The Riparian Assessment Field Guide 2016

Extensive Riparian Vegetation Monitoring – Remote Sensing Pilot Study

Agreement No. IAA 16-205

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Prepared for Washington Department of Natural Resources

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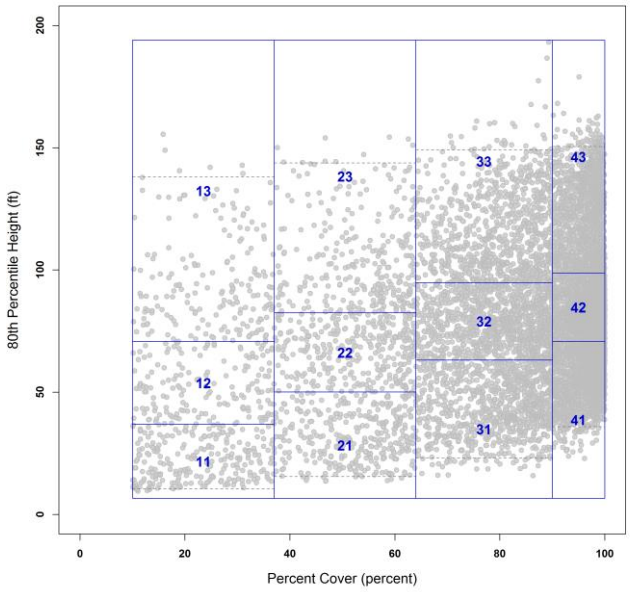
1 TABLE OF CONTENTS

THE RIPARIAN ASSESSMENT
♦ Field Data Collection System ♦

INTRODUCTION

This document defines the field work methodology that will support the ground-truthing segment of The Riparian Assessment. The field plot data consists of 100+ 1/8th acre circular plots located within respective riparian buffers throughout the Mashel Watershed. Plots are determined using stratified random sampling, where LiDAR-based structural information (size class, cover) is used to stratify the area covered by the strips into structural classes, and plots distributed so as to cover the full range of LiDAR structural size and cover classes. Ultimately, plots will fall within one of 12 distinct BINS as show below:



Each individual sample plot will be Identified by a four-digit code: XXYY where XX is the BIN number [shown above] and YY is unique plot within that BIN. 2309, example, is the 9th eligible sample plot within the BIN 23 grouping.

This field guide is a reference for the installation and measurement of fixed-area field plots used in this study.

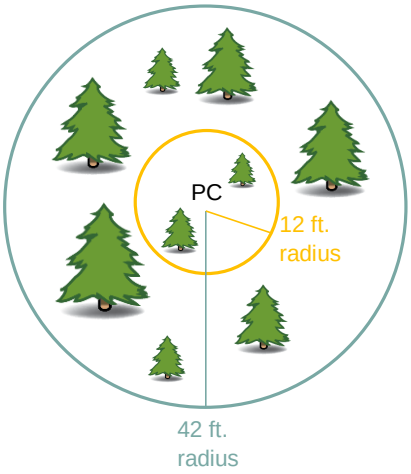
The field guide will do the following:

- Instruct field personnel in how to locate, install, and take measurements on field plots.
- Document the field procedures, methods, and data collection specifications used in this inventory

1.1 GENERAL DESCRIPTION

The field plots are approximately 1/8 acre in size. This translates to a circle with a radius of 41.63 ft. [rounded up to 42 ft.]. The sample plot is then subdivided with radius of 12ft., which delineates the small tree plot. All tally trees with a DBH >= 5.0 in. within the entire plot will be individually assessed and recorded. Tally trees with a DBH >=1.0 in. and <5.0 in. will only be recorded if they fall within the bounds of the smaller, sub-plot. What constitutes as a tally tree is discussed later in more detailed methodology.

"**P**lot **C**enter" is defined as the exact center of the of the field plot and will be used for essential functions such as navigation, distance from other points of interest, and creating the boundaries of the data collection procedure.



1.2 UNITS OF MEASURE, BOUNDARIES, & CONDITIONS

English units will be used for all measurements, unless otherwise specified.

All azimuths will be magnetic (no declination allowance).

Plot Dimensions:

- **Macroplot Radius** = 42.0 feet
- **Macroplot Area** = $5{,}445\ \text{ft.}^2$ | $0.125\ \text{Acres}$ | $505.86\ \text{m}^2$

- **Subplot Radius** = 12.0 feet
- **Subplot Area** = $452.39\ \text{ft.}^2$ | $0.01\ \text{Acres}$ | $42.03\ \text{m}^2$

Tree Limiting Dimensions:

- Breast height: 4.5 feet | 1.4 m
- Stump height: 1.0 foot
- Trees with 1.0 in. <= DBH < 5.0 in. will be sampled within subplot only
- Trees with 5.0 in. < DBH will be sampled within entire macroplot

1.3 DEFINITIONS AND ACRONYMS

- **DBH**: **D**iameter at **B**reast **H**eight; the point at which a tree's diameter is measured. See Appendix B for further information
- **CWD**: **C**oarse **W**oody **D**ebris
- **Tree height** is defined as the vertical distance between two horizontal planes: one plane passing through the highest twig and the other through the base of the tree at mid-slope. Tree height is not synonymous with trunk
- **Canopy Cover** is defined as the area of ground surface covered by a vertical projection of the canopy of a vascular plant. The canopy is described by a polygon surrounding the outer edges of the foliage, without subtracting any normal spaces occurring between the leaves of plants (Daubenmire 1959). Overlapping crowns within a species or growth habit are not double-counted; the maximum possible cover is 100%. See Appendix C for further information.

2 SAFETY

Safety is a number one priority within this segment of the Riparian Assessment. In the field there are many safety hazards. Everyone must always be conscious of these hazards to avoid accidents.

1. Don't take chances!
2. Eliminate horseplay and carelessness!
3. Think Safety!
4. No task is more important than personal safety!
5. Always make sure that someone else knows where you plan to work each day!

2.1 SAFETY IN THE WOODS

- Wear protective clothing: Long-sleeved shirts, long pants, and gloves may protect you from contact with brush and rocks, cow parsnip, poison oak and ivy and stinging or biting insects. Trouser legs should be loose enough to avoid binding or cramping, and should not have cuffs. Wear a hardhat at all times in the woods. During hunting seasons, wear bright red or orange clothing.
- Wear good quality boots that provide good support and traction. For example: 8-inch high leather work boots with lug-soles (Vibram-type soles).
- Walk, don't run in the woods. Take your time and plan your route. Avoid plunging through the brush. The best route of travel may not be the shortest. Routes across brushy, irregular terrain with rocks and down logs can be hazardous.
- Be watchful of twigs and branches, which may cause eye injury. Be especially alert when stepping up to trees which retain their small dead twigs. Keep a sufficient distance behind the person ahead of you to avoid being slapped by branches.
- Lift knees high to clear obstacles in heavy undergrowth or slash. Slow down and watch your step.
- When contouring a steep slope, do not lean into the hill. This tends to loosen footing. Erect posture or slightly leaning out gives more secure footing.
- Know how to fall to avoid hard impacts. Keep flexible with knees slightly bent. If you feel yourself slipping, pick a landing spot. Do not stick your arms out to break a fall. Roll with the fall. Try to take the impact on the side of your body rather than your back.
- Don't take chances by walking across ravines on small logs.
- Bee aware. Keep an eye out for yellow jacket and hornet activity. Yellow jackets nest in the ground, often in well-decayed logs or in thick moss on trees or in snag cavities. Yellow jackets are particularly active (nasty) during late summer and early fall when forest conditions are very dry. Hornets nest above ground in "paper" nests that are suspended from branches. If allergic to insect stings, carry medication to counteract the effects of stings. Let co-workers know about your allergies and how they can assist in an emergency.
- Keep hatchets in their sheath except when actually using them, and snap the sheath shut.
- First Aid. Keep your individual first-aid kit completely supplied, and know how to use it. Treat all wounds promptly.
- Carry plenty of water. Don't expect your partner to carry water for you.

- Beware of lightning. Watch for approaching storms. Avoid prominent high exposed ground and tall/lone trees. Abandon field gear, especially that made of metal. Seek shelter in the vehicle if possible, otherwise in thick timber, large caves or in valley bottoms. Crouch on the balls of your feet with your head covered. Separate 100 feet from other crew members.
    - Snake aware: A wide variety of snakes exist in the study areas, some poisonous. Be careful with your foot and hand placements in areas that may shelter snakes, such as rock outcrops, low-lying shrub cover, tree cavities, under logs, etc. Don't reach where you can't see. Walk in open areas that maximize visibility. Never approach or try to pick up a snake. If a snake is confronted, remain still and back away slowly. If bitten by a snake, remain calm, remove jewelry and restrictive clothing, and receive medical attention immediately. Take note of the appearance of the snake, such as color, length, and distinguishing patterns for ID purposes.
    - Poison Oak/Ivy: For some people, exposure to poison oak/ivy may result in severe allergic reactions. Take precaution by wearing long sleeve clothing to cover skin and avoid touching the plants. If you are allergic, avoid working or hiking in areas with poison oak/ivy and carry appropriate medical supplies (ex. Benadryl or Epi-pen). Poison oak/ivy can grow as a small shrub or as a vine and exhibit the characteristic 3 leaves. If unsure, remember, "Leaves of 3? Let them be!" If an allergic reaction results from exposure, wash skin and clothing thoroughly and treat immediately.
    - Biting and stinging Insects: Protect yourself from insects by wearing long pants, socks, and shirts. Wear boots at least 10 inches high. If needed, secure cuffs of pants and shirts to prevent insects from getting underneath clothing. Use insect repellants that contain DEET or Picaridin. Treat bites and stings with over-the-counter products that relieve pain and prevent infection.

2.2 SAFETY ON THE ROAD

It all pays the same, so drive with care, with courtesy, regardless of others' actions, and with common sense.

Seat belt use is required in all vehicles.

Drive Defensively. Expect the other person, whether a vehicle operator or a pedestrian to do the worst thing and be prepared. Do not drive when sleepy, taking medications, or when other personal conditions make it **unsafe to drive a vehicle**. Get someone else to drive or, if alone, stop driving and nap (out of public view).

Always drive with your headlights on. This practice increases the visibility of the vehicle. It is particularly important when driving in fog, on dusty roads, traveling in and out of shadows, and any other low light/ visibility situations.

Do not operate vehicle in unsafe conditions. Check your vehicle frequently to keep it in good mechanical condition. Lights, horn, steering and brakes should be kept in proper adjustment at all times

2.3 CONTACTS

Riparian Assessment Team Members

Name	Position	Phone Number(s)
Monika Moskal	Principal Investigator	(work) (cell)
Andrew Cooke	Research Consultant	
Megan O'Shea (work)	UW Admin Assistant	206-543-9744
Travis Axe	Research Assistant [field crew]	775-686-0550
Trygve Madsen	Research Assistant [field crew]	206-235-1248

Emergency Contacts – In the event of an emergency, call 911 for availability of nearest medical and emergency services.

3 PLOT NAVIGATION AND INSTALLATION

3.1 INTRODUCTION

Establishing the field plot location is the crucial first step in collecting valid field data. While measurements at each location are used to collect statistical information for the entire inventory area, each location is also compared to high-density airborne laser scanning information (Lidar) and imagery for the same point.

Because these sampling layers must measure attributes on the same location, it is critical that the ground sample be located as accurately as possible.

All ground locations will be established at the target GPS coordinates assigned for each field plot. Crews will use a GPS unit, maps and satellite imagery provided in the plot folder to find the ground location of the plot center (PC).

3.2 PLOT INSTALLATION

Before leaving for the field:

1. Be sure all electronic devices are fully charged, and backup batteries are fully charged.
2. Open data collection program and create a new plot file by selecting the number for the scheduled plot. Check the displayed target latitude and longitude against maps and imagery for the scheduled plot.
3. Create a new route in the GPS and name it “NAV_nnnn”, where “nnnn” is the plot ID, and add the plot center waypoint to it.

Before leaving the starting point to locate the plot:

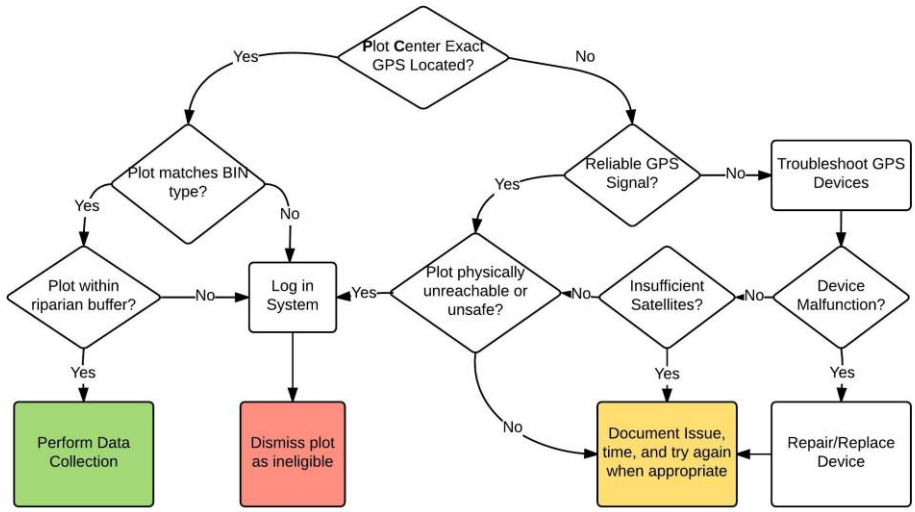
7. Turn off Location Services on the iPad to conserve battery power and put the iPad in sleep mode.
8. Plan your route using available maps and imagery and add waypoints to the GPS route as needed.
9. Start GPS navigation to the plot target coordinates.
10. If a reliable waypoint cannot be obtained at the initial stopping point, move to a clearing as near the stopping point as possible and obtain new coordinates. Repeat this process, if needed, to obtain reliable coordinates for a stopping point.

On the plot

14. When a reliable plot center location is found, name the plot center waypoint “PC_nnnn”, where “nnnn” is the plot number.
15. Install a white plot pin at the plot center location (PC) and tie a piece of flagging to it. The pin should be inserted into the ground far enough to leave about 1/3 visible (about 5-7 inches, soil permitting).
16. Review the entire plot area to determine whether or not all required measurements can be made. Use the decision flow chart in the next section as a guide. Should a be dismissed as ineligible it will be categorized as “Nonsampled” in the program. The Plot Status and Nonsampled Reason must be recorded for a nonsampled plot, as described below.
17. Should a plot be eligible, follow the procedures also described below.

3.3 FIELD PLOT DECISION FLOW CHART

The following is a flow chart outlining the procedure of successfully locating a plot, dismissing it as ineligible, or how to handle other possible outcomes.



3.3.1 Replacement Plots

Replacement plots will not be determined in the field or at the discretion of the field crew. A surplus of suitable sample plots were generated at the outset through selection methodology performed in the lab. Therefore, the field crew will use discretion only in determining the feasibility and logistics of locating the next plot from a set list.

4 PLOT DATA

4.1 PLOT ATTRIBUTES

4.1.1 Plot

Select the unique identifier for the plot from the list available in Data collection program.

When collected:	All plots
Field width:	4 digits
Values:	XXYY where XX refers to the bin# and YY is the sample plot within
Comments:	XX= 11, 12, 13, 21, 22, 23, 31, 32, 33, 41, 42, or 43 YY = 01-48 as each bin is composed of 48 generated sample plots

4.1.2 Target Latitude

The target plot center latitude in decimal degrees, WGS84, will be displayed. The value cannot be updated by the user.

When collected:	All plots
Field width:	9 characters, including decimal point
Values:	31.000000 to 50.000000

4.1.3 Target Longitude

The target plot center longitude in decimal degrees, WGS84, will automatically be displayed by Data collection program. The value cannot be updated by the user.

When collected:	All plots
Field width:	10 - 11 characters, including the decimal point and minus sign
Values:	-66.000000 to -125.000000

4.1.4 Plot Status

Record the code describing whether or not the plot can be established and measurements started. Plot Status is based on an initial assessment of plot conditions.

If the plot cannot be established because of a hazardous condition, denied access, or other situation, Plot Status is “Nonsampled”.

After the plot is established, review the entire plot area. If there is no hazardous condition, denied access, or other situation preventing the measurement of all required data, the Plot Status is “Sampled”. If any situation clearly prevents recording of any required data, the Plot Status is “Nonsampled”. For example, if some tally trees cannot be measured because of a cliff on the plot, the plot is nonsampled.

If the plot is nonsampled, specify the reason for not measuring the plot in **Plot Nonsampled Reason**.

Plot Status

When collected:	All Plots	
Field width:	7 - 10 characters	
Values:	Code	Definition
	Sampled	Plot can be established and measured (even if a later occurrence prevents collection of all data)
	Ineligible	Plot cannot be established, or some measurements cannot be made based on an initial assessment.
	Available	DEFAULT VALUE The set list of all possible plot locations for the purposes of this project. Any remaining "available" plots at the end of this field exercise should be considered non-visited.

4.1.5 Plot Nonsampled Reason

If Plot Status = "Nonsampled", record the reason. If Plot Nonsampled Reason = "Other", include a description of the situation in Plot Notes.

When collected:	Plot Status = "Nonsampled"	
Field width:	5-13 characters	
Values:	Code	Definition
	Denied access	Access to any portion of the plot needed for required measurements is denied by the legal owner, or by the owner of the only reasonable route to the plot.
	Hazardous	Any portion of the plot needed for required measurements cannot be accessed because of a hazard or danger, for example cliffs, quarries, strip mines, illegal substance.
	Incorrect BIN	When the canopy cover and 80th percentile height of the sample plot do not accurately reflect the canopy cover and 80th percentile height of its respective BIN type
	Buffer Violation	The sample plot does not fall within the required buffer limit of its nearest, respective riparian feature
	Other	Any situation other than the items listed above that presents a condition that clearly prevents measurement of any required data.

4.1.6 Start Date

Select the date on which plot sampling began.

When collected:	All plots
Field width:	10 characters

4.1.7 End Date

Select the date on which plot sampling was completed.

When collected:	All plots
Field width:	10 characters

4.1.8 Plot Complete

Enter “Yes” if **al**l required plot-level data items were recorded. If any required data items are not complete, including the plot panoramic photo, enter “No”. If Plot Complete = “No” it will be replaced with a pre-selected replacement plot.

When collected:	Plot Status = “Sampled”	
Field width:	2 – 3 characters	
Values:	Code	Definition
	Yes	All plot-level data items are complete.
	No	One or more plot-level data items are not complete. Enter Plot Notes describing what is not complete and why.

4.1.9 Additional Plot Notes

Use this field to record any additional notes pertaining to the plot.

When collected:	As needed; required when any protocol Complete status = “No”
Field width:	Maximum of 2000 characters
Values:	Concise text in English. Do not use texting abbreviations.

5 PLOT ATTACHMENTS

5.1 PLOT ATTACHMENT ATTRIBUTES

Multiple plot attachments may be recorded for each sampled plot. The Plot Panoramic Photo is the only required plot attachment. Other optional attachments might include other photos showing unique conditions on the plot. Storage on the iPad is limited, so photos and other attachments should only be recorded if they add significant value to plot information.

5.1.1 Plot Attachment Type

Enter a Plot Attachment Type for each plot attachment record. The Attachment Type describes the type of attachment recorded. For the "Other" type, record additional information in Plot Attachment Notes. A

When collected:	All plots, all Plot Attachment records.. Panoramic Photo required when **Plot Status** = "Sampled", optional when **Plot Status** = "Nonsampled".	
Field width:	5 - 20 characters	
Values:	Code	Definition
	Plot Panoramic Photo	A complete panoramic photograph showing both ground cover and overstory vegetation.
	Other	An attachment other than the Plot Panoramic Photo. Plot Attachment Notes describing the attachment are required.

5.1.2 Plot Attachment

When collected:	All plots, all Plot Attachment records
Field width:	N/A
Values:	Usually photos, but PDFs, video and audio recordings can be attached.

Insert an attachment in the Plot Attachment field by tapping on the field, then selecting the appropriate attachment type (e.g. Photos). When taking videos, begin with narration stating date, time, and plot bin ID.

5.1.3 Plot Attachment Notes

Enter any notes needed to describe the purpose and contents of the attachment. A note can be entered for each individual photo or other attachment. Plot Attachment Notes are required when Plot Attachment Type = "Other".

When collected:	All plots, all Plot Attachment records. Required if **Plot Attachment Type** = "Other", otherwise optional.
Field width:	2000 characters
Values	Concise text in English. Do not use texting abbreviations.

6 NAVIGATION (NAV) GPS DATA

6.1 INTRODUCTION

The following data points reflect all GPS information collected at each eligible sample plot. Any subsequent steps in this methodology cannot commence until all of the following navigation points are accounted for and verified.

6.2 NAV GPS ATTRIBUTES

6.2.1 GPS Location Type

Record the location type for the coordinates.

When collected:	Plot Status = "Sampled", all Nav GPS records	
Field width:	2-6 characters	
Values:	Code	Definition
	PC	Plot Center
	SP	Stream Sample Point Point taken at the bankfull edge of the nearest stream: shortest in distance from plot center to stream
	Other	Describe in GPS Notes/Location Record. Requires notes.

6.2.2 GPS ID

Enter the last six digits of the serial number for the handheld GPS used to collect coordinates.

When collected:	Plot Status = "Sampled", all Nav GPS records
Field width:	6 digits
Values:	000000 - 999999

6.2.3 Plot Center Latitude

Record the handheld GPS latitude in decimal degrees, WGS84 datum, for the selected GPS Location Type.

When collected:	When Plot Status = "Sampled", all Nav GPS records
Field width:	8 characters, including the decimal point
Values:	31.00000 to 50.00000

6.2.4 Plot Center Longitude

Record the handheld GPS longitude in decimal degrees, WGS84 datum. Negative longitude values apply to all 2015 CMS plots.

When collected:	Plot Status = "Sampled", all Nav GPS records
Field width:	9 - 10 characters, including the minus sign and decimal point
Values:	-66.00000 to -125.00000

6.2.5 Stream Sample Point - Latitude

The latitude and longitude will be taken on the edge of the plot's respective riparian feature; closest in distance to the Plot Center. A reference point will be physically installed using a pole, which will help to collect distance and azimuth readings.

When collected:	Plot Status = "Sampled"
Field width:	9 characters, including decimal point
Values:	31.000000 to 50.000000

6.2.6 Stream Sample Point - Longitude

When collected:	Plot Status = "Sampled"
Field width:	10 - 11 characters, including the decimal point and minus sign
Values:	-66.000000 to -125.000000

6.2.7 Azimuth to PC from Stream Sample Point

When collected:	Plot Status = "Sampled"
Field width:	1 - 3 digits
Values:	1 - 360

6.2.8 GPS Notes

Enter any notes needed to clarify or explain a special situation in the GPS record. A note can be entered for each individual GPS record. GPS Notes are required when GPS Location Type = "Other".

When collected:	Plot Status = "Sampled". Required if GPS Location Type = "Other", otherwise optional.
Field width:	2000 characters
Values	Concise text in English. Do not use texting abbreviations.

7 SURVEY GRADE GPS DATA

7.1 SURVEY GRADE GPS ATTRIBUTES

7.1.1 GPS Unit ID

Enter the GPS Unit ID found on a label attached to the GPS unit.

When collected:	Plot Status = "Sampled"
Field width:	5 digits
Values:	00001 - 99999, all five digits must be recorded

7.1.2 Antenna Height

Enter the antenna height to the nearest 1/100 foot. Include the decimal point.

When collected:	Plot Status = "Sampled"
Field width:	4 characters, including the decimal point
Values:	0.01 - 9.99 ft.

7.1.3 Time Started

Enter the starting time for GPS data recording. Record military (24 hour) time in hours and minutes (HH:MM). The Data collection program time picker will show time in hours and minutes, AM/PM, but your choice will be converted to 24-hour time when you exit the picker.

When collected:	Plot Status = "Sampled"
Field width:	5 characters
Values:	00:00 – 24:00 (working hours are usually in the range 07:00 – 20:00)

7.1.4 Time Stopped

Enter the time GPS data recording was stopped. Record military (24 hour) time in hours and minutes (HH:MM). The Data collection program time picker will show time in hours and minutes, AM/PM, but your choice will be converted to 24-hour time when you exit the picker.

When collected:	Plot Status = "Sampled"
Field width:	5 characters
Values:	00:00 – 24:00 (working hours are usually in the range 07:00 – 20:00)

7.1.5 Survey GPS Notes

Record any important Survey Grade GPS Notes.

When collected:	Plot Status = "Sampled". Optional for all Survey Grade GPS records.
Field width:	2000 characters
Values:	Concise text in English. Do not include texting abbreviations.

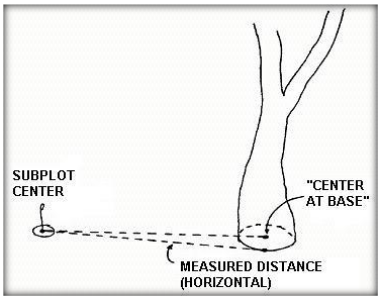
8 TREE DATA

8.1 TREE SELECTION AND MEASUREMENT

Tally trees are defined as all live and standing dead trees that are located within the bounds of the plot and that meet all threshold criteria [elucidated below]. All tally trees are assessed, measured, and "captured"; the resulting data yielding information on individual size, canopy density, species, etc.

- Trees are **alive** if they have any living parts (leaves, buds, and cambium) at or above the DBH. Trees that have been temporarily defoliated are still alive.
    - Macroplot: DBH >= 5 in.
    - Subplot only: DBH >= 1.0 in. and < 5.0 in.
- To qualify as a standing **dead** tally tree, the tree must exhibit the following:
    - A reciprocal of the living tree conditions
    - Unbroken bole
    - Actual Length >= 4.5 ft.
    - A lean less than 45 degrees from vertical as measured from the base to DBH
    - Macroplot: DBH >= 5 in.
    - Subplot only: DBH >= 1.0 in. and < 5.0 in.

Tally trees are selected for measurement only when the horizontal distance from their bole center (a.k.a. pith) at the ground to the plot center is less than the radius of the plot (see figure below).



Portions of boles on dead trees that are separated greater than 50 percent (either above or below 4.5 feet), are considered severed and are considered Coarse Woody Debris (CWD) and are therefore not tallied. **Note: Working around dead trees is a safety hazard - crews should exercise extreme caution. Trees that are deemed unsafe to measure should be estimated.**

Live and dead-standing, tally trees and partially separated boles of dead tally trees do not have to be self-supported. They may be supported by other trees, branches, or their crown.

Trees that have been cut above DBH qualify as tally trees, provided they meet the diameter size (DBH) requirement.

If no tally trees are found on the large or small radius plots, enter **Trees Complete** = "Yes" in the Plot Attributes screen and enter a plot note "No tally trees".To collect tree data:

1. Record all live tally trees and standing dead tally trees >=5.0 inches DBH (large trees) that are within the large tree plot. Start at 1 degree and work clockwise to 360 degrees azimuth.
2. Next, record all live tally trees and standing dead tally trees 1.0 to 4.9 inches DBH that are within the small tree plot. Start again at 1degree and wor222k clockwise to 360 degrees azimuth. (Large tree and small tree plots are being tallied independently).

8.2 TREE ATTRIBUTES

8.2.1 Tree Number

The data collection program will automatically display the tree number as each new tree record is created. The tree number is unique on the given plot.

Tree numbering will start at 1 and continue in sequence. Record trees clockwise from azimuth 1 to 360, and work outwards from plot center to the CMS field plot perimeters.

If after entering several trees you find that a tree was missed, go ahead and add it even though the tree number will not match the sequence based on Azimuth.

When collected:	Plot Status = "Sampled", all tree records
Field width:	1 -3 digits
Values:	1 to 999

8.2.2 Tree Status

Record a current Tree Status for each tallied tree.

When collected:	Plot Status = "Sampled", all tree records	
Field width:	1 digit	
Values:	Code	Definition
	1	Live tree
	2	Dead tree

8.2.3 Tree Species

Record the appropriate Tree Species code.

The available NRCS species codes (see APPENDIX B) are for those species considered to be trees in the US Forest Service Forest Inventory and Analysis (FIA) inventory standards. Do not record tree records for other species. If you encounter a species not listed and are not sure if it should be tallied as a tree, consult your Crew Leader/Unit Coordinator.

If you cannot positively identify the tree species, record a Genus or NRCS unknown code and

proceed to the Final ID data .

When collected:	Plot Status = “Sampled”, all tree records	
Field width:	4 digits	
Values:	Code	Definition
	See NRCS species code pick list in Data collection program and APPENDIX B.	
	2TC	Unknown conifer/softwood
	2TB	Unknown hardwood/broadleaf

8.2.4 Final Tree ID

During field data collection, record “Yes” if the **Tree Species** identification is certain, otherwise record “No”.

If the species ID is not certain, record “No” and take any photos needed to identify the species in the office. See the TREE ATTACHMENTS section for instructions on how to attach tree species photos.

If the **Final Tree ID** was set to “No” in the field, **Tree Species** will be reviewed in the office using species photos or other methods. After office review, **Tree Species** will be updated if needed and **Final Tree ID** set to “Yes”. **Final Tree ID** = “Yes” indicates that the recorded **Tree Species** is the best possible call.

When collected:	Plot Status = “Sampled”, all tree records	
Field width:	2 -3 characters	
Values:	Code	Definition
	Yes	Tree Species is positively identified in the field, or determined to be final after office review and possible update of Tree Species.
	No	Tree Species identification is uncertain in the field, and not yet reviewed and determined to be final in the office.

8.2.5 DBH

Diameters are measured at breast height (4.5 feet above ground line on the uphill side of the tree). On trees where the root collar is above ground level, DBH should be taken 4.5’ up the bole from the highest point of the root collar.

NOTE: when measuring diameter with the DBH tape, if the measurement falls between two 1/10th inch marks on the tape, always record to the smallest (lowest) mark…don’t round up.

8.2.6 Height

If the top of the tree is broken (top on live trees is completely detached; top on dead trees is greater than 50 percent detached from the tree), use the length to the break for Actual Length.

When collected:	Plot Status = “Sampled”, all tree records
Field width:	1 - 3 digits

Values:	5 - 200

8.2.1 Crown Height

The height of the crown as a measured vertically from the ground level to the point where the lowest green branches form green crown all round.

When collected:	Plot Status = "Sampled", all tree records
Field width:	1 - 3 digits
Values:	5 - 200

8.2.2 Crown Diameter

Record the maximum diameter of a tree's crown.

When collected:	Plot Status = "Sampled", all tree records
Field width:	1 - 3 digits
Values:	5 - 200

8.2.3 Tree Notes

Record any notes pertaining to an individual tree as called for to explain or describe another variable. TREE NOTES are available for each individual tree record.

When collected:	As needed
Field width:	2000
Values:	Single words and abbreviated sentences. Do not use texting abbreviations.

9 TREE ATTACHMENTS

9.1 TREE ATTACHMENT ATTRIBUTES

Multiple tree attachments may be recorded for each tally tree. At least one species ID photo is required when **Final Tree ID** = "No". Other optional attachments might include other photos showing tree conditions affecting required measurements. Storage on the iPad is limited, so photos and other attachments should only be recorded if they add significant value to tree information.

9.1.1 Tree Attachment Type

Enter a Tree Attachment Type for each plot attachment record. The Attachment Type describes

the type of attachment recorded. For the “Other” type, record additional information in **Tree Attachment Notes**.

When collected:	Plot Status = “Sampled”, all Tree Attachment records. Required when Final Tree ID = “No”.	
Field width:	5 – 30 characters	
Values:	Code	Definition
	Species Photo – Bark/Bole	A photo showing tree bark/bole for species ID in the office.
	Species Photo – Fruit/Foliage	A photo showing plant fruit and/or foliage for species ID in the office.
	Species Photo – Form	A photo showing overall plant form or situation for species ID in the office.
	Other	An attachment other than the species ID photos listed above. Tree Attachment Notes describing the attachment are required.

9.1.2 Tree Attachment

When collected:	Plot Status = “Sampled”, all Tree Attachment records. Required when Final Tree ID = “No”.
Field width:	N/A
Values:	Usually photos, but PDFs, video and audio recordings can be attached.

Insert an attachment in the Tree Attachment field by tapping on the field, then selecting the appropriate attachment type (e.g. Photos).

9.1.3 Tree Attachment Notes

Enter any notes needed to describe the purpose and contents of the attachment. A note can be entered for each individual photo or other attachment. Tree Attachment Notes are required when Tree Attachment Type = “Other”.

When collected:	All Tree Attachment records when Plot Status = “Sampled”. Required when Tree Attachment Type = “Other”, otherwise optional.
Field width:	2000
Values	Concise text in English. Do not use texting abbreviations.

10 VEGETATION PROFILE DATA

10.1 INTRODUCTION

Vegetation data are collected to provide vegetation structure for vascular plants. The data collected provide a horizontal and vertical estimation of vegetation located within the sample area. Information on the abundance and structure of understory plant communities can be used to help assess biomass.

The Vegetation Profile will be conducted on the entire 42.0 foot plot and includes measurements of vegetation structure - cover by layer and total aerial cover of each growth habit. Additional data on the most abundant species in each growth habit will also be collected.

10.2 GENERAL DEFINITIONS

Canopy Cover: Canopy cover is defined as the area of ground surface covered by a vertical projection of the canopy of a vascular plant. The canopy is described by a polygon surrounding the outer edges of the foliage (figure 1), without subtracting any normal spaces occurring between the leaves of plants (Daubenmire 1959). Overlapping crowns within a species or growth habit are not double-counted; the maximum possible cover is 100%.

All estimates on the cover of vegetation are focused on plants or plant parts that are located within the total plot parameter and any foliar parts overhanging the sampled area.

Canopy cover is collected by height layer or as a total (aerial view) cover across all layers for all growth habits**.**

Cover is estimated to the nearest 1 percent. See tabulation below for cover to area relationships for a 1/5 acre CMS field plot and figure 1 and 2 below for additional visual calibrations. Group practice in the field is a mandatory training exercise.

Cover %	Area (sq ft)	Square length of side (ft)	Circle radius (ft)
1	88.25	9.39	5.30
3	264.74	16.27	9.18
5	441.24	21.01	11.85
10	882.47	29.71	16.76
15	1323.71	36.38	20.53
20	1764.95	42.01	23.70
25	2206.18	46.97	26.50
50	4412.36	66.43	37.48
100	8824.73	93.94	53.00

Growth Habits: Vegetation data are collected by growth habitat each level of detail. Growth habits for vascular plants includes tally trees, non-tally trees, shrubs and woody vines, subshrubs, forbs, and grass-like plants (graminoids). Growth Habit groups are assessed by layer.

NRCS PLANTS database: The Natural Resource Conservation Service (NRCS) PLANTS Database provides standardized information about the vascular plants, mosses, liverworts, hornworts, and lichens of the U.S. and its territories. It includes names, plant information, automated tools, onward Web links, and references: USDA, NRCS. 2000. The PLANTS Database (http://plants.usda.gov ,1 January 2000) National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

FIA currently uses a stable code set downloaded in January of 2010. If possible use this code for coding the most abundant species by growth habit. If not, scientific names or common names may be coded.

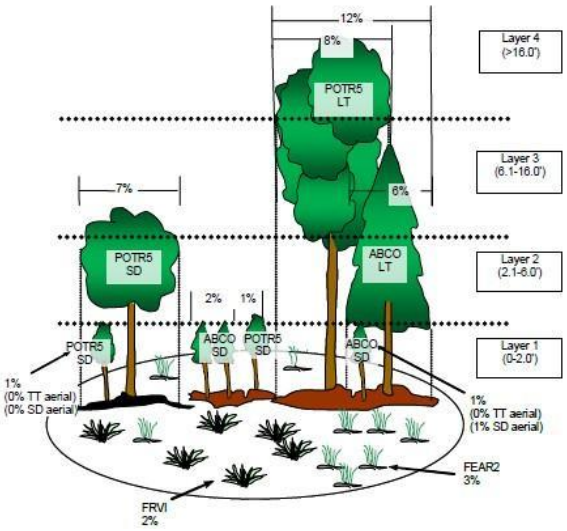


Figure 3 Example of Growth Habit by layer (Including Species)

Table 1 - Estimation of canopy cover by layer and aerial view of each growth habit in Figure 3

10.3 VEGETATION PROFILE ATTRIBUTES

In this section, use ocular methods to estimate canopy cover by layer and aerial view coverage for each growth habit, and record to the nearest percent.

Canopy cover by layer:

Estimate the canopy cover for each of the four layers. Include growth habits present on the field plot and any foliar parts overhanging the field plot boundary. For each layer cover, examine the canopy cover of each growth habit as if the other layers do no exist. Do not double count overlapping layers within a growth habit; visualize the cover layer collapsed into a 2-dimensional space. If a growth habit group does not have foliage in a layer, enter 0 (do not count tree boles as cover).

Aerial View Coverage:

Determine the total canopy cover by growth habit (trees, shrubs, forbs, and graminoids). Examine each growth habit individually as if the other growth habits do not exist. Do not double count overlapping layers within a growth habit (maximum cover=100%). To determine, estimate the area of ground surface covered by a vertically-projected polygon, described by the outline of the foliage, ignoring any normal spaces occurring between the leaves of plants (Daubenmire 1959) for the particular growth habit (figure 1).

The aerial cover for a specific growth habit must be equal to or greater than the highest cover recorded for an individual layer in that growth habit, but can't be greater than the sum of the covers + 2 (to allow for rounding of covers) recorded for all the layers in that growth habit.

10.3.1 Growth Habit

Apply the definitions that follow based on the appearance of the plants on the CMS field plot. If a tree species has been selected as a tally tree species, always record that species in the tally tree species growth habit (LTT or DTT), even if it grows as a shrub in some environments. Tally tree species are listed in Appendix B, TREE SPECIES LIST. However, other species may be tallied in multiple growth habits on a plot (example: willows can grow in Non-tally tree and shrub form). In this case separate these plants into the appropriate growth forms. Woody plants not on the unit's tally tree list may have a tree growth habit in some environments, and these should be recorded as non-tally tree species (LNT or DNT). If the growth habit is shrub in another environment, record that species as a shrub (SH).

When collected:	Plot Status = "Sampled", all growth habit records	
Field width:	3 characters	
Values:	**LTT**	**Live Tally Tree Species**: All core tree species and any core-optional tree species selected by a particular FIA unit. Any plant of that species is included, regardless of its shape and regardless of whether it was tallied on the large tree or small tree plot during tree tally (include plants with canopy hanging into the CMS field plot). Seedlings, small and large trees are included.
	DTT	**Dead Tally Tree Species**: All dead material from core tree species and any core-optional tree species. NOTE: This includes dead material from both live and dead tally tree species, along with dead and detached material on the ground (Down Woody Material), standing, or leaning. Do include dead material from trees that have already been tallied as large and small trees on the plot.

LNT	**Live Non-tally Tree Species**: Tree species not on the tally species list that are woody plants with a single stem, not supported by other vegetation or structures (not vines), and which are, or are expected to become, greater than 13 feet in height. Seedlings, small and large trees are included.
DNT	**Dead Non-tally Tree Species**: All dead material from tree species not the tally species list that are woody plants with a single stem. NOTE: This includes dead material from both live and dead non-tally tree species, along with dead and detached material on the ground (Down Woody Material), standing, or leaning.
LSH	**Live Shrubs:/Woody Vines**: Woody, multiple-stemmed plants of any size, and vines. Do not include subshrubs in this growth form.
DSH	**Dead Shrubs:/Woody Vines**: All dead material from woody, multiple-stemmed plants of any size and vines. NOTE: This includes dead material from both live and dead shrubs and vines, along with dead and detached material on the ground (Down Woody Material), standing, or leaning. Do not include subshrubs in this growth form..

OGH	**Other Growth Habit**: This includes forbs (herbaceous, broad-leaved plants), non-woody- vines, ferns (does not include mosses and cryptobiotic crusts), graminoids (grasses and grass-like plants including rushes and sedges), and subshrubs (low-growing shrub usually under 1.5 feet tall and never exceeding 3 feet tall at maturity). A dwarf-shrub in the FGDC classification.
AGH	**All Growth Habits**: This includes all live and dead tally trees, non-tally trees, shrubs/woody vines, and other growth habits. Estimate represents a cumulative, "bird's eye" perspective of all live and dead growth forms present on the plot.

10.3.2 Has Veg

Record whether or not a particular growth habit has vegetation within the 42.0 foot radius plot. If **Aerial Cover** is less than one percent, record “No”. If **Aerial Cover** is >= 1% record “YES” for all Growth Habits except OGH (Other Growth Habit) which requires at least 3% total cover to record “YES”.

Commented [DM1]: 42 ft ???

Commented [TA2R1]: Good catch!

When collected:	Plot Status = “Sampled”, all growth habit records	
Field width:	2 – 3 characters	
Values:	Code	Description
	Yes	3% or more aerial cover for “Other Growth Habit” (OGH); 1% or more aerial cover for all other growth habits.
	No	<3% aerial cover for “Other Growth Habit (OGH):; < 1% aerial cover for all other growth habits.

10.3.3 Aerial Cover

Record the total canopy coverage for all species within a particular growth habit For Tally Tree growth habit, cover includes all tally tree species present, regardless of DBH.

When collected:	Plot Status = “Sampled”, Has Veg = “Yes”
Field width:	1 - 3 digits
Values:	1 - 100

10.3.4 Cover Layer 1

Record a total canopy coverage for all species within layer 1 (0-2.0 feet) to the nearest percent. For Tally Tree growth habit, cover includes all tally tree species present, regardless of DBH.

When collected:	Plot Status = “Sampled”, Has Veg = “Yes”
Field width:	1 - 3 digits
Values:	0-100

10.3.5 Cover Layer 2

Record a total canopy coverage for all species within layer 2 (2.1 - 6.0 feet) to the nearest percent. For Tally Tree growth habit, cover includes all tally tree species present, regardless of DBH.

When collected:	Plot Status = “Sampled”, Has Veg = “Yes”
Field width:	1 - 3 digits
Values:	0-100

10.3.6 Cover Layer 3

Record a total canopy coverage for all species within layer 3 (6.1 - 16.0 feet) to the nearest percent. For Tally Tree growth habit, cover includes all tally tree species present, regardless of DBH.

When collected:	Plot Status = “Sampled”, Has Veg = “Yes”
Field width:	1 - 3 digits
Values:	0 - 100

10.3.7 Cover Layer 4

Record a total canopy coverage for all species within layer 4 (16.1feet and above) to the nearest percent. For Tally Tree growth habit, cover includes all tally tree species present, regardless of DBH.

When collected:	Plot Status = “Sampled”, Has Veg = “Yes”
Field width:	1 - 3 digits
Values:	0 - 100

10.3.8 Canopy Notes

Record notes pertaining to the growth habit record.

When collected:	Plot Status = “Sampled”, Has Veg = “Yes”, as needed.
Field width:	2000
Values:	Concise text in English. Do not include texting abbreviations.

11 COARSE WOODY DEBRIS (CWD) DATA

11.1 TALLY RULES FOR CWD

If either to 90 or 360 transect intersects a non-sampled area (e.g., a hazardous or access denied area) mark the Plot variable Transect 90 Complete or Transect 360 Complete = "No", add a Plot Note to describe the non-sampled area and contact your coordinator for a replacement plot.

Note: **CWD Decay Class** 5 pieces can be difficult to identify because they often blend into the duff and litter layers. They must still resemble a log; therefore, the first tally rule is that they must be ≥5.0 inches in diameter and ≥ 5.0 inches from the surface of the ground. Decomposed logs that are slightly elevated 'humps' on the ground are not tallied.

If a log is case hardened (hard, intact outer sapwood shell) but the heartwood is rotten, code this log as a **CWD Decay Class** 2. **CWD Decay Class** 1 should be reserved for 'freshly fallen' logs that are completely intact (i.e., recent windfalls, or harvest).

For a detailed procedure on the decision rules for this section, refer to Appendix D.

11.2 ATTRIBUTES

11.2.1 Transect

Record the azimuth of the transect on which the CWD piece is sampled. This is automatically entered by Data collection program based on the transect selected. This value cannot be changed by the user.

When collected:	Plot Status = "Sampled", all tally pieces
Field width:	3 digits
Values:	Transect direction (degrees) from center of subplot
	090
	360

11.2.2 Decay Class

Record a 1-digit code indicating the decay class of the piece. Code the decay class that predominates along the observed length of the piece. Use the guide below to determine **CWD Decay Class**.

When collected:	Plot Status = "Sampled", All tally pieces					
Field width:	1 digit					
Values:	Decay Class	Structural Integrity	Texture of Rotten Portions	Color of Wood	Invading Roots	Branches and Twigs
	1	Sound, freshly fallen, intact logs	Intact, no rot; conks of stem decay absent	Original color	Absent	If branches are present, fine twigs are still attached and have tight bark
	2	Sound	Mostly intact; sapwood partly soft (starting to decay) but can't be pulled apart by hand	Original color	Absent	If branches are present, many fine twigs are gone and remaining fine twigs have peeling bark
	3	Heartwood sound; piece supports its own weight	Hard, large pieces; sapwood can be pulled apart by hand or sapwood absent	Reddish-brown or original color	Sapwood only	Branch stubs will not pull out
	4	Heartwood rotten; piece does not support its own weight, but maintains its shape	Soft, small blocky pieces; a metal pin can be pushed into heartwood	Reddish or light brown	Through-out	Branch stubs pull out
	5	None, piece no longer maintains its shape, it spreads out on ground	Soft; powdery when dry	Red-brown to dark brown	Through-out	Branch stubs and pitch pockets have usually rotted down

11.2.3 CWD Species

Record the NRCS species code for the piece. Since CWD pieces are not necessarily always tally tree species, record the most detailed available species code. For shrubs or vines enter code "2PLANT".

Species identification may be uncertain for some pieces. The piece's bark (either attached or sloughed and lying beside the piece), branching pattern (if the branches are still present), or heartwood smell (particularly if cedars, Douglas-fir, or western hemlock) may provide clues. One way to distinguish hardwoods from softwoods is by the type of decay present. Hardwoods usually have a white or grayish stringy rot, while softwoods usually have a reddish-brown blocky rot. If it is not possible to identify the species, attempt to estimate if it is softwood or hardwood. Enter code "2TC" for unknown dead conifer or "2TB" for unknown dead hardwood (broadleaf).

Note: Codes "2TC" and "2TB" are **not valid** when CWD Decay Class = 1, 2 or 3.

When collected:	Plot Status = "Sampled", CWD Decay Class = 1 to 4.	
Field width:	4 digits	
Values:	Code	Definition
	See NRCS species code pick list in Data collection program	
	2PLANT	Shrub or Vine
	2TC	Unknown conifer/softwood, with CWD Decay Class > 3
	2TB	Unknown hardwood/broadleaf, with CWD Decay Class > 3

11.3 CWD DIAMETER MEASUREMENTS

If possible, the best way to measure CWD piece diameter is to wrap the tape perpendicular to the longitudinal axis at the point of transect intersection. If that is not possible it is useful to carry a steel carpenters retracting tape to measure diameters. Other methods include wrapping a tape around the bole if possible, holding a straight-edge ruler above the piece, or using calipers.

For pieces that cannot be taped and are not round in cross-section because of missing chunks of wood or "settling" due to decay, measure the diameter in two directions and take an average. Estimate the longest and shortest axis of the cross-section ("A" and "B" in Figure 5), and enter the average in the diameter field. This technique applies to intersect, small-end, and large-end diameters.

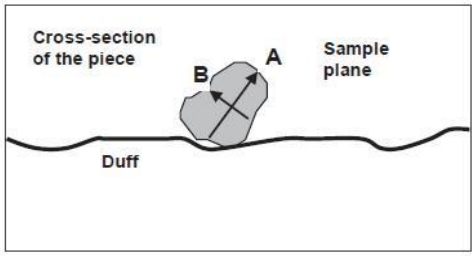


Figure 5: Estimating the diameter of pieces that are not round in cross-section

If the transect intersects the log at the decayed or splintered end (Figure 6), record the diameter at this location as the intersect diameter. If the splintered end appears to be two separate pieces (i.e., a major split located just at the end) – in this situation treat it as one log and take a diameter around the end (take two measurements if it is odd shaped.

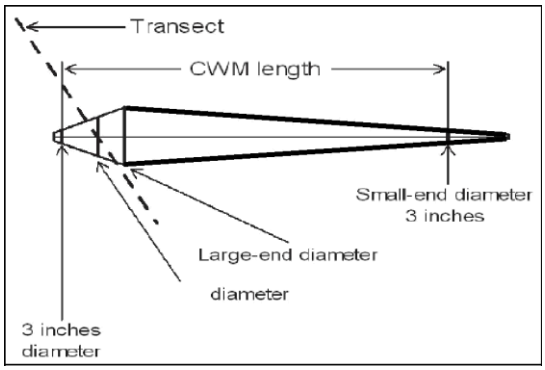


Figure 6: Example of decayed end intersecting the transect

11.3.1 CWD Diameter

Record the piece's diameter at the point where the transect intersects the longitudinal center of the piece. Record the diameter to the nearest inch. If the diameter is close to 3 inches, measure the diameter to the nearest 0.1 inch to determine if the piece is actually ≥3.0 inches and a valid tally piece.

When collected:	Plot Status = "Sampled", all tally CWD pieces
Field width:	3 digits
Values:	003 to 200 inches

11.4 CWD LENGTH MEASUREMENTS

Measure the length of the piece (to the nearest foot) along its centerline, either to the end of the piece or to the point where the diameter reaches 3 inches. If the piece tapers at both sides, due to decay or breakage, the length is measured for the 3-inch diameter cutoff at both ends, regardless of where the large end-diameter may be (see Figure 6).

11.4.1 CWD Length Class

Record the code that indicates whether the CWD piece total length is less than 3 feet long (and at least 0.5 foot long). Distinguish length orientation by direction of the pith. Note: the diameter of a small piece may be larger than its length. Total length of the log is measured between the physical ends of the log.

When collected:	Plot Status = "Sampled", all tally pieces >0.5 foot long	
Field width:	1 digit	
Values:	1	CWD TOTAL LENGTH ≥3 feet
	2	CWD TOTAL LENGTH ≥0.5 foot and <3 feet

APPENDIX A TREE SPECIES LIST

TREE SPECIES LIST

This list includes all tree species tallied in the Continental *United States*. Woodland species designate species where DRC is measured instead of DBH.

Woodland	FIA Code	PLANTS Code	Common name	Genus	Species
	0011	ABAM	Pacific silver fir	*Abies*	*amabilis*
	0012	ABBA	balsam fir	*Abies*	*balsamea*
	0014	ABBR	Santa Lucia fir, bristlecone fir	*Abies*	*bracteata*
	0015	ABCO	white fir	*Abies*	*concolor*
	0016	ABFR	Fraser fir	*Abies*	*fraseri*
	0017	ABGR	grand fir	*Abies*	*grandis*
	0018	ABLAA	corkbark fir	*Abies*	*lasiocarpa var. arizonica*
	0019	ABLA	subalpine fir	*Abies*	*lasiocarpa*
	0020	ABMA	California red fir	*Abies*	*magnifica*
	0021	ABSH	Shasta red fir	*Abies*	*shastensis*
	0022	ABPR	noble fir	*Abies*	*procera*
	0041	CHLA	Port-Orford-cedar	*Chamaecyparis*	*lawsoniana*
	0042	CUNO	Alaska yellow-cedar	*Cupressus*	*nootkatensis*
	0043	CHTH2	Atlantic white-cedar	*Chamaecyparis*	*thyoides*
	0051	CUAR	Arizona cypress	*Cupressus*	*arizonica*
	0052	CUBA	Baker cypress, Modoc cypress	*Cupressus*	*bakeri*
	0053	CUFO2	tecate cypress	*Cupressus*	*forbesii*
	0054	CUMA2	Monterey cypress	*Cupressus*	*macrocarpa*
	0055	CUSA3	Sargent's cypress	*Cupressus*	*sargentii*
	0056	CUMA	MacNab's cypress	*Cupressus*	*macnabiana*
w	0058	JUPI	Pinchot juniper	*Juniperus*	*pinchotii*
w	0059	JUCO11	redberry juniper	*Juniperus*	*coahuilensis*
w	0061	JUAS	Ashe juniper	*Juniperus*	*ashei*
w	0062	JUCA7	California juniper	*Juniperus*	*californica*
w	0063	JUDE2	alligator juniper	*Juniperus*	*deppeana*
	0064	JUOC	western juniper	*Juniperus*	*occidentalis*
w	0065	JUOS	Utah juniper	*Juniperus*	*osteosperma*
w	0066	JUSC2	Rocky Mountain juniper	*Juniperus*	*scopulorum*
	0067	JUVIS	southern redcedar	*Juniperus*	*virginiana var. silicicola*
	0068	JUVI	eastern redcedar	*Juniperus*	*virginiana*
w	0069	JUMO	oneseed juniper	*Juniperus*	*monosperma*
	0071	LALA	tamarack (native)	*Larix*	*laricina*
	0072	LALY	subalpine larch	*Larix*	*lyallii*
	0073	LAOC	western larch	*Larix*	*occidentalis*
	0081	CADE27	incense-cedar	*Calocedrus*	*decurrens*
	0091	PIAB	Norway spruce	*Picea*	*abies*
	0092	PIBR	Brewer spruce	*Picea*	*breweriana*
	0093	PIEN	Engelmann spruce	*Picea*	*engelmannii*

Woodland	FIA Code	PLANTS Code	Common name	Genus	Species
	0094	PIGL	white spruce	*Picea*	*glauca*
	0095	PIMA	black spruce	*Picea*	*mariana*
	0096	PIPU	blue spruce	*Picea*	*pungens*
	0097	PIRU	red spruce	*Picea*	*rubens*
	0098	PISI	Sitka spruce	*Picea*	*sitchensis*
	0101	PIAL	whitebark pine	*Pinus*	*albicaulis*
	0102	PIAR	Rocky Mountain bristlecone pine	*Pinus*	*aristata*
	0103	PIAT	knobcone pine	*Pinus*	*attenuata*
	0104	PIBA	foxtail pine	*Pinus*	*balfouriana*
	0105	PIBA2	jack pine	*Pinus*	*banksiana*
w	0106	PIED	Common pinyon, two-needle pinyon	*Pinus*	*edulis*
	0107	PICL	sand pine	*Pinus*	*clausa*
	0108	PICO	lodgepole pine	*Pinus*	*contorta*
	0109	PICO3	Coulter pine	*Pinus*	*coulteri*
	0110	PIEC2	shortleaf pine	*Pinus*	*echinata*
	0111	PIEL	slash pine	*Pinus*	*elliottii*
	0112	PIEN2	Apache pine	*Pinus*	*engelmannii*
	0113	PIFL2	limber pine	*Pinus*	*flexilis*
	0114	PIST3	southwestern white pine	*Pinus*	*strobiformis*
	0115	PIGL2	spruce pine	*Pinus*	*glabra*
	0116	PIJE	Jeffrey pine	*Pinus*	*jeffreyi*
	0117	PILA	sugar pine	*Pinus*	*lambertiana*
	0118	PILE	Chihuahua pine	*Pinus*	*leiophylla*
	0119	PIMO3	western white pine	*Pinus*	*monticola*
	0120	PIMU	bishop pine	*Pinus*	*muricata*
	0121	PIPA2	longleaf pine	*Pinus*	*palustris*
	0122	PIPO	ponderosa pine	*Pinus*	*ponderosa*
	0123	PIPU5	Table Mountain pine	*Pinus*	*pungens*
	0124	PIRA2	Monterey pine	*Pinus*	*radiata*
	0125	PIRE	red pine	*Pinus*	*resinosa*
	0126	PIRI	pitch pine	*Pinus*	*rigida*
	0127	PISA2	gray pine, California foothill pine	*Pinus*	*sabiniana*
	0128	PISE	pond pine	*Pinus*	*serotina*
	0129	PIST	eastern white pine	*Pinus*	*strobus*
	0130	PISY	Scotch pine	*Pinus*	*sylvestris*
	0131	PITA	loblolly pine	*Pinus*	*taeda*
	0132	PIVI2	Virginia pine	*Pinus*	*virginiana*
w	0133	PIMO	singleleaf pinyon	*Pinus*	*monophylla*
w	0134	PIDI3	border pinyon	*Pinus*	*discolor*
	0135	PIAR5	Arizona pine	*Pinus*	*arizonica*
	0136	PINI	Austrian pine	*Pinus*	*nigra*
	0137	PIWA	Washoe pine	*Pinus*	*washoensis*
	0138	PIQU	four-leaf pine, Parry pinyon pine	*Pinus*	*quadrifolia*
	0139	PITO	Torrey pine	*Pinus*	*torreyana*
w	0140	PICE	Mexican pinyon pine	*Pinus*	*cembroides*
	0142	PILO	Great Basin bristlecone pine	*Pinus*	*longaeva*
w	0143	PIMOF	Arizona pinyon pine	*Pinus*	*monophylla var. fallax*
	0144	PIELE2	Carribean pine	*Pinus*	*elliottii var. elliottii*
	0201	PSMA	bigcone Douglas-fir	*Pseudotsuga*	*macrocarpa*
	0202	PSME	Douglas-fir	*Pseudotsuga*	*menziesii*

Woodland	FIA Code	PLANTS Code	Common name	Genus	Species
	0211	SESE3	redwood	*Sequoia*	*sempervirens*
	0231	TABR2	Pacific yew	*Taxus*	*brevifolia*
	0212	SEGI2	giant sequoia	*Sequoiadendron*	*giganteum*
	0221	TADI2	baldcypress	*Taxodium*	*distichum*
	0222	TAAS	pondcypress	*Taxodium*	*ascendens*
	0232	TAFL	Florida yew	*Taxus*	*floridana*
	0241	THOC2	northern white-cedar	*Thuja*	*occidentalis*
	0242	THPL	western redcedar	*Thuja*	*plicata*
	0251	TOCA	California torreya (nutmeg)	*Torreya*	*californica*
	0252	TOTA	Florida torreya (nutmeg)	*Torreya*	*taxifolia*
	0261	TSCA	eastern hemlock	*Tsuga*	*canadensis*
	0262	TSCA2	Carolina hemlock	*Tsuga*	*caroliniana*
	0263	TSHE	western hemlock	*Tsuga*	*heterophylla*
	0264	TSME	mountain hemlock	*Tsuga*	*mertensiana*
	0311	ACBA3	Florida maple	*Acer*	*barbatum*
	0312	ACMA3	bigleaf maple	*Acer*	*macrophyllum*
	0313	ACNE2	boxelder	*Acer*	*negundo*
	0314	ACNI5	black maple	*Acer*	*nigrum*
	0315	ACPE	striped maple	*Acer*	*pensylvanicum*
	0316	ACRU	red maple	*Acer*	*rubrum*
	0317	ACSA2	silver maple	*Acer*	*saccharinum*
	0318	ACSA3	sugar maple	*Acer*	*saccharum*
	0319	ACSP2	mountain maple	*Acer*	*spicatum*
	0320	ACPL	Norway maple	*Acer*	*platanoides*
w	0322	ACGR3	bigtooth maple	*Acer*	*grandidentatum*
	0323	ACLE	chalk maple	*Acer*	*leucoderme*
	0331	AEGL	Ohio buckeye	*Aesculus*	*glabra*
	0332	AEFL	yellow buckeye	*Aesculus*	*flava*
	0333	AECA	California buckeye	*Aesculus*	*californica*
	0334	AEGLA	Texas buckeye	*Aesculus*	*glabra var. arguta*
	0337	AESY	painted buckeye	*Aesculus*	*sylvatica*
	0341	AIAL	ailanthus	*Ailanthus*	*altissima*
	0345	ALJU	mimosa/silktree	*Albizia*	*julibrissin*
	0351	ALRU2	red alder	*Alnus*	*rubra*
	0352	ALRH2	white alder	*Alnus*	*rhombifolia*
	0353	ALOB2	Arizona alder	*Alnus*	*oblongifolia*
	0355	ALGL2	European alder	*Alnus*	*glutinosa*
	0361	ARME	Pacific madrone	*Arbutus*	*menziesii*
	0362	ARAR2	Arizona madrone	*Arbutus*	*arizonica*
	0367	ASTR	Pawpaw	*Asimina*	*triloba*
	0371	BEAL2	yellow birch	*Betula*	*alleghaniensis*
	0372	BELE	sweet birch	*Betula*	*lenta*
	0373	BENI	river birch	*Betula*	*nigra*
	0374	BEOC2	water birch	*Betula*	*occidentalis*
	0375	BEPA	paper birch	*Betula*	*papyrifera*
	0377	BEUB	Virginia roundleaf birch	*Betula*	*uber*
	0378	BEUT	northwestern paper birch	*Betula*	*X utahensis*
	0379	BEPO	gray birch	*Betula*	*populifolia*
	0381	SILAL3	Chittamwood, gum bumelia	*Sideroxylon*	*lanuginosum ssp.*
	0391	CACA18	American hornbeam, musclewood	*Carpinus*	*caroliniana*
	0401	CAAQ2	water hickory	*Carya*	*aquatica*

Woodland	FIA Code	PLANTS Code	Common name	Genus	Species
	0402	CACO15	bitternut hickory	*Carya*	*cordiformis*
	0403	CAGL8	pignut hickory	*Carya*	*glabra*
	0404	CAIL2	pecan	*Carya*	*illinoinensis*
	0405	CALA21	shellbark hickory	*Carya*	*laciniosa*
	0406	CAMY	nutmeg hickory	*Carya*	*myristiciformis*
	0407	CAOV2	shagbark hickory	*Carya*	*ovata*
	0408	CATE9	black hickory	*Carya*	*texana*
	0409	CAAL27	mockernut hickory	*Carya*	*alba*
	0410	CAPA24	sand hickory	*Carya*	*pallida*
	0411	CAFL6	scrub hickory	*Carya*	*floridana*
	0412	CAOV3	red hickory	*Carya*	*ovalis*
	0413	CACA38	southern shagbark hickory	*Carya*	*carolinae-septentrionalis*
	0421	CADE12	American chestnut	*Castanea*	*dentata*
	0422	CAPU9	Allegheny chinkapin	*Castanea*	*pumila*
	0423	CAPUO	Ozark chinkapin	*Castanea*	*pumila var. ozarkensis*
	0424	CAMO83	Chinese chestnut	*Castanea*	*mollissima*
	0431	CHCHC4	giant chinkapin, golden chinkapin	*Chrysolepis*	*chrysophylla var.*
	0451	CABI8	southern catalpa	*Catalpa*	*bignonioides*
	0452	CASP8	northern catalpa	*Catalpa*	*speciosa*
	0461	CELA	sugarberry	*Celtis*	*laevigata*
	0462	CEOC	hackberry	*Celtis*	*occidentalis*
	0463	CELAR	netleaf hackberry	*Celtis*	*laevigata var. reticulata*
	0471	CECA4	eastern redbud	*Cercis*	*canadensis*
	0481	CLKE	yellowwood	*Cladrastis*	*kentukea*
	0491	COFL2	flowering dogwood	*Cornus*	*florida*
	0492	CONU4	Pacific dogwood	*Cornus*	*nuttallii*
	0501	CRCR2	cockspur hawthorn	*Crataegus*	*crus-galli*
	0502	CRMO2	downy hawthorn	*Crataegus*	*mollis*
	0511	EUGL	Tasmanian bluegum, eucalyptus	*Eucalyptus*	*globulus*
	0512	EUCA2	river redgum	*Eucalyptus*	*camaldulensis*
	0513	EUGR12	grand eucalyptus	*Eucalyptus*	*grandis*
	0514	EURO2	swamp mahogany	*Eucalyptus*	*robusta*
	0521	DIVI5	common persimmon	*Diospyros*	*virginiana*
	0522	DITE3	Texas persimmon	*Diospyros*	*texana*
	0531	FAGR	American beech	*Fagus*	*grandifolia*
	0541	FRAM2	white ash	*Fraxinus*	*americana*
	0542	FRLA	Oregon ash	*Fraxinus*	*latifolia*
	0543	FRNI	black ash	*Fraxinus*	*nigra*
	0544	FRPE	green ash	*Fraxinus*	*pennsylvanica*
	0545	FRPR	pumpkin ash	*Fraxinus*	*profunda*
	0546	FRQU	blue ash	*Fraxinus*	*quadrangulata*
	0547	FRVE2	velvet ash	*Fraxinus*	*velutina*
	0548	FRCA3	Carolina ash	*Fraxinus*	*caroliniana*
	0549	FRTE	Texas ash	*Fraxinus*	*texensis*
	0551	GLAQ	waterlocust	*Gleditsia*	*aquatica*
	0552	GLTR	honeylocust	*Gleditsia*	*triacanthos*
	0555	GOLA	loblolly bay	*Gordonia*	*lasianthus*
	0561	GIBI2	Ginkgo, maidenhair tree	*Ginkgo*	*biloba*
	0571	GYDI	Kentucky coffeetree	*Gymnocladus*	*dioicus*
	0581	HACA3	Carolina silverbell	*Halesia*	*carolina*
	0582	HADI3	two-wing silverbell	*Halesia*	*diptera*

Woodland	FIA Code	PLANTS Code	Common name	Genus	Species
	0583	HAPA2	little silverbell	*Halesia*	*parviflora*
	0591	ILOP	American holly	*Ilex*	*opaca*
	0601	JUCI	butternut	*Juglans*	*cinerea*
	0602	JUNI	black walnut	*Juglans*	*nigra*
	0603	JUHI	Northern California black walnut	*Juglans*	*hindsii*
	0604	JUCA	Southern California black walnut	*Juglans*	*californica*
	0605	JUMI	Texas walnut	*Juglans*	*microcarpa*
	0606	JUMA	Arizona walnut	*Juglans*	*major*
	0611	LIST2	sweetgum	*Liquidambar*	*styraciflua*
	0621	LITU	yellow-poplar	*Liriodendron*	*tulipifera*
	0631	LIDE3	tanoak	*Lithocarpus*	*densiflorus*
	0641	MAPO	Osage-orange	*Maclura*	*pomifera*
	0651	MAAC	cucumbertree	*Magnolia*	*acuminata*
	0652	MAGR4	southern magnolia	*Magnolia*	*grandiflora*
	0653	MAVI2	sweetbay	*Magnolia*	*virginiana*
	0654	MAMA2	bigleaf magnolia	*Magnolia*	*macrophylla*
	0655	MAFR	mountain magnolia, Fraser magnolia	*Magnolia*	*fraseri*
	0657	MAPY	pyramid magnolia	*Magnolia*	*pyramidata*
	0658	MATR	umbrella magnolia	*Magnolia*	*tripetala*
	0661	MAFU	Oregon crabapple	*Malus*	*fusca*
	0662	MAAN3	southern crabapple	*Malus*	*angustifolia*
	0663	MACO5	sweet crabapple	*Malus*	*coronaria*
	0664	MAIO	prairie crabapple	*Malus*	*ioensis*
	0681	MOAL	white mulberry	*Morus*	*alba*
	0682	MORU2	red mulberry	*Morus*	*rubra*
	0684	MONI	black mulberry	*Morus*	*nigra*
	0691	NYAQ2	water tupelo	*Nyssa*	*aquatica*
	0692	NYOG	Ogeechee tupelo	*Nyssa*	*ogeche*
	0693	NYSY	blackgum	*Nyssa*	*sylvatica*
	0694	NYBI	swamp tupelo	*Nyssa*	*biflora*
	0701	OSVI	eastern hophornbeam	*Ostrya*	*virginiana*
	0711	OXAR	sourwood	*Oxydendrum*	*arboreum*
	0712	PATO2	paulownia, empress-tree	*Paulownia*	*tomentosa*
	0721	PEBO	redbay	*Persea*	*borbonia*
	7211	PEAM3	avocado	*Persea*	*americana*
	0722	PLAQ	water-elm, planertree	*Planera*	*aquatica*
	0730	PLRA	California sycamore	*Platanus*	*racemosa*
	0731	PLOC	American sycamore	*Platanus*	*occidentalis*
	0732	PLWR2	Arizona sycamore	*Platanus*	*wrightii*
	0741	POBA2	balsam poplar	*Populus*	*balsamifera*
	0742	PODE3	eastern cottonwood	*Populus*	*deltoides*
	0743	POGR4	bigtooth aspen	*Populus*	*grandidentata*
	0744	POHE4	swamp cottonwood	*Populus*	*heterophylla*
	0745	PODEM	plains cottonwood	*Populus*	*deltoides ssp. monilifera*
	0746	POTR5	quaking aspen	*Populus*	*tremuloides*
	0747	POBAT	black cottonwood	*Populus*	*balsamifera ssp.*
	0748	POFR2	Fremont's cottonwood	*Populus*	*fremontii*
	0749	POAN3	narrowleaf cottonwood	*Populus*	*angustifolia*
	0752	POAL7	silver poplar	*Populus*	*alba*
	0753	PONI	Lombardy poplar	*Populus*	*nigra*

Woodland	FIA Code	PLANTS Code	Common name	Genus	Species
w	0756	PRGL2	honey mesquite,western honey mesquite	*Prosopis*	*glandulosa*
w	0757	PRVE	velvet mesquite	*Prosopis*	*velutina*
w	0758	PRPU	screwbean mesquite	*Prosopis*	*pubescens*
	0761	PRPE2	pin cherry	*Prunus*	*pensylvanica*
	0762	PRSE2	black cherry	*Prunus*	*serotina*
	0763	PRVI	common chokecherry	*Prunus*	*virginiana*
	0765	PRNI	Canada plum	*Prunus*	*nigra*
	0766	PRAM	American plum, wild plum	*Prunus*	*americana*
	0768	PREM	bitter cherry	*Prunus*	*emarginata*
	0771	PRAV	sweet cherry (domesticated)	*Prunus*	*avium*
	0801	QUAG	California live oak, coast live oak	*Quercus*	*agrifolia*
	0802	QUAL	white oak	*Quercus*	*alba*
w	0803	QUAR	Arizona white oak and gray oak	*Quercus*	*arizonica*
	0804	QUBI	swamp white oak	*Quercus*	*bicolor*
	0805	QUCH2	canyon live oak	*Quercus*	*chrysolepis*
	0806	QUCO2	scarlet oak	*Quercus*	*coccinea*
	0807	QUDO	blue oak	*Quercus*	*douglasii*
	0808	QUSIS	Durand oak	*Quercus*	*sinuata var. sinuata*
	0809	QUEL	northern pin oak	*Quercus*	*ellipsoidalis*
w	0810	QUEM	Emory oak	*Quercus*	*emoryi*
	0811	QUEN	Engelmann oak	*Quercus*	*engelmannii*
	0812	QUFA	southern red oak	*Quercus*	*falcata*
	0813	QUPA5	cherrybark oak	*Quercus*	*pagoda*
w	0814	QUGA	Gambel oak	*Quercus*	*gambelii*
	0815	QUGA4	Oregon white oak	*Quercus*	*garryana*
	0816	QUIL	scrub oak	*Quercus*	*ilicifolia*
	0817	QUIM	shingle oak	*Quercus*	*imbricaria*
	0818	QUKE	California black oak	*Quercus*	*kelloggii*
	0819	QULA2	turkey oak	*Quercus*	*laevis*
	0820	QULA3	laurel oak	*Quercus*	*laurifolia*
	0821	QULO	California white oak	*Quercus*	*lobata*
	0822	QULY	overcup oak	*Quercus*	*lyrata*
	0823	QUMA2	bur oak	*Quercus*	*macrocarpa*
	0824	QUMA3	blackjack oak	*Quercus*	*marilandica*
	0825	QUMI	swamp chestnut oak	*Quercus*	*michauxii*
	0826	QUMU	chinkapin oak	*Quercus*	*muehlenbergii*
	0827	QUNI	water oak	*Quercus*	*nigra*
	0828	QUTE	Nuttall oak, Texas red oak	*Quercus*	*texana*
w	0829	QUOB	Mexican blue oak	*Quercus*	*oblongifolia*
	0830	QUPA2	pin oak	*Quercus*	*palustris*
	0831	QUPH	willow oak	*Quercus*	*phellos*
	0832	QUPR2	chestnut oak	*Quercus*	*prinus*
	0833	QURU	northern red oak	*Quercus*	*rubra*
	0834	QUSH	Shumard's oak	*Quercus*	*shumardii*
	0835	QUST	post oak	*Quercus*	*stellata*
	0836	QUSI2	Delta post oak	*Quercus*	*similis*
	0837	QUVE	black oak	*Quercus*	*velutina*
	0838	QUVI	live oak	*Quercus*	*virginiana*

	0839	QUWI2	interior live oak	*Quercus*	*wislizeni*
	0840	QUMA6	dwarf post oak	*Quercus*	*margarettiae*

Woodland	FIA Code	PLANTS Code	Common name	Genus	Species
	0927	SAAL2	white willow	*Salix*	*alba*
	0841	QUMI2	dwarf live oak	*Quercus*	*minima*
	0842	QUIN	bluejack oak	*Quercus*	*incana*
w	0843	QUHY	silverleaf oak	*Quercus*	*hypoleucoides*
	0844	QUOG	Oglethorpe oak	*Quercus*	*oglethorpensis*
	0845	QUPR	dwarf chinkapin oak	*Quercus*	*prinoides*
w	0846	QUGR3	gray oak	*Quercus*	*grisea*
w	0847	QURU4	netleaf oak	*Quercus*	*rugosa*
	0856	CAGL11	gray sheoak	*Casuarina*	*glauca*
	0857	CALE28	Australian pine	*Casuarina*	*lepidophloia*
	0901	ROPS	black locust	*Robinia*	*pseudoacacia*
w	0902	RONE	New Mexico locust	*Robinia*	*neomexicana*
	0912	SAPA	cabbage palmetto	*Sabal*	*palmetto*
	0919	SASAD	western soapberry	*Sapindus*	*saponaria var. drummondii*
	0921	SAAM2	peachleaf willow	*Salix*	*amygdaloides*
	0922	SANI	black willow	*Salix*	*nigra*
	0925	SACA5	coastal plain willow	*Salix*	*caroliniana*
	0926	SAPY	balsam willow	*Salix*	*pyrifolia*
	0929	SASE10	weeping willow	*Salix*	*sepulcralis*
	0931	SAAL5	sassafras	*Sassafras*	*albidum*
	0935	SOAM3	American mountain ash	*Sorbus*	*americana*
	0936	SOAU	European mountain ash	*Sorbus*	*aucuparia*
	0937	SODE3	northern mountain ash	*Sorbus*	*decora*
	0951	TIAM	American basswood	*Tilia*	*americana*
	0952	TIAMH	white basswood	*Tilia*	*americana var. heterophylla*
	0953	TIAMC	Carolina basswood	*Tilia*	*americana var. caroliniana*
	0971	ULAL	winged elm	*Ulmus*	*alata*
	0972	ULAM	American elm	*Ulmus*	*americana*
	0973	ULCR	cedar elm	*Ulmus*	*crassifolia*
	0974	ULPU	Siberian elm	*Ulmus*	*pumila*
	0975	ULRU	slippery elm	*Ulmus*	*rubra*
	0976	ULSE	September elm	*Ulmus*	*serotina*
	0977	ULTH	rock elm	*Ulmus*	*thomasii*
	0981	UMCA	California laurel	*Umbellularia*	*californica*
	0989	RHMA2	American mangrove	*Rhizophora*	*mangle*
w	0990	OLTE	desert ironwood,tesota, Arizona-ironwood	*Olneya*	*tesota*
	0992	MEQU	melaleuca	*Melaleuca*	*quinquenervia*
	0993	MEAZ	chinaberry	*Melia*	*azedarach*
	0994	TRSE6	Chinese tallowtree	*Triadica*	*sebifera*
	0995	VEFO	tungoil tree	*Vernicia*	*fordii*
	0996	COOB2	smoketree	*Cotinus*	*obovatus*
	0997	ELAN	Russian-olive	*Elaeagnus*	*angustifolia*

APPENDIX B: HOW TO MARK DIAMETER IN SPECIAL CASES

DIAMETER AT BREAST HEIGHT (DBH)

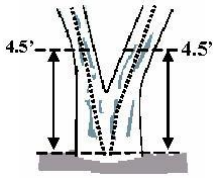
Unless one of the following special situations is encountered, measure DBH at 4.5 feet above the ground line on the uphill side of the tree. Round each measurement down to the last 0.1 inch. For example, a reading of 3.68 inches is recorded as 3.6 inches.

Special DBH situations:

1. Forked tree:

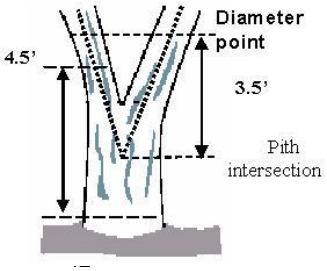
   In order to qualify as a fork, the stem in question must be at least 1/3 the diameter of the main stem and must branch out from the main stem at an angle of 45 degrees or less. Forks originate at the point on the bole where the piths intersect. Forked trees are handled differently depending on whether the fork originates below 1.0 foot, between 1.0 and 4.5 feet, or above 4.5 feet.

   - Trees forked below 1.0 foot. Trees forked in this region are treated as distinctly separate trees. Distances and azimuths are measured individually to the center of each stem where it splits from the stump. DBH is measured for each stem at 4.5 feet above the ground. When stems originate from pith intersections below 1 foot, it is possible for some stems to be within the limiting distance of the large tree or small tree plot, and others to be beyond the limiting distance. If stems originating from forks that occur below 1.0 foot fork again between 1.0 and 4.5 feet, the rules in the next paragraph apply.



Pith intersection

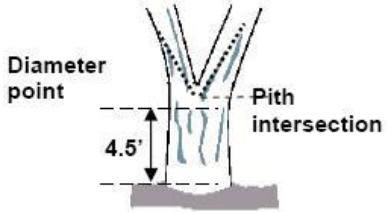
Trees forked between 1.0 foot and 4.5 feet. Trees forked in this region are also counted as separate trees, but only one distance and azimuth (to the central stump) is used for all. Although a single azimuth and distance applies to all, multiple stems should be recorded as they occur in clockwise order (from front to back when one stem is directly in front of another). The DBH of each fork is measured at a point 3.5 feet above the pith intersection. When forks originate from pith intersections between 1.0 and 4.5 feet, the limiting distance is the same for all forks--they are either all on, or all off the plot.



Multiple forks are possible if they all originate from approximately the same point on the main stem. In such cases, measure DBH on all stems at 3.5 feet above the common pith intersection.

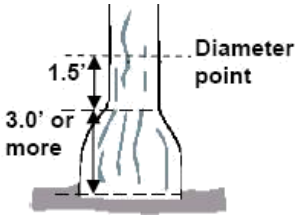
Once a stem is tallied as a fork that originated from a pith intersection between 1.0 and 4.5 feet, do not recognize any additional forks that may occur on that stem. Measure the diameter of such stems below the base of stem separation (i.e., do not move the point of diameter the entire 3.5 feet above the first fork).

- Trees forked at or above 4.5 feet. Trees forked in this region count as one single tree. If a fork occurs at or immediately above 4.5 feet, measure diameter below the fork just beneath any swelling that would inflate DBH.

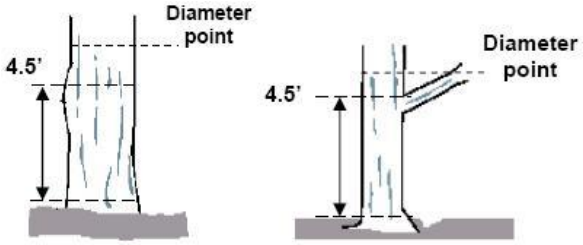


2. Stump Sprouts: Stump sprouts originate between ground level and 4.5 feet on the boles of trees that have died or been cut. Stump sprouts are handled the same as forked trees, with the exception that stump sprouts are not required to be 1/3 the diameter of the dead bole. Stump sprouts originating below 1.0 foot are measured at 4.5 feet from ground line. Stump sprouts originating between 1.0 foot and 4.5 feet are measured at 3.5 foot above their point of occurrence. As with forks, rules for measuring distance and azimuth depend on whether the sprouts originate above or below 1.0 foot.

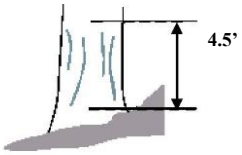
3. Tree with butt-swell or bottleneck: Measure these trees 1.5 feet above the end of the swell or bottleneck if the swell or bottleneck extends 3.0 feet or more above the ground



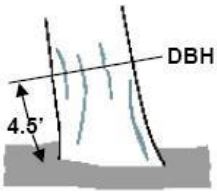
4. Tree with irregularities at DBH: On trees with swellings, bumps, depressions, and branches at DBH, diameter will be measured immediately above the irregularity at the place it ceases to affect normal stem form.



5. Tree on slope: Measure diameter at 4.5 feet from the ground along the bole on the uphill side of the tree.



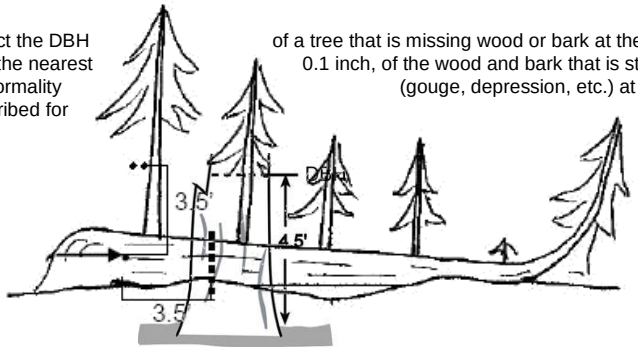
6. Leaning tree: Measure diameter at 4.5 feet from the ground along the bole. The 4.5 foot distance is measured along the underside face of the bole.



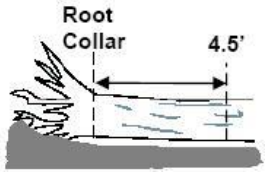
7. Turpentine tree: On trees with turpentine face extending above 4.5 feet, estimate the diameter at 10.0 feet above the ground and multiply by 1.1 to estimate DBH outside bark

8. Independent trees that grow together: If two or more independent stems have grown together at or above the point of DBH, continue to treat them as separate trees. Estimate the diameter of each, set the "DIAMETER CHECK" code to “Estimated”, and explain the situation in the notes.

9. Missing wood or bark: Do not reconstruct the DBH of a tree that is missing wood or bark at the point of measurement. Record the diameter, to the nearest 0.1 inch, of the wood and bark that is still attached to the tree. If a tree has a localized abnormality (gouge, depression, etc.) at the point of point of DBH, apply the procedure described for trees with irregularities at DBH.



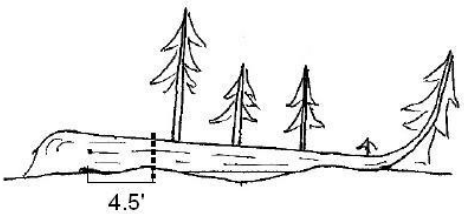
10. Live wind thrown tree: Measure from the top of the root collar along the length to 4.5 feet.



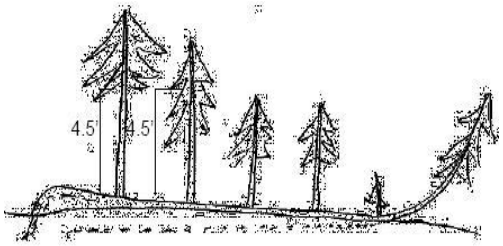
11. Down live tree with tree-form branches growing vertical from main bole: When a down live tree, touching the ground, has vertical (less than 45 degrees from vertical) tree-like branches coming off the main bole, first determine whether or not the pith of the main bole (averaged along the first log of the tree) is above or below the duff layer.

Duff consists of decomposing leaves and other organic material. You should see no recognizable plant parts; the duff layer is usually dark decomposed organic matter. When moss is present, the top of the duff layer is just below the green portion of the moss. The bottom of this layer is the point where mineral soil (A horizon) begins.

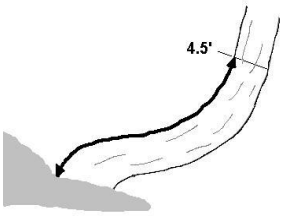
- If the pith of the main bole is above the duff layer, use the same forking rules specified for a forked tree, and take all measurements accordingly (figure below).
- If the pith intersection of the main down bole and vertical tree-like branch occurs below 4.5 feet from the stump along the main bole, treat that branch as a separate tree, and measure DBH 3.5' above the pith intersection for both the main bole and the tree-like branch.
- If the intersection between the main down bole and the tree-like branch occurs beyond the 4.5 foot point from the stump along the main bole, treat that branch as part of the main down bole.



- If the pith of main tree bole is below the duff layer, ignore the main bole, and treat each tree-like branch as a separate tree; take DBH and length measurements from the ground, not necessarily from the top of the down bole. However, if the top of the main tree bole curves out of the ground towards a vertical angle, treat that portion of that top as an individual tree originating where the pith leaves the duff layer.

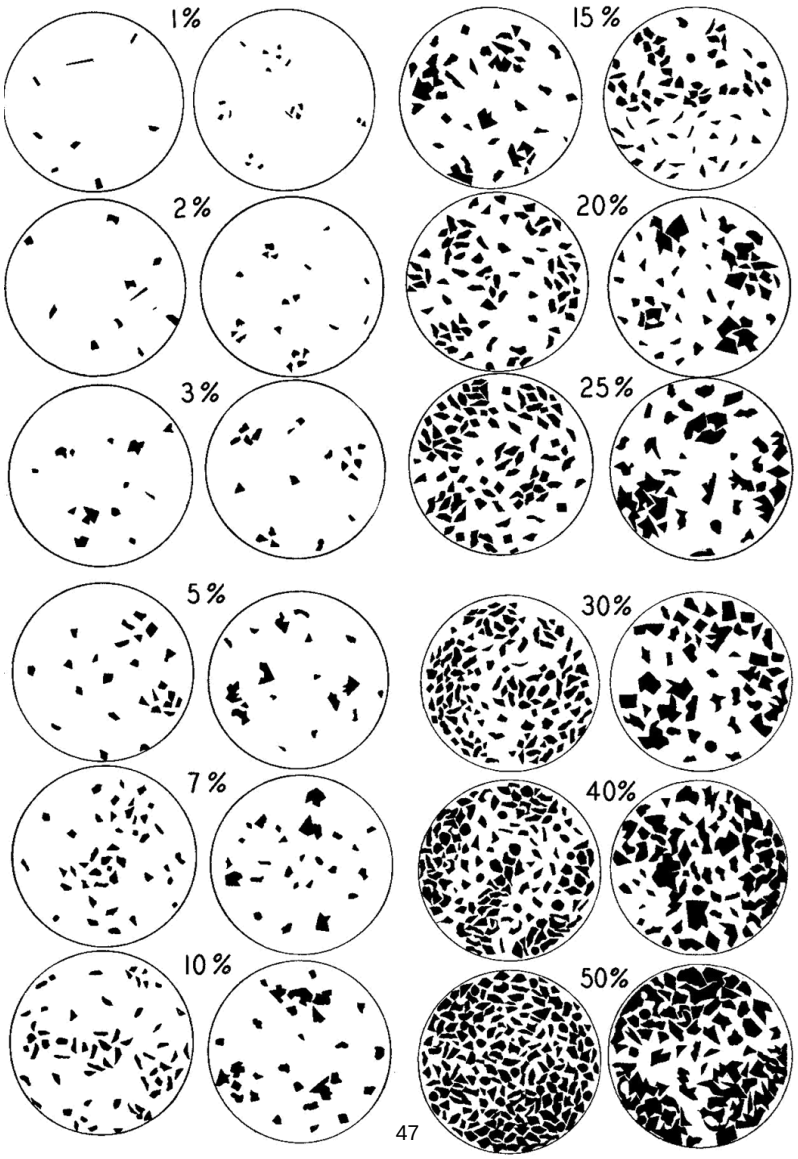


12. Tree with curved bole (pistol butt tree): Measure along the bole on the uphill side (upper surface) of the tree.



APPENDIX C: SUPPLEMENTAL MATERIALS FOR ESTIMATING CANOPY COVER

FIGURE 1: CANOPY DENSITY ESTIMATION



APPENDIX D: TALLY RULES FOR COARSE WOODY DEBRIS

If either to 90 or 360 transect intersects a non-sampled area (e.g., a hazardous or access denied area) mark the Plot variable Transect 90 Complete or Transect 360 Complete = "No", add a Plot Note to describe the non-sampled area and contact your coordinator for a replacement plot

1. Coarse woody debris (CWD) is sampled on all plots on Transect 90 and Transect 360. Tally CWD by starting at the plot center and working towards the fixed radius plot boundary. Measurements should not be taken along transects moving inward toward subplot center. Tally a piece if its central longitudinal axis intersects the transect (Figure 1)

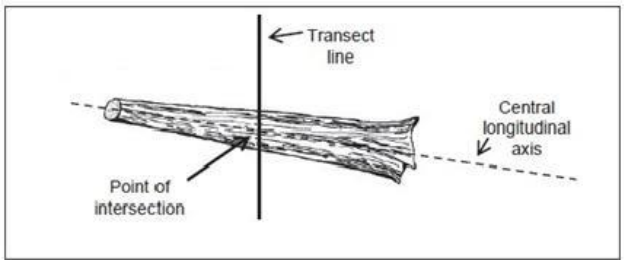


Figure 1: Tally rules for CWD

2. Tally dead trees and tall stumps that are leaning > 45 degrees from vertical. Do not tally live trees or standing dead trees and tall stumps that are still upright and leaning < 45 degrees from vertical. Follow the same rules for down trees as outlined in TREE SELECTION AND MEASUREMENT for determining what qualifies as standing and down dead trees and portions/tops of trees. Most CWD will be lying on the ground.

   Note: In order to avoid double counting or totally missing trees or portions of trees, once a decision is made on whether a tree or portion/top of a tree is considered standing or down it is important to include it in either one or the other protocol (standing tree or CWD), but not both.

3. The minimum length for any tally piece is 0.5 feet and it needs to meet the minimum transect diameter guidelines.

4. Decay class of the piece determines whether or not the piece is tallied

   For decay classes 1 to 4: tally a piece if it is ≥3.0 inches in diameter at the point of intersection with the transect (*Figure* 2).

   For decay class 5: tally a piece if it is ≥5.0 inches inches diameter at the point of intersection and ≥5.0 inches high from the uphill side of the ground. The reason for treating decay class 5 pieces differently is because they are difficult to identify, especially when heavily decomposed. Only pieces that still have some shape and log form are tallied—humps of decomposed wood that are becoming part of the duff layer are not tallied.

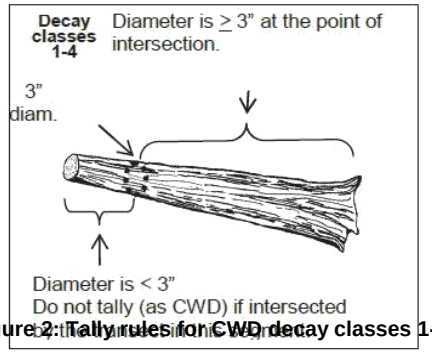


Figure 2: Tally rules for CWD decay classes 1-4

5. Tally pieces created by natural causes (examples: natural breakage or uprooting) or by human activities such as cutting. In some cases it may be impossible to measure or estimate individual pieces—for example when CWD pieces are in machine-piled slash piles or windrows, or are part of *a* jumble from flooding, landslide or avalanche. In these situations, piles are described using the instructions in RESIDUE PILE DATA. Because biomass estimates from piles have great uncertainty associated with them, pieces should be measured individually if at all possible.
6. Tally a piece only if the point of intersection occurs above the ground. If one end of a piece is buried in the litter, duff, or mineral soil, the piece ends at the point where it is no longer visible. Measure the diameter and length at this point.
7. If the central longitudinal axis of a piece is intersected more than once on a transect line or if it is intersected by two transect lines, tally the piece each time it is intersected (uncommon situation, see Figure 3).

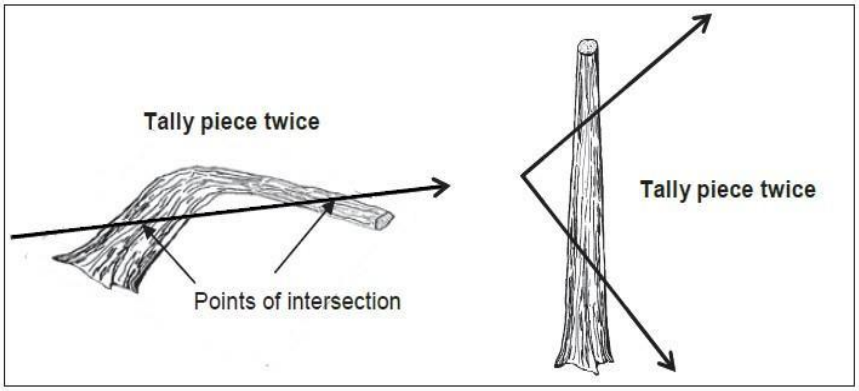


Figure 3: Tally Rules for CWD for intersections

8. Tally a piece only once if the subplot center falls directly on the central longitudinal axis of the piece. Tally the piece on the smallest azimuth degree transect.
9. If a piece is fractured across its diameter or length, and would pull apart at the fracture if pulled from either end or sides, treat it as two separate pieces. If judged that it would not pull apart, tally as one

piece. Tally only the piece intersected by the transect line.

10. Do not tally a piece if it intersects the transect on the root side of the root collar. Do not tally roots.
11. When the transect crosses a forked down tree bole or large branch connected to a down tree, tally each qualifying piece separately. To be tallied, each individual piece must meet the minimum diameter requirements.
12. In the case of forked trees, consider the "main bole" to be the piece with the largest diameter at the fork. Variables for this fork such as **CWD Decay Class** should pertain to the entire main bole. For smaller forks or branches connected to a main bole (even if the main bole is not a tally piece), variables pertain only to that portion of the piece up to the point where it attaches to the main bole (see Figure 4).

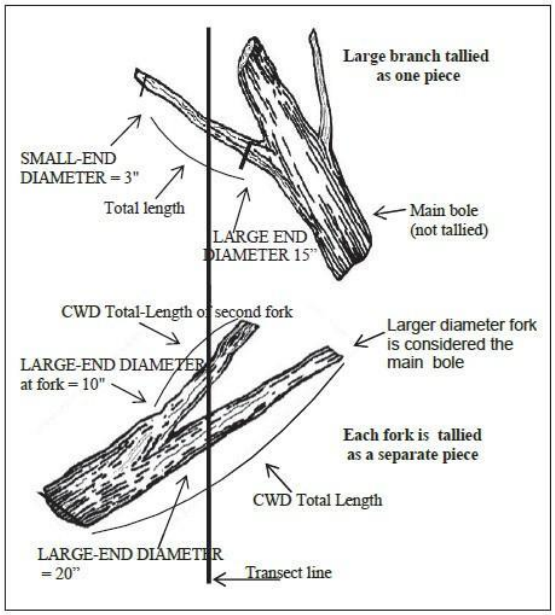


Figure 4: Tally Rules for CWD for forked trees

APPENDIX E: EQUIPMENT

RANGEFINDER

- Make: Laser Technology
- Model: TruPulse 360R
- Quantity: 2
- Procedure
    - Calibrate the internal compass of the rangefinder whenever changing batteries
    - When using the rangefinder ensure that it is not within a close distance of any metal devices that may cause magnetic interference. 6 in (15 cm) minimum: Metal rim glasses, pen/pencil, metal watch band, pocket knife, metal zipper/buttons, belt buckle, batteries, binoculars, cell phone, keys, camera, camcorder, survey nails, metal tape measure. 18 in (50 cm) minimum: Clipboard, data collector, computer, GPS antenna, 2-way radio, hand gun, hatchet, cell phone case with magnetic closure. 6 ft (2 m) minimum: Bicycle, fire hydrant, road signs, sewer cap or drain, steel pole, ATV, guy wire, magnets, chain-link fence, bar-wire fence, data collectors that use a magnet to hold the stylus. 15 ft (5 m) minimum: Electrical box, small car/truck, powerline, building with concrete & steel. 30 ft (10 m) minimum: Large truck, metal building, heavy machinery.
    - Measure Height in 3 shots[1] Press function keys until **HT** and **HD** flashes. [2] Aim anywhere you have a clear line of sight and press-and-hold **FIRE**. [3] (*Ang_1*) Aim to top, then press-and-hold FIRE. [4] (*Ang_2*) Aim to bottom, press-and- hold **FIRE**.
    - Measure Height in 2 shots [1] Press function keys until (**VD**), aim at top of target then press-and-hold **FIRE**. Note value [*VDt*]. [2] Aim at the bottom of the target then press-and-hold **FIRE**. Note value [*VDb*] [3] Calculate height: *HT = VDt - VDb*

SPHERICAL DENSIOMETER

- Make: Forestry Suppliers Inc.
- Model: Model-C
- Quantity: 1
- Procedure
  Each square of the grid is then equally subdivided mentally into 4 smaller squares (1/8 ″ x 1/8 ″) and represented by an imaginary dot in the center of each of the smaller squares. Thus a total of 96 dots representing smaller square areas can then be counted within the grid.

  Once the representative forest site has been selected for measurement, the user holds the instrument level and far enough away from his/her body such that the operator's head is just outside the grid. The operator can then count the number of dots, representing the smaller (1/8 ″ x 1/8 ″) square areas of canopy openings, up to a total of 96. The number determined is then multiplied by 1.04 to obtain the percent of overhead area not occupied by canopy.

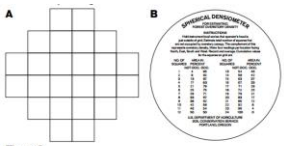


Figure 3
(A) Cross-shaped grid scratched on the convex surface of the mirror in Model A. Each square is 1/4 inch on a side. (B) Instructions for using Model A. This is fastened to the inside of the lid of the mounting box.

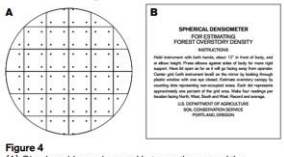


Figure 4
(A) Circular grid superimposed between the eye and the concave mirror in Model B. Each square is 1/4 inch on a side. (B) Instructions for using Model B. This is fastened to the bottom of the mounting box.

APPENDIX F: USERS GUIDE TO HEMISPHERICAL PHOTOGRAPH ACQUISITION AND ANALYSIS

The purpose of this supplement is to record the method used in this study for acquiring and analyzing hemispherical photographs. There are many sources of error in this process, and this presents the detailed method used to produce estimates of LAIE. Acquisition 1. The camera used was Nikon CoolPix 4500 with a Nikon FC-E8 Fisheye lens. This camera was also used in the development of the method for acquiring hemispherical photographs in Zhang et al. (2005). If other cameras are to be used, this guide should be modified. 2. The camera was put into Fisheye mode and manual focus mode. 3. The aperture was set to 5.3 4. The camera was placed on a 1 m tall tripod, brought into an open field and leveled. The shutter speed was then adjusted until the light meter was two "clicks" to the right of the suggested level. 5. The camera was then brought to the plot location, leveled, set to face magnetic north, and set to timer mode. 6. The shutter was depressed and the operator ducked to be out of the field of view of the photograph. 7. If light levels are changing rapidly (as they do at dawn and dusk), the camera should be brought into an open field at regular interviews to adjust the shutter speed using the methodology in step 4.

Analysis

1. Digital Hemispherical Photography (DHP) software was used for the analysis. This software can be obtained for free from Sylvain G. LeBlanc (Sylvain.Leblanc@CCRS.NRCan.gc.ca). 41

2. Click "Browse Input" and select the image file of the photograph.

3. You will be prompted to select the camera used in obtaining the photograph. If not prompted, select the camera in the drop down menu. If the camera is not shown, consult the software's user manual.

4. Click "Blue" in Input Options.

5. For the CoolPix 4500, enter 2.2 for Gamma. Consult the software manual if using a different camera.

6. The software breaks the photograph into 10 annulus rings. You can switch between rings using "Up" and "Down".

7. Make sure "Histogram Logarithm View" is checked

8. Select "Down" until ring 10 is selected.

9. A histogram of the pixel values in the blue band is shown at the right, on a logarithmic scale. The sliders above and below the histogram can be moved to se the thresholds for "foliage" pixels, "mixed" pixels, and "sky" pixels.

10. Each ring will follow a similar pattern in its histogram. There will be a steep peak at the left leveling off to a near linear area, followed by a steep peak at the right.

11. The bottom slider should be set at the left edge of the linear area, at the point where the "slope" of the histogram moves from linear to exponential.

12. The top slider should be set at the right edge of the linear area, at the point where the "slope" of the histogram moves from linear to exponential.

13. If the histogram is not clear, the thresholds can be adjusted using visual inspection of the ring. The area at the left displays the image of the ring. Higher resolution can be achieved using "Full Resolution" and

areas denoted as “mixed pixels” will be displayed in green if “Gaps Colour Code” is selected. By moving the sliders, inspecting the histogram, and inspecting the image, the proper threshold can be set.

14. Continue on to each of the next nine rings, following steps 11-13. 42

15. When finished, LAIE estimates can be retrieved by entering the number of rings the analysis should process in the box “Rings #.” Select “Process” to retrieve the estimates.

16. The upper right window will display the LAIE (displayed as PAIe) at the top column for the rings selected. It will also display the individual LAIE for each of the 10 rings below that.

17. The thresholds for each photo will be saved in a text file and can be accessed at a later date.

18. The output can also be exported to TRACwin. See the user manual for more information.

GPS DEVICES

- Make: Javad
- Model: Triumph-2
- Serial: Not Yet Available

- Make: Trimble
- Model: GeoHX
- Serial: 4822434883