inorganic (man-made and non-biodegradable in the short term) mulching material, such as rubber or plastic pellets.
Grass	Turf grass.
Perennial	Perennial plants, flowers, shrubs; live more than one growing season; most bushes are perennial plants.
Annual	Annual plants or flowers; only live one growing season; examples include most food plants, impatiens, begonias, petunias, most geranium flowers.
Gravel	Small pebbles, gravel, or landscaping rocks.
Weeds	Weeds, nuisance plants, grass, etc. greater than 30 cm (1 ft) in height.
Pavement	Pavement, cement, asphalt, paving stones, etc.; may be broken and cracked but should still be in large, identifiable pieces to qualify as pavement (small, gravel-sized pieces would be gravel).
Other, permeable	Any other ground covering not mentioned above that is permeable (water would run through the substance and reach the soil below).
Other, impermeable	Any other ground covering not mentioned above that is impermeable (water runs off in the direction of gravity or pools on the top but does not reach the soil immediately below).

**V17**

**Water Bag**

Water bags, also called irrigation bags or Gator Bags, are plastic or canvas bags around the trunk and/or base of the tree. When filled, they slowly release water to the roots of the tree through a porous bottom. A water bag can either be filled or partially filled with water (“Present, filled”), i.e., not dry, not filled with any water (“Present, dry”), or not present (“Absent”).

**V18**

**Evidence of Care Notes**

*Evidence of Care* variables are other actions individuals can take that indicate an ethic of care for the tree and surrounding area, outside of the tree-specific maintenance practices described in the previous section. Evidence of care for a tree may indicate a sense of ownership and responsibility that someone may have for that tree, and may be related to improved tree condition, survival and growth rate.

This variable is written as a notes field so as to minimize time spent checking through specific evidence of care variables. The field team should be aware of any notable evidences of care (or harm) specifically tailored to the tree. These include but are not limited to: (within 3 feet) benches, trash/debris, and domesticated/intentionally planted flowers; bicycle locked to tree, graffiti to tree, ornaments on tree, etc.

## Neighborhood/Site Notes Voice Memo

The *Neighborhood/Site Notes Voice Memo* is a qualitative, time efficient field used at the end of data gathering for a particular area. The voice memo should be recorded for no more than two minutes, and in it the field crew describes the surrounding neighborhood or site as they see it. This may include any encounters the field crew has with notable individuals (maintenance crew, stewards), descriptions of community engagement, or any notable features in the local environment. Some examples include bird feeders, yard art, chalk art on sidewalk, graffiti nearby, untrimmed sidewalk, proper or improper disposal of pet waste, presence of local community garden, etc.

### **Additional Notes**

The Additional Notes field is an important place to record information about the tree that is not captured by any of the variables discussed above. Additional notes on a tree become particularly important when the tree does not fit any of the possible values of a categorical. Additional notes can also be a place for data collectors to write important notes to whomever will be analyzing and interpreting the tree inventory data.