

Pine Creek Improved Management Project
Initial Offset Project Data Report: Inventory Methodology
Meets Forest Offset Protocol 2015 §7.2.1(24)(C)

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Please note: Section 8 in this document is the same as Section 5 in the attachment modelling-methodology.pdf.

1 OFFSET PROJECT BOUNDARY DESCRIPTION & LIST OF ONSITE CARBON POOLS INCLUDED

Forest Offset Protocol Appendix A(b)(1)

The Project consists of forestland within the Pine Creek property, refined by recent silvicultural treatments, road and watercourse locations, and stand stocking.

In addition to non-forested and low-stocked areas, The following were removed from the Project:

- Roads with existing rights-of-way benefitting third parties
- Non-forest areas
- Areas with stocking generally below common practice

The width of the road removal areas varied and was dependent on the terms of the right-of-way agreements.

Table 1. Carbon Pools/Sources That Must Be Accounted for

Greenhouse Gas (GHG) Assessment Boundaries Carbon Pools/Sources That Must Be Accounted for in Quantifying Project Reductions and Removals			
Carbon Pool or Source (Forest Offset Protocol, §5.2)	Included or Optional (Forest Offset Protocol, §5.2)	Included in this project?	Justification/Quantification Method
Primary Effect Sources, Sinks, and Reservoirs			
IFM-1 Standing Live Carbon (living trees)	Included	Included	Mandatory pool for measurement – Baseline modeled using initial field inventory measurements; Project measured by field measurements and updating forest carbon inventory.
IFM-2 Shrubs and Herbaceous Understory	Excluded	Excluded	NA
IFM-3 Standing dead carbon (carbon in all portions of dead, standing trees)	Included	Included	Mandatory pool for measurement – Baseline modeled using initial field inventory measurements; Project measured by updating forest carbon inventory.
IFM-4 Lying dead wood carbon	Excluded	Excluded	NA

Pine Creek Improved Management Project
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Greenhouse Gas (GHG) Assessment Boundaries Carbon Pools/Sources That Must Be Accounted for in Quantifying Project Reductions and Removals			
Carbon Pool or Source (Forest Offset Protocol, §5.2)	Included or Optional (Forest Offset Protocol, §5.2)	Included in this project?	Justification/Quantification Method
Primary Effect Sources, Sinks, and Reservoirs			
IFM-5 Litter and duff carbon (carbon in dead plant material)	Excluded	Excluded	NA
IFM-6 Soil Carbon	Included/ Excluded	Excluded	It is not necessary to quantify soil carbon in this project in accordance with the Protocol, as deep ripping, furrowing, plowing, soil disturbance exceeding 25% of the project area and mechanical site preparation not on contour will not be permitted on the project area.
IFM-7 Carbon in in-use forest products	Included	Included	Baseline estimated from modeled harvesting volumes. Project estimated from measured harvest volumes.
IFM-8 Forest product carbon in landfills	Included or Excluded	Included	Excluded when project harvesting exceeds baseline. Included when project harvesting is below baseline. Baseline estimated from modeled harvesting volumes. Project estimated from measured harvest volumes.
Secondary Effect Sources, Sinks, and Reservoirs			
IFM-9 Biological Emissions from site preparation activities	Included	Included	Biological emissions from site preparation activities are not quantified separately, but rather are captured by measuring changes in included carbon reservoirs.
IFM-10 Mobil combustion emissions from site preparation activities	Excluded	Excluded	N/A
IFM-11 Mobile combustion emission from ongoing project operation and maintenance	Excluded	Excluded	N/A
IFM-12 Stationary combustion emissions from ongoing project operation and maintenance	Excluded	Excluded	N/A
IFM-13 Biological emissions from clearing of forestland outside of the Project Area	Excluded	Excluded	N/A

Greenhouse Gas (GHG) Assessment Boundaries Carbon Pools/Sources That Must Be Accounted for in Quantifying Project Reductions and Removals			
Carbon Pool or Source (Forest Offset Protocol, §5.2)	Included or Optional (Forest Offset Protocol, §5.2)	Included in this project?	Justification/Quantification Method
Primary Effect Sources, Sinks, and Reservoirs			
IFM-14 Biological emission/ removals from changes in harvesting on forestland outside the project area.	Included/ Excluded	Included	Not estimated for baseline. Estimated for project by using a default 20% "leakage" factor applied to the difference in harvest volume relative to baseline.
IFM-15 Combustion emissions from production, transportation, and disposal of forest products	Excluded	Excluded	N/A
IFM-16 Combustion emission from production, transportation, and disposal of alternative materials to forest products	Excluded	Excluded	N/A
IFM-17 Biological emissions from decomposition of forest products	Included	Included	For baseline, quantified as a component of calculating carbon stored for 100 years in wood products (SSR #IFM-7) and landfills (SSR #IFM-8) For project, quantified as a component of calculating carbon stored for 100 years in wood products (SSR #IFM-7) and landfills (SSR #IFM-8)

2 STRATIFICATION

Forest Offset Protocol Appendix A(b)(2)

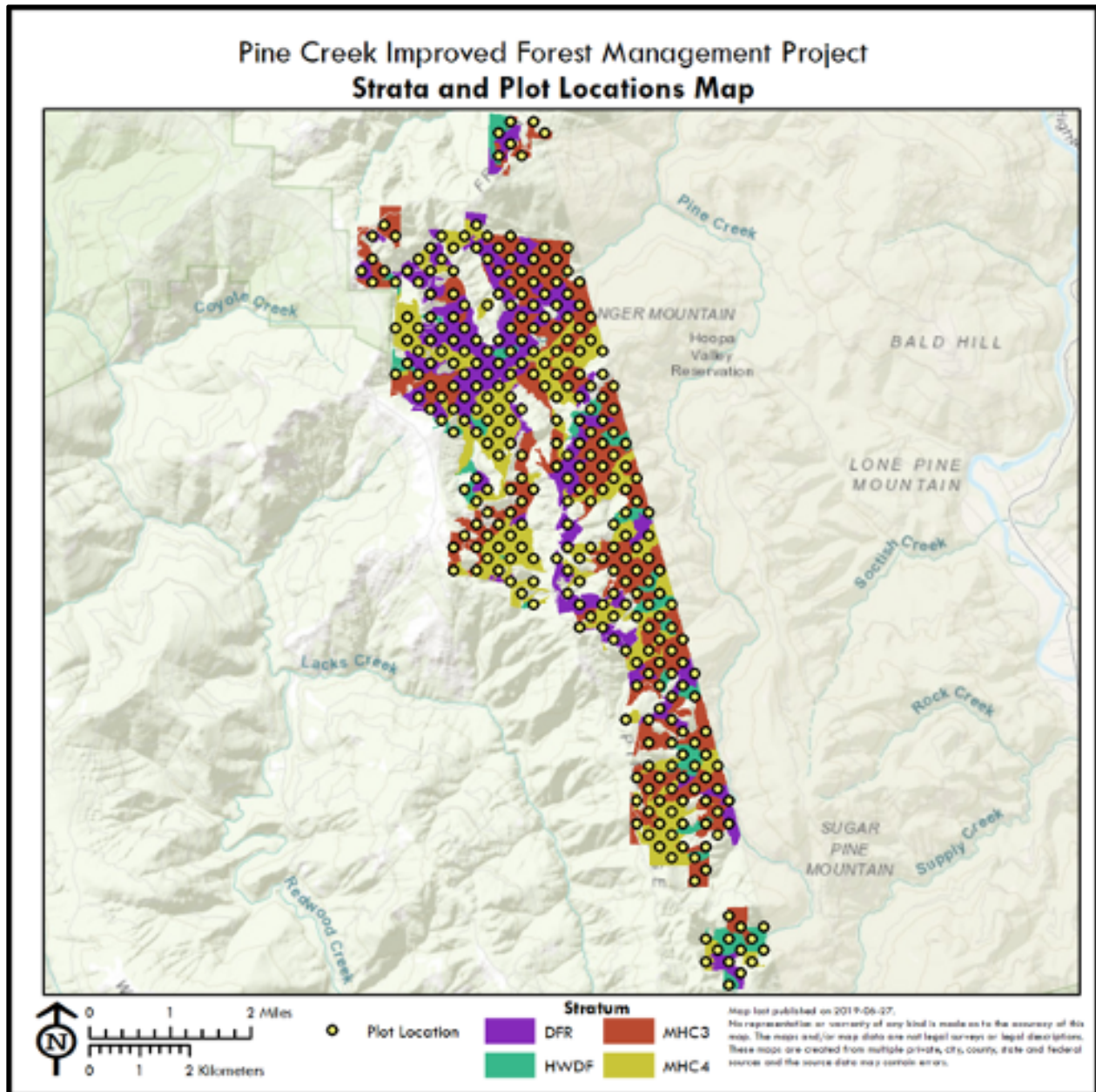
2.1 STRATIFICATION RULES

Stand typing was done for the property by the previous owner prior to sale. The original stand typing was based on similar species, size class and density and had 1,582 stands amongst 34 vegetation types. A subset of forested stands was selected for inclusion in the carbon project and once the carbon inventory was completed, stands were grouped into strata. Stand boundaries were adjusted as needed to align with roads and/or watercourses, updated ownership boundaries, and recent management. Once the carbon inventory was completed, stands were grouped into four

strata (Figure 1, Table 2) based on similarities in site index and soil type, age, species composition, mean tree diameter, location, and professional judgement.

2.2 MAP OF VEGETATION STRATA

Figure 1. Inventory Strata and Plot Locations Map



2.3 STRATIFICATION RESULTS

Table 2. Stratification Results by Area

Stratum	Area (acres)
DFR	2,027
HWDF	704
MHC3	3,083
MHC4	2,192
Grand Total	8,005

2.4 TOOLS FOR APPLICATION

Tools used in the development of the strata layer included:

- ESRI ArcMap GIS software version 10.+
- NAIP orthophotographic imagery raster layers
- Google and ESRI webserver imagery
- Stand typing done by the previous owner
- Maps of past silviculture implemented
- Inventory plot data

2.5 BOUNDARY DETERMINATION

The Project is timberland within the property with stocking generally above common practice and that had not been recently heavily harvested prior to land acquisition. Stand delineation and vegetation typing done by the previous owner were used as the initial basis for project area consideration. Stands were selected for inclusion in the carbon project based on the original vegetation typing, stand size and location, and examination of recent aerial imagery to confirm appropriate typing was conducted (2016 National Agriculture Imagery Program (NAIP) orthoimagery). The Project boundary was refined further based on stream and road locations, recent vegetation treatments not visible in aerial imagery, and ownership/property boundary evaluation. Some areas were dropped from the project due to low stocking. Roads with existing ingress and egress easements were buffered and removed from the project.

Project boundaries were checked against the legal descriptions of the property ownership using data from the Bureau of Land Management (BLM). The BLM's CADNSDI (or Cadastral Publication Data Standard) is the cadastral data component of the National Spatial Data Infrastructure (NSDI). These are the cadastral reference features that provide the basis and framework for parcel and other mapping. The BLM is the authoritative source for PLSS information at the federal level; the BLM is required to perform cadastral surveys on all federal interest and Indian lands and, as part of the survey work, maintains an essential land grid, known as the rectangular survey system or Public Land

Survey System (PLSS), which is the basis for identifying legal descriptions of land parcels. This data set represents the GIS Version of the PLSS, including both rectangular and non-rectangular surveys, and other Survey System data. The other survey systems include subdivision plats. The primary source for the data is cadastral survey records housed by the BLM supplemented with local records and geographic control coordinates from states, counties as well as other federal agencies such as the USGS and USFS.

We used the CADNSDI dataset in combination with field-located survey monuments, records of survey, and/ or other boundary markers (like blazed trees, cut lines, or property signs) to determine boundaries.

3 INVENTORY DESIGN AND SAMPLING PROCESS

Types of Sample Plots, Plot Layout, Plot Location, and Plot Monumenting Description
Forest Offset Protocol §7.1.1(a)(24), Appendix A(b)(3), Appendix A (b)(4), Appendix A (b)(5)

The following inventory methodology has been used to quantify the required carbon pools for project registration:

The sampling points were laid out in GIS across the Pine Creek Carbon Project property on a 231-m grid, and every other column and row on the grid was selected as a sampling location (Figure 1). The sampling grid was overlaid over the initial project area which was also buffered to include any potential inaccuracies in the initial ownership mapping; *i.e.*, areas outside the initial mapped stands were included based on potential boundary locations. Points landing in places anticipated to be removed from the project were still visited in the field to determine accurately whether plot center fell in or out of a defined project boundary. Plots located close to project boundaries were not offset and were evaluated as potential boundary plots in the field, following the project's inventory manual. These areas included the permanent road easement buffers, a 100-foot buffer around Class I and II-L watercourses, and a 15-foot core buffer on Class II-S watercourses. If plot center landed in one of these buffer areas, it was dropped and not installed. However, later in project development it was decided that all watercourse buffers would be included in the project, so these points were revisited and installed in the last week of April 2019.

The plot design is a set of 1/20th acre fixed-area plots distributed systematically across the project area on a pre-determined grid with random origin. The mapped grid of plots was loaded into GPS units and plot centers were located in the field using GPS. Plot centers were permanently monumented using a 2' long 3/8" piece of rebar painted orange and driven into the ground. Pink flagging was tied to a branch about 7 feet high near the plot center and to the plot stake. Standard timber cruising tools were used, including diameter tapes for measuring diameter at breast height (DBH) and laser range finders for measuring distances and tree heights. All standing live trees 5" or greater were measured regardless of their merchantability. DBH was measured to the nearest 1/10th inch using a diameter tape at the point that is 4.5 ft. off the ground. Total height was measured to the nearest foot using a laser range finder or estimated for all trees. The inventory manual specific to this project contains instructions for DBH and height measurements in unusual situations.

On every 4th plot, if a potentially suitable site tree was found, it was bored for age to determine site index. Additional information collected on each tree included species and total percent carbon defect. Height to break was measured on each tree with a broken top and the inside bark diameter at the break was estimated.

The details of the methodology are contained in the inventory manual found in Addendum A. Carbon Inventory Manual. The manual was provided to the crew that installed the inventory, along with training and check cruising to ensure accurate and consistent data collection.

4 UPDATING/REPLACING SAMPLE PLOTS & INVENTORY

Forest Offset Protocol Appendix A(b)(6)

Annual monitoring of the project is required to ensure up-to-date estimates of carbon stocks and provide assurance that GHG reductions achieved by the project have not been reversed. A re-inventory will comply with the requirement that no field inventory data will be more than 12 years old; as such all project plots will be re-inventoried no later than 2030 and carbon stocks will be updated. Because the plots are permanently located, it is anticipated that any re-measurement will use the existing plot locations as the basis for updating project stock estimates. If plot density is reduced at subsequent re-inventory, plots will be dropped systematically and/or randomly such that the inventory continues to meet sampling error requirements. Future re-measurements may also incorporate an updated inventory methodology and/or stratification system. Any changes will be noted in the inventory change log.

5 DATA MANAGEMENT SYSTEMS & PROCESSES

*Analytic Methods, Calculation Methodologies, Volume & Biomass Equations and Models
Forest Offset Protocol Appendix A(b)(7)*

All growth and yield modeling required for this report as well as the carbon quantification has been conducted by Registered Professional Foresters at Baldwin, Blomstrom, Wilkinson and Associates, Inc., Arcata, California, specifically by Mr. Paul Harper RPF# 2672. The carbon quantification tools used were developed by Dr. Timothy Robards RPF# 2521 and Dr. Peter Tittman of New Forests. Thus, this report has been prepared with the oversight of a Professional Forester as required in Section 7.2(e) of the Protocol.

The data were analyzed in Microsoft Excel, Microsoft Access and the Forest Vegetation Simulator (FVS) ICASCA variant (Keyser 2014). This variant was used because of the large number of species it tracks and its regional applicability. The Suppose user interface for FVS V2.07 (Crookston 1997) and FVSSTAND were also used to develop baseline prescription key files. These key files were uploaded to a proprietary stack of data processing algorithms in the Cloud that run all the FVS prescriptions, produce treelist output and perform all biomass calculations. Programs in the Cloud

FVS model include SQLite, PostgreSQL with PostGIS spatial extension, the Python programming language and OpenFVS[1] version (CA FVS VARIANT -- RV:20190307).

The above ground standing live tree portion was calculated for all trees ≥ 5 " dbh using the approved species-specific FIA equations and methodology for cubic foot volume and biomass of tree bole, bark and branches as required by ARB (FIA Volume Equation Documentation & Regional Biomass Equations Used by FIA, Updated 9-19-2014). For broken top trees, bole volume was calculated to account for the missing volume of the broken top. On broken top standing live trees, the height to break was measured and DIB at break estimated. The original height was estimated in the field using comparable sized trees and overall canopy height. The height of the break (TruncHt) was compared to the intact tree height and volume missing was estimated using the thirds method. This method assumes that 10%, 25%, and 65% of the tree volume is in the top, middle and bottom third of the tree, respectively. This missing volume was then subtracted from the gross intact bole volume of the tree as if the tree were not broken.

Biomass for crown and bark (where calculated as separate elements, i.e., not hardwoods) was reduced proportionally for a missing top using the thirds method.

Above ground standing dead wood was estimated using the snag data collected in the inventory for all standing dead trees greater than or equal to 5" DBH and 15' in height. The total and broken top heights were measured or estimated in the field for all standing dead trees. Bole defects causing missing wood on standing dead trees observed in the field were deducted when calculating carbon. Broken top trees were calculated exactly the same way as live trees, with the exception that bark biomass was only added to the above-ground tree calculations for trees in decay classes 1 and 2 and crown biomass was only added for decay class 1, due to the way that more highly decayed trees lose their bark and crown biomass. For hardwood species where bark and crown are included in the bole volumes, these components were present for all decay classes and were adjusted for missing top volume as described above for bole volume. Biomass for each standing dead tree was calculated by multiplying the net bole volume by the appropriate specific gravity value, and by the density reduction factor from Appendix D in Harmon et al. (2011).

Below ground standing live and dead tree biomass was estimated by using the protocol stipulated equation (Cairns, 1997). This equation uses plot-level above ground biomass density in tonnes per hectare to predict the below ground biomass in tonnes per hectare. The Cairns equation was applied to the sum of live and dead aboveground biomass by plot to calculate live and dead belowground biomass. This was then converted to CO₂e and subsequently divided into live and dead belowground carbon pools by applying the proportion of live or dead aboveground carbon to total aboveground carbon to total belowground carbon. Thus, the carbon pools could be represented by total live and total dead carbon independently, as required by the Protocol.

All biomass estimates were converted to carbon by multiplying by 0.5 and to CO₂e by multiplying by 3.667, which is the conversion factor specified in the Protocol.

Harvested wood products pools require an estimate of the average amount of carbon that remains stored in wood products over a 100-year period. This was done according to the steps outlined in Appendix C of the protocol, which utilize the average DOE (2007) wood products factors for accounting for the long-term storage of wood products. The procedure begins with an estimate of the total harvested carbon that will be delivered to a mill to be turned into wood products; but note that due to the lack of a hardwood wood products market the hardwood wood storage was ignored. Next, the series of worksheets from Appendix C in the Protocol were used to determine the amount transferred to wood products, the amount stored in in-use wood products, and the amount stored in landfills. The carbon stored in wood products and landfills are summed to determine the total average annual carbon storage in wood products over 100 years.

For the calculation of secondary effects, the above and belowground carbon of all harvested live trees is determined using the same equations and methods for determining standing live tree carbon over time.

All data, growth and yield simulation results, and carbon calculations remain stored on personal computers and back-up drives at Forest Carbon Partners' offices.

6 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) PROCEDURES

Assessing & Insuring Data Quality, Transfer & Archiving of Field Data, Data Entry & Analysis Procedures, Data Maintenance & Archiving, Other Relevant Procedures
Forest Offset Protocol Appendix A(b)(8)

Quality was assessed at every step of the data collection, processing and reporting process during initial project development. Going forward, these procedures will be used as inventory plots are re-measured to update the inventory and monitor and report on carbon stocks over time.

DATA COLLECTION

Inventory plot installation was conducted by trained inventory crews to the specifications and tolerances described in the inventory manual. Data was recorded on paper plot sheets and entered into a spreadsheet before being provided to the analyst at BBW. Check cruising was conducted on roughly 5 percent of the plots according to the parameters in the inventory manual to ensure quality measurements and feedback to field crews during data collection. The corrected plot data was used in all modeling and analysis. For future re-measurements, if the crews conducting inventory re-measurements have not utilized the inventory methodology before, check cruising will be conducted on at least 5 percent of the plots. If applicable, timely on-site feedback of the issues found on each of the checked plots will be provided to the cruisers, and the corrected plot data will be used in all modeling and analysis.

DATA PROCESSING

Inventory data underwent extensive internal review by an RPF while it was being entered and processed. All plot data was combined in EXCEL to perform error checking and ensure consistency in coding and formatting. Further data quality checking was done by the RPF running the silvicultural prescriptions while formatting the data for processing by FVS and while creating the silvicultural prescriptions within FVS (e.g., by checking FVS output summary tables). A subset of carbon queries was independently validated to ensure that carbon calculations were correct and met ARB specifications. Data was also spot-checked for accuracy at each transfer between Excel, FVS and harvest scheduling. Going forward, the same procedures will be utilized for future re-measurements, and a QAQC checklist will be implemented to minimize the risk of missed steps or inadvertent errors throughout data processing and transfer.

DATA MANAGEMENT

All data files used for reporting calculations within the OPDR follow standardized naming and dating conventions to allow for data tracing and version control. All digital files are stored in a digital filing system and backed up on multiple remote servers for data archiving and security. Physical files will also be maintained and stored.

7 CHANGE LOG OF INVENTORY METHODS OR VOLUME & BIOMASS EQUATIONS

Forest Offset Protocol Appendix A(b)(9)

Changes to the inventory methods will be noted in section 8 of the inventory manual (Addendum A. Carbon Inventory Manual). Changes to volume or biomass quantification methods will be recorded in Table 3. Volume and Biomass Quantification Methods Change Log.

Table 3. Volume and Biomass Quantification Methods Change Log

#	Date of Change	Description of Change
1		
2		
3		

8 PROCEDURES FOR UPDATING THE FOREST CARBON INVENTORY

Documented Procedures to Account for Harvest, Growth, Mortality, Disturbance, Incorporating New Inventory & Plot Data, Retiring Older Sample Plots, Changes in Modelling, Appropriate Confidence Deduction

Forest Offset Protocol Appendix A(b)(10)

For reporting stocks on an annual basis until the next inventory, the inventory update procedure will rely on growth projections from FVS. If any timber harvesting occurs in the project area, the timber harvest area will be re-inventoried within 3 years. A simulation of the harvest to update the inventory may be utilized in the interim. Timber harvests in the project area shall be designed to treat plots the same as the surrounding stand. Effort will be made to limit knowledge of exact plots locations from the foresters designing and implementing timber harvests, so that the risk of bias is minimized during harvest planning. In addition, a post-harvest review of recent harvested areas shall be conducted by a RPF and if a plot appears, based on professional judgment, to no longer be representative of the surrounding stand due to being treated differently than prescribed in the harvest plan, then the plot will be moved to a random distance and direction within a 2.5-acre area around the original plot.

At the occasion of a disturbance event other than planned timber harvest, such as fire or windthrow, that appears to alter a significant portion of the project acreage, or results in a reversal under the protocol (e.g. reduction is greater than annual growth if project is verified annually) then the plots in the affected area will be re-measured. If the disturbance appears to meet the specified threshold but does not affect any of the permanent plots in the inventory, new plots will be established in the affected area in sufficient quantity and distribution to account for the disturbance. The newly measured plots will be installed consistent with the inventory manual used to establish the original inventory; any improvements or changes to inventory methods or calculations would be documented and justified in the change log. Once the plot data has been gathered, a new calculation of the Actual On-Site Carbon Stocks will be completed in order to revise the GHG Reductions and Removals as well as a new calculation of the confidence deduction. The effects of disturbances on the carbon stocks of the project area will be estimated by monitoring the acreage affected utilizing the average per acre carbon stocks for the applicable strata. If the disturbance affects a significant portion of the strata acreage, then a new stratum will be delineated, and the project stocks and confidence deduction calculated using the new strata.

Disturbance events will be monitored as part of normal management activities, as well as through an annual review of aerial imagery and local and state disturbance reports (e.g., fire maps) if available and applicable. Given the plot density (approximately 1 plot/26 acres) any disturbance that affects less than 26 acres (e.g. salvage of burned trees) is assumed to have a diminutive effect on project carbon stocks given that each plot represents approximately 0.3% of the entire stock calculation. Thus, any disturbance that is not large enough in scope to affect a plot, by definition would only affect less than 0.3% of the carbon stocks on the project area.

If, in the process of re-measuring plots, the plots cannot be relocated, new plots will be established in the same locations as the old plots. The replacement plot data will replace the old plot data for the purposes of calculating project carbon stocks.

ADDENDUM A. CARBON INVENTORY MANUAL

Forest Offset Protocol Appendix A(b)(4), Appendix A(b)(5)

NEW FORESTS, FOREST CARBON PROJECT INVENTORY MANUAL

Version 3.0



This manual is adapted from:

FOREST INVENTORY AND ANALYSIS NATIONAL CORE FIELD GUIDE, VOLUME I:
FIELD DATA COLLECTION PROCEDURES FOR PHASE 2 PLOTS

Version 7.2, October 2017

and,

FIA FIELD INSTRUCTIONS FOR THE ANNUAL INVENTORY OF CALIFORNIA,
OREGON, AND WASHINGTON 2017

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PINE CREEK CRUISE SUMMARY

Cruise element	Pine Creek Carbon
Plot size	1/20 acre
Plot Radius	26.33'
Trees to include	≥ 5" DBH
Microplot size	1/200 acre
Microplot Radius	8.33'
Microplot trees to include	≥ 1" DBH
DBH	Round <i>down</i> to nearest 0.1". Example: 3.68 recorded as 3.6.
Tree length (formerly Height)	Round to the nearest foot Measure height of all trees > 14" DBH Measure height of all site index trees Measure height of all trees of uncommon species Apply cosine, slope correction, or use ML on laser to correct for lean on trees >14" that lean >15 degrees Estimate correction or use ML on laser for trees <14" that lean >15 degrees (this replaces former Angle of Lean field) OK to estimate height of common trees <14" DBH
Trees with broken tops	Now called TRUNCATED LENGTH, formerly HEIGHT TO BREAK or ACTUAL LENGTH Measure height to break (TRUNCATED LENGTH), see 5.5 Total Length and 5.6 Truncated Length for updated instructions Estimate diameter inside-bark at break Estimate unbroken height (TOTAL LENGTH) for all broken top trees.
Plot spacing	Systematic grid (layout by BBW)
Plot near project boundary	Don't offset plot - See 2.14 Distance to Project Boundary and 5.13 Tree Outside Boundary for instructions
Site trees	Collect 1 site tree every 4th plot, if one isn't available, make note, collect from the next plot. See minor updates to language in 6.1 Site Tree Selection and 6.2 Species
Defect	Cubic foot defect is recorded for missing wood on live or dead trees Board foot defect is recorded on live conifers ≥10" DBH Don't include volume of missing top
Condition class data	Forest type, Stand size class, and Regeneration status are now assessed at the scale of "area visible from the plot"
Watercourses	See updates to 2.15 Water Protection Zone Condition. Measure slope distance to WTL if within 125 feet slope distance of a mapped Class I, II-L, or II-S watercourse Make determination regarding overlap with project boundary

	Drop plot if plot center is within the effective no cut buffer, but fill out header sheet.
Plot status	1 = plot with trees $\geq 5''$ DBH, 2 = No trees $\geq 5''$ DBH, 3 = Non-sampled, See <u>2.2 Plot Status</u> for updates Condition class status is no longer used
Standing Dead Tally tree	Lean is measured from base of tree to point of diameter measurement. See updated definition

INTRODUCTION

This document describes the standards, codes, methods, and definitions for New Forests carbon project field data items. The objective is to describe field procedures that are consistent and uniform across all carbon projects. Unless otherwise noted, the items in this field guide are considered required, that is, the information will be collected on all projects as specified. Items or codes specified as OPTIONAL may not be required by individual projects; however, if the item is collected or coded, it will be done as specified in this field guide. It is expected that on average all items in this guide can be measured by a two-person field crew in less than one day, including travel time to and from at least 4 plots; although plot production will obviously vary with terrain and weather.

This field guide is adapted from the USDA FOREST INVENTORY AND ANALYSIS NATIONAL CORE FIELD GUIDE, VOLUME I: FIELD DATA COLLECTION PROCEDURES FOR PHASE 2 PLOTS Version 7.2, October 2017. The intent of FIA inventory differs from carbon inventory and thus procedures have been edited as necessary to meet the data collection requirements of carbon projects. Where data items are in common with the above FIA manual, reference to the source section/subsection follows the New Forests section/subsection title in the following format “FIA NCFG §”.

FIELD GUIDE LAYOUT

Each section of the field guide corresponds to one of the following sections.

- 0 General Description
- 1 Plot Level Data
- 2 Condition Class
- 3 Tree and Sapling Data
- 4 Site Tree Information

Each section begins with a general overview of the data elements collected at that level and background necessary to prepare field crews for data collection. Descriptions of data elements follow in this format:

DATA ELEMENT NAME -- <brief variable description>

When collected: <when data element is recorded>

Field width: <X digits>

Tolerance: <range of measurement that is acceptable>

MQO: <measurement quality objective>

Values: <legal values for coded variables>

Field width designates the number of columns (or spaces) needed to properly record the data element.

Tolerances may be stated in +/- terms or number of classes for ordered categorical data elements (e.g., +/- 2 classes); in absolute terms for some continuous variables (e.g., +/- 0.2 inches); or in terms of percent of the value of the data element (e.g., +/- 10 percent of the value). For some data elements, no errors are tolerated (e.g., PLOT NUMBER).

MQO's state the percentage of time that the collected data are required to be within tolerance. Percentage of time within tolerance is generally expressed as "at least X percent of the time," meaning that crews are expected to be within tolerance at least X percent of the time.

PLOT NOTES and TREE NOTES will be available for recording notes. Important information regarding plot access or hazards that would be helpful for future cruisers to know should be recorded in the PLOT NOTES section. Anything unusual or notable about either the plots or individual trees on the plots should be recorded in the appropriate sections.

UNITS OF MEASURE

The field guide will use **ENGLISH** units as the measurement system.

Plot Dimensions:

	Area (acres)	Area (sq. feet)	Radius (feet)
Standard Plot	1/10 th	4,356.0	37.24
Alternate Larger Plot	1/7 th	6,222.86	44.51
Alternate Smaller Plot	1/20 th	2,178.0	26.33
Microplot	1/200 th	217.8	8.33

Tree Dimensions:

breast height	4.5 ft
stump height	1.0 ft
merchantable top	4.0 in DOB
sapling/tree DBH break	5.0 in DOB

DATA RECORDING

Data may be recorded on paper plot sheets, digital Excel versions of the plot sheets, or on hand-held data recording devices that has been set up in the same format as the plot sheets. Make sure that the version of the plot sheets being used matches the version of the inventory manual that has been selected for the project. Items in the plot sheets correspond to various sections in the inventory manual and are labeled with the appropriate section numbers for

reference. If a particular section does not apply to the plot being sampled, the cruiser has the option of inserting a horizontal line or “NA” so that the reviewers performing field checks and office checks know that the item was not missed by the inventory crew.

1.0 GENERAL DESCRIPTION

1.1 PLOT SIZE

The standard methodology has one plot 1/10 acre in size with a radius of 37.24 feet. If less than an average of 7 trees per plot is estimated during inventory planning then an alternate larger plot size of 1/7 acre with a radius of 44.51 feet may be used. If more than an average of 11 trees per plot is estimated during inventory planning, then an alternate smaller **plot size of 1/20 acre with a radius of 26.33 feet** may be used. A final decision on plot size should be made in consultation with New Forests prior to commencing the inventory. All plots on a project must use the same size plot. 'Plot center' is defined as the center of the plot, which is permanently monumented with rebar or fiberglass pole. The plots are used to collect data on trees with a diameter (at breast height, DBH) of 5.0 inches or greater.

Each plot contains a **microplot of approximately 1/200 acre in size with a radius of 8.33 feet**. The center of the microplot is the same as the center of the plot. Microplots are used to collect data on saplings (DBH of 1.0 inch through 4.9 inches) during the initial inventory and are used in the baseline modeling.

Data are collected on field plots at the following levels:

Plot	Data that describe the single fixed sized plot.
Condition Class	A discrete combination of landscape attributes that describe the environment on all or the majority of the plot. These attributes include, FOREST TYPE, STAND SIZE CLASS, REGENERATION STATUS, and TREE DENSITY.
Tree	Data describing saplings with a diameter 1.0 inch through 4.9 inches, and trees with diameter greater than or equal to 5.0 inches.
Site Tree	Data describing site index trees.

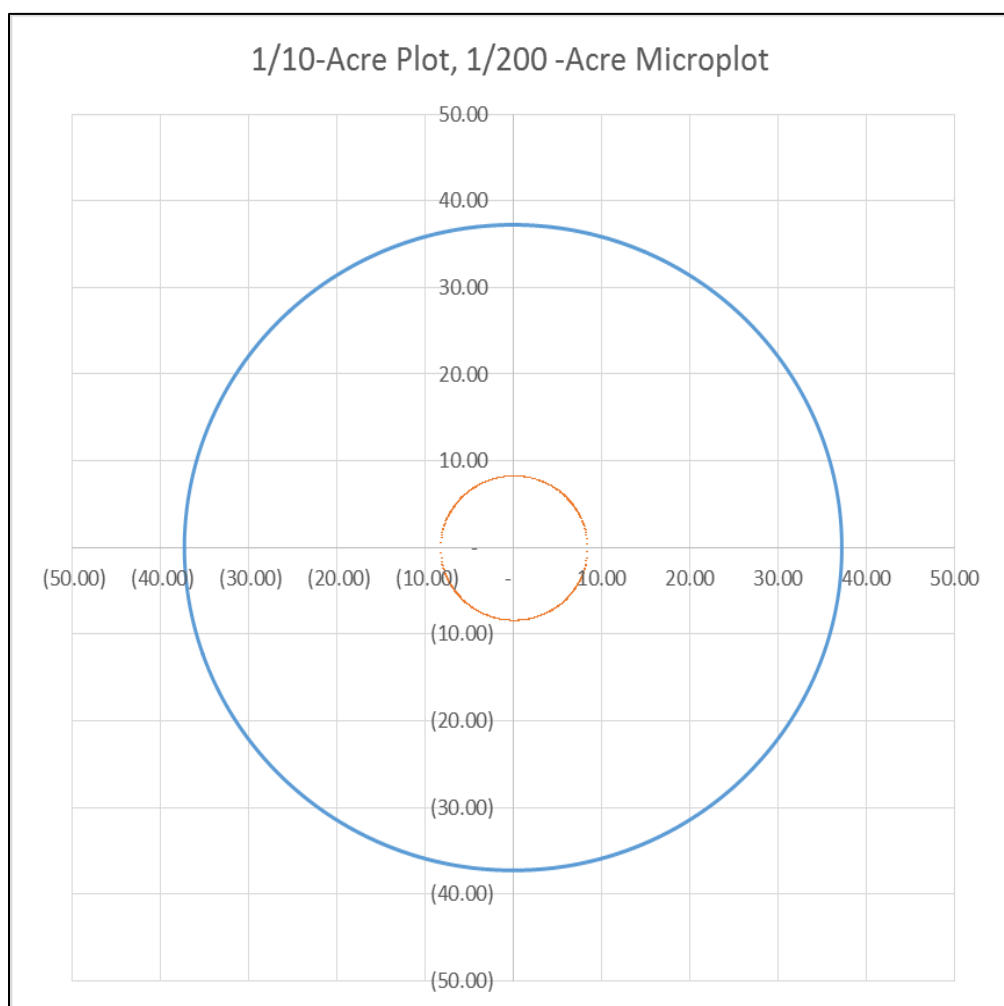


FIGURE 1. SETUP OF A STANDARD 1/10-ACRE PLOT AND A 1/200-ACRE MICROPLOT.

1.2 PLOT SETUP

Plots will be established according to the GIS analysis and plot location layout for the project, which will be finalized ahead of time in consultation with New Forests and the landowner.

OPTIONAL: A digital photo should be taken of each plot by someone at the southern plot edge facing due north. The photo should be labeled with the appropriate plot number, initials of the person taking the photo, and the date the photo was taken.

When the crew cannot occupy the plot center because safety hazards exist, or the plot center is inaccessible or out of the sample, no tree data will be collected from that plot; instead, a header sheet should be filled out that classifies the plot according to the non-sampled plot reason preventing occupancy.

If a plot was installed incorrectly at the previous visit, the current crew should remeasure the plot in its present location and contact the field supervisor. In cases where individual plots are lost (cannot be relocated), use the following procedures:

- Assign the appropriate present SAMPLE KIND Code(s) to the new plot
- Assign TREE STATUS = 0 to all downloaded trees (i.e., trees tallied at the previous survey).
- Assign RECONCILE codes 3 or 4 (i.e., missed live or missed dead) to all trees on the new plot.
- Assign the next TREE RECORD NUMBER in sequence, starting with the first tree on the new plot.

1.3 PLOT INTEGRITY

Each project crew is responsible for minimizing damage to current or prospective sample trees and the project lead, in consultation with the landowner, for specifying how these trees are monumented for re-measurement. Marking plot trees with their Tree Record Number in permanent paint is the preferred method of identifying and monumenting trees in a plot for consistent re-measurement. When using this method, trees should be marked in sequence starting with the northern most tree on the plot and proceeding clockwise. Numbers should be painted to facilitate height measurement. Decisions regarding the color of the marking paint and the location of the markings should be made with the goal of reducing confusion with other marking techniques used on the property, such as those used to mark timber harvests. Final decisions should be made in advance of commencing the inventory in consultation with the project lead and the landowner. In general, the following field procedures are permitted:

- Scribing and nailing tags on reference trees so that plot centers can be relocated.
- Boring trees for age on or near plots to determine tree age, site index, stand age, or for other reasons.
- Nailing and tagging, or painting numbers, on trees on plots so that these trees can be identified and relocated efficiently and positively at times of re-measurement.
- Nailing, scribing, or painting plot trees so that the point of diameter measurement can be accurately relocated and remeasured. Note that verifiers will NOT use this when checking plots; therefore, if the measurement mark appears inaccurate then measure from correct location (usually breast height).
- All other potentially damaging procedures that may erode plot integrity are prohibited.
- The following practices are specifically prohibited:
 - Boring and scribing some specific tree species that are known to be negatively affected (e.g., the initiation of infection or callusing).
 - Chopping vines from tally trees. When possible, vines should be pried off trunks to enable accurate measurement. If this is not possible, alternative tools (calipers, biltmore sticks) should be used.

Note: Avoid becoming part of the problem! There is a risk that field crews walking into plot locations could pick up seeds along roadsides or other patches of invasive plants and spread them through the forest and on to the plot. Be aware of the vegetation you are traveling through and consider stopping and removing seeds from boots and clothing before entering uninvaded lands, particularly remote areas that are rarely visited.

1.4 PLOT MONUMENTATION

Plot center will be marked with a piece of rebar (approximately 30") or fiber glass pole, with roughly 8 inches left above the ground. The rebar or fiberglass pole will be painted and flagged. A piece of flagging will also be tied at eye level near plot center. This flag should be marked with the plot number cruisers initials and date with a permanent marker.

Each tree on plot will be marked with an aluminum tree tag pre-numbered 1-999 nailed at the point of diameter measurement. Tree numbering should start with the first tree right of north and move around the plot clockwise. Tree numbers will be unique within each plot. Trees less than 5 inches DBH will not be tagged and will be tallied last. Nails should be placed at a slight downward angle so that the tag hangs away from the bark of the tree and is not consumed by the tree as it grows.

An orange band should be painted one foot above DBH height around designated reference trees.

1.5 LOCATING THE PLOT AND ESTABLISHING PLOT CENTER

Navigate to the plot location using a GPS unit. Move towards the plot location until the icon overlaps the plot symbol at the 30 foot zoom level.

2.0 PLOT LEVEL DATA (FIA NCFG § 1.0)

All variables listed in Section 2.0 are collected for plots with plot status 1 or 2. For plots with plot status 3, collect variables 2.1 through 2.10 only. In general, plot level data apply to the entire plot and they are recorded from the center of the plot. A plot is nonsampled if the entire plot is not sampled for one of the reasons listed in PLOT NONSAMPLED REASON.

If a forest plot has been converted to nonforest or becomes a nonsampled plot, the previous data are reconciled and an attempt is made to visit the plot during the next inventory. If a nonforest plot becomes forest or access is gained to a previously nonsampled plot, a new inventory plot is installed. All nonforest and nonsampled plots are visited if there is any reasonable chance that they might include some forest land.

Trees on previously forest land plots will be reconciled during data processing. There is a distinction between plots that have been clearcut, and plots that have been converted to another land use. A clearcut plot is considered forest land until it is actively converted to another land use.

2.1 PLOT NUMBER (FIA NCFG § 1.3)

Record the identification number, unique for each plot and assigned by the GIS analysis.

When collected: All plots

Field width: 4 digits

Values: 0001 to 9999

2.2 PLOT STATUS (FIA NCFG § 1.4)

Record the code that describes the sampling status of the plot.

- 1 Sampled – *at least one tree greater than or equal to 5" dbh on plot*
- 2 Sampled – *no trees greater than or equal to 5" dbh on plot*
- 3 Nonsampled - *entire plot is not sampled for one of the reasons listed in PLOT NONSAMPLED REASON*

When collected: All plots

Field width: 1 digit

Values:

2.3 PLOT NONSAMPLED REASON (FIA NCFG § 1.7)

For plots that cannot be sampled, record one of the following reasons.

When collected: When PLOT STATUS = 3

Field width: 2 digits

Values:

- 01 Outside project boundary – Plot center is outside of the project boundary.
- 02 Denied access – Access to the entire plot is denied by the owner of the only reasonable route to the plot. Because a denied-access plot can become accessible in the future, it remains in the sample and is re-examined at the next occasion to determine if access is available.
- 03 Hazardous – Entire plot cannot be accessed because of a hazard or danger, for example cliffs, quarries, strip mines, cannabis plantations, high water, etc. Although most hazards will not change over time, a hazardous plot remains in the sample and is re-examined at the next occasion to determine if the hazard is still present.
- 06 Lost Plot – Entire plot cannot be found. Whenever this code is assigned, a replacement plot is required. The plot that is lost is assigned SAMPLE KIND = 2 and NONSAMPLED REASON = 6. The replacement plot is assigned SAMPLE KIND = 3.
- 07 Wrong Location – Previous plot can be found, but its placement is beyond the tolerance limits for plot location. Whenever this code is assigned, a replacement plot is required. The plot being relocated is assigned SAMPLE KIND = 2 and NONSAMPLED REASON = 7. Its replacement plot is assigned SAMPLE KIND = 3.
- 09 Dropped intensified plot - Intensified plot dropped due to a change in grid density. This code is for office use only.
- 10 Other – Entire plot not sampled due to a reason other than one of the specific reasons already listed. A field note is required to describe the situation.

2.4 SAMPLE KIND (FIA NCFG § 1.10)

Record the code that describes the kind of plot being installed.

When collected: All plots

Field width: 1 digit

Values: 1 to 3

- 1 Initial plot establishment - the initial establishment and sampling of a project plot.
- 2 Remeasurement – remeasurement of a project plot that was sampled at the previous inventory.
- 3 Replacement plot - a replacement plot for a previously established plot.

2.5 FIELD GUIDE VERSION (FIA NCFG § 1.12)

Record the version number of the Forest Carbon Project Inventory Manual that was used to collect the data on this plot. FIELD GUIDE VERSION will be used to match collected data to the proper version of the field guide.

When collected: All plots

Field width: 3 digits (xx.y)

Values: 1.0 to value of this version found on cover page.

2.6 CURRENT DATE (FIA NCFG § 1.13)

Record the year, month, and day that the current plot visit was completed in the format YYYYMMDD.

When collected: All plots

Field width: 8 digits (xxxxxxxx)

2.7 DECLINATION (FIA NCFG § 1.14)

Record the azimuth correction used to adjust magnetic north to true north. All azimuths are assumed to be true azimuths unless otherwise designated. This field carries a decimal place because the USGS corrections are provided to the nearest half degree. DECLINATION is defined as:

Declination = (true north - magnetic north)

When collected: All plots

Field width: 5 digits including sign (+xxx.y)

Values: +/- 50

2.8 QA STATUS (FIA NCFG § 1.17)

Record the code to indicate the type of plot data collected.

When collected: All plots

Field width: 1 digit

Values:

- 1 Standard production plot
- 2 Check plot
- 4 Training/practice plot (off grid)

2.9 CREW INITIALS (FIA NCFG § 1.18)

Record up to 5 crew initials; always record the crew leader first.

When collected: All plots

Field Width: 500 characters

2.10 GPS

Use a global positioning system (GPS) unit to determine the location, elevation and GPS error of all field-visited plot locations. Collect a GPS waypoint at plot center using waypoint averaging. Collect readings at the plot center. Make sure the GPS units are set to feet, the position format to UTM, and the Datum to WGS 84. Name the waypoint with "pc" and the plot number. Record a GPS point for plots that are dropped for any reason other than hazard. Download GPS points to Dropbox (BBW\Inventory Projects\PineCreek_NF\PineCreek_Carbon\GPS Downloads) on a weekly basis.

2.10.1 GPS ELEVATION (FIA NCFG § 1.19.16)

Record the elevation above mean sea level of the plot center, in feet, as determined by GPS.

When collected: All sampled plots (Plot Status 1 or 2)

Field width: 4 digits (4 digits are numeric)

Values: -0000-99999

Units: Feet

2.10.2 GPS ERROR (FIA NCFG § 1.19.17)

Record the error as shown on the GPS unit to the nearest foot. make every effort to collect readings only when the error less than or equal to 50 feet. However, if after trying several different times at several different locations, this is not possible, record readings with an error of up to 999 feet.

When collected: All sampled plots (Plot Status 1 or 2)

Field width: 3 digits

Values: 000 to 999

Units: Feet

2.10.3 GPS DATUM

The GPS datum sets the coordinate system on which the map is structured. Consult the GPS unit operating manual or other regional instructions to ensure that the GPS unit internal settings, including Datum and Position Format, are correctly configured. Each GPS unit should use the WGS 84 Map Datum to collect coordinates.

When collected: All sampled plots (Plot Status 1 or 2)

Field width: 5 characters (cccn)

Values: WGS 84

Units: N/A

2.10.4 GPS POSITION FORMAT

The position format sets the format in which a location reading (coordinates) appears. The position format of a UTM coordinate system is UTM Easting, Northing, and Zone. The UTM position format is called "UTM UPS" on Garmin GPS units. Recording "UTM" on the header sheet is sufficient.

When collected: All sampled plots (Plot Status 1 or 2)

Field width: 3 characters (ccc)

Values: UTM

Units: N/A

2.11 PLOT SLOPE

Record the angle of slope across the plot to the nearest 1 percent. PLOT SLOPE is determined by sighting the clinometer along a line parallel to the average incline (or decline) of each plot. This angle is measured along the shortest pathway down slope before the drainage direction changes. To measure PLOT SLOPE, Observer 1 should stand at the uphill edge of the plot and sight Observer 2, who stands at the downhill edge of the plot. Sight Observer 2 at the same height as the eye-level of Observer 1. Read the slope directly from the percent scale of the clinometer:

- If slope changes gradually across the plot, record an average slope.
- If slope changes across the plot but the slope is predominantly of one direction, code the predominant slope percentage rather than the average.
- If the plot falls directly on or straddles a canyon bottom or narrow ridge top, code the average slope of the side hill(s).
- If the plot falls on a canyon bottom or on a narrow ridge top, but most of the area lies on one side hill, code the slope of the side hill where most of the area lies.

When collected: All sampled plots (Plot Status 1 or 2)

Field width: 3 digits

Tolerance: +/- 10%

Values: 000 to 155

2.12 PLOT ASPECT

Record the aspect across the plot, to the nearest 1 degree. PLOT ASPECT is determined along the direction of slope for land surfaces with at least 5 percent slope in a generally uniform direction. PLOT ASPECT is measured with a hand compass along the same direction used to determine slope.

- If aspect changes gradually across the plot, record an average aspect.
- If aspect changes across the plot but the aspect is predominately of one direction, code the predominate direction rather than the average.
- If the plot falls on or straddles a canyon bottom or narrow ridge top, code the aspect of the ridge line or canyon bottom.
- If the plot falls on a canyon bottom or on a narrow ridge top, but most of the area lies on one side hill, code the aspect of the side hill.

When collected: All sampled plots (Plot Status 1 or 2)

Field width: 3 digits

Tolerance: +/- 10 degrees

Values:

000	no aspect, slope < 5 percent
001	1 degree
002	2 degrees
...	
360	360 degrees, due north

2.13 PLOT NOTES (FIA NCFG § 1.21)

Use this field to record notes pertaining to the plot.

When collected: All plots

Field width: Unlimited alphanumeric character field

Values: English language words, phrases and numbers

2.14 DISTANCE TO PROJECT BOUNDARY

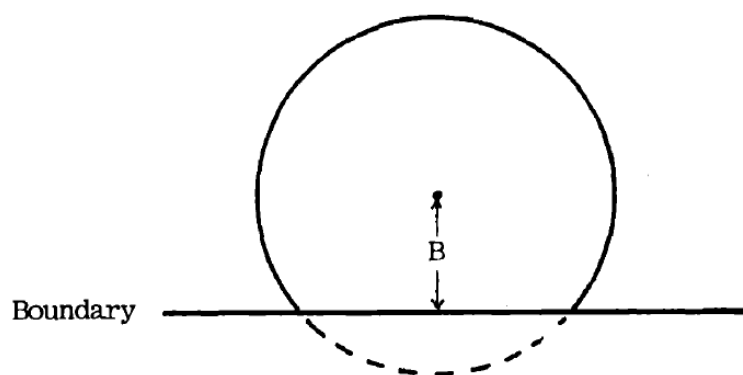
If a plot overlaps the project boundary, do not offset the plot. Boundary overlap is measured differently depending on the type of boundary and if the boundary is clearly discernable in the field. A project boundary is considered clearly discernable in the field if there are blazes, a fence, an abrupt change in vegetation, or property line markers. A project boundary is also discernible when it can be established by measuring a pre-established distance from a road or watercourse, reflecting an area that has been removed from the project.

If the project boundary is not clearly discernible in the field, the entire plot is sampled and no DISTANCE TO BOUNDARY is recorded.

Where the boundary is clearly discernable, or is established by measuring from a watercourse or road, the direct weighting method is applied (from *Practical Correction of boundary Overlap* by Beers, 1977). Measure the horizontal distance from plot center to the project boundary using tape and clinometer or laser rangefinder, and record in DISTANCE TO BOUNDARY field. The distance measurement should be taken perpendicular to the boundary. Round to the nearest 10th of a foot. Take a photograph of the boundary.

If the boundary overlap is greater than 50% (i.e., plot center is over the boundary), the plot is outside the project and the plot is not sampled (PLOT STATUS = 3, NONSAMPLED PLOT REASON = 1).

If a plot intersects a boundary with irregular geometry (e.g. the intersection of two buffered watercourses, or a corner in a property line), draw a diagram of the overlap and record which trees are outside the project area. Estimate the percentage of the plot area that is outside the project area and record in the plot notes. Do not record DISTANCE TO BOUNDARY.



Direct weighting method

THE DIRECT WEIGHTING METHOD, WHERE B IS THE DISTANCE TO BOUNDARY

When to record distance to boundary:

Project Boundaries Determined by Vegetation Change	Plot is near a mapped project area boundary which corresponds with a clearly discernible change in vegetation on the ground (e.g., forest/non-forest, distinct harvest boundary) which intersects the plot. Use the drip-line of the trees to establish the boundary.
Project Boundaries Determined by Distance to Road Centerline	Plot area overlaps the buffer of a road that has been removed from the project area because of a road easement. See plot maps for removed roads and their buffer distances. Road buffers are measured in horizontal distance from road centerline.
Project Boundaries Determined by Distance to Watercourses	Near Class I, Class II-L (Large) or Class II-S (Standard) watercourses, the project area boundary is defined by the watercourse buffer and must be measured in the field. The cruiser must determine whether the plot is in or out of the project area, or if it overlaps it, based on the measured distance to the watercourse. Refer to inventory maps for watercourse classifications (Note: watercourses labeled "Class II" are the same as "Class II-S"). The buffer is measured in slope distance from plot center to the watercourse transition line (WTL), as defined in the California Forest Practice Rules.

Use the table below to determine if the plot is within, or overlaps, the effective no-cut buffer.

Effective No-Cut Portion Of WLPZ Buffer That Is Removed From Project Area	
Class I	100 feet slope distance to WTL
Class II-L	100 feet slope distance to WTL
Class II-S	15 feet slope distance to WTL

When collected: All plots where distance to boundary is less than or equal too the plot radius

Field width: 3 digits

Values: 0 to radius of plot

Tolerance: +/- 2ft

MQO: At least 90% of the time

Units: feet

2.15 WATER PROTECTION ZONE CONDITION

Record the code that best describes the water protection condition and the distance to the mapped watercourse if less than 125 feet slope distance. Refer to inventory maps for watercourse classifications.

2.15.1 WATER PROTECTION CONDITION

Record whether the plot center falls within 125 feet of a mapped Class I, Class II-L or Class II-S watercourse or lake. This field is for tracking plots that are near the no-cut buffers.

- 0 Plot is not located within 125 feet of a Class I, Class II-L, or Class II-S watercourse
- 1 Plot is located within 125 feet of a Class I, Class II-L, or Class II-S watercourse
- 2 Not possible to determine (record reason in PLOT NOTES)

When collected: All sampled plots (Plot Status 1 or 2)

Field width: 1 digit

Tolerance: None

MQO: At least 90% of the time

Values: 0 to 2

2.15.2 DISTANCE TO WATERCOURSE

Where WATER PROTECTION CONDITION = 1 or 2, record the slope distance from the plot center to the watercourse transition line.

When collected: When WATER PROTECTION CONDITION = 1 or 2.

Field width: 3 digits

Values: 001 to 125

Tolerance: +/- 5ft

MQO: At least 90% of the time

Units: Feet

3.0 CONDITION CLASS DATA (FIA NCFG § 2.0)

3.1 FOREST TYPE (FIA NCFG § 2.5.3)

Record the code corresponding to the WHR TYPE (from Appendix 2) that best describes the species with the plurality of *stocking* for all live trees in the area visible from the plot that are not overtopped. Note: Canopy cover is used to determine whether an area is forest or nonforest. Stocking is used with other variables such as this one.

Common WHR types are summarized below.

- DFR, Douglas-fir, > 50% DF, and could have other conifers or hardwoods
- MHC, Montane hardwood conifer, >50% hardwoods and > 25% conifer
- MHW Montane hardwood, > 50% hardwood and less than 25% conifer
- VOW, valley oak woodland, > 50% valley oak and < 25% conifer
- BOW, blue oak woodland, > 50% blue oak and < 25% conifer

If STAND SIZE CLASS is nonstocked, then FOREST TYPE is determined by the following hierarchy:

- For SAMPLE KIND = 2 plots, record the FOREST TYPE of the previous inventory.
- For all other plots:
 1. Evaluate any seedlings available to determine the FOREST TYPE.
 2. If no seedlings exist, use adjacent stands and your best professional judgment to determine FOREST TYPE.

When collected: All sampled plots (Plot Status 1 or 2)

Field width: 3 digits

Values: See Appendix 2

3.2 STAND SIZE CLASS (FIA NCFG § 2.5.4)

Record the code that best describes the predominant size class of all live trees, seedlings and saplings in the area visible from the plot. Note: Canopy cover is used to determine whether an area is forest or nonforest. Stocking is used with other variables such as this one.

When collected: All sampled plots (Plot Status 1 or 2)

Field width: 1 digit

Values:

- 0 Nonstocked -less than 10 percent stocked by trees, seedlings, and saplings, and not classified as cover trees.
- 1 < 4.9 inches (seedlings / saplings)
At least 10 percent stocking (or 10 percent canopy cover if stocking standards are not available) in trees, seedlings, and saplings; and at least 2/3 of the canopy cover is in trees less than 5.0 inches DBH.
- 2 5.0 – 8.9 inches (softwoods) / 5.0 – 10.9 inches (hardwoods)

At least 10 percent stocking (or 10 percent canopy cover if stocking standards are not available) in trees, seedlings, and saplings; and at least 1/3 of the canopy cover is in trees greater than 5.0 inches DBH and the plurality of the canopy cover is in softwoods between 5.0 – 8.9 inches diameter and/or hardwoods between 5.0 – 10.9 inches DBH.

3 9.0 – 19.9 inches (softwoods) / 11.0 – 19.9 inches (hardwoods)

At least 10 percent stocking (or 10 percent canopy cover if stocking standards are not available) in trees, seedlings, and saplings; and at least 1/3 of the canopy cover is in trees greater than 5.0 inches DBH and the plurality of the canopy cover is in softwoods between 9.0 – 19.9 inches diameter and/or hardwoods between 11.0 – 19.9 inches DBH.

4 20.0 – 39.9 inches

At least 10 percent stocking (or 10 percent canopy cover if stocking standards are not available) in trees, seedlings, and saplings; and at least 1/3 of the canopy cover is in trees greater than 5.0 inches DBH and the plurality of the canopy cover is in trees between 20.0 – 39.9 inches DBH.

5 40.0 + inches

At least 10 percent stocking (or 10 percent canopy cover if stocking standards are not available) in trees, seedlings, and saplings; and at least 1/3 of the canopy cover is in trees greater than 5.0 inches DBH and the plurality of the canopy cover is in trees >40.0 inches DBH.

When using canopy cover as the surrogate for stocking to determine STAND SIZE CLASS, view the plot from the top down and examine canopy cover. The stand must have at least 10 percent of the canopy cover in STAND SIZE CLASSES of 1, 2, 3, 4, or 5 or any combination of these STAND SIZE CLASSES; otherwise the STAND SIZE CLASS is 0. If 2/3 of the canopy cover is STAND SIZE CLASS = 1, classify as STAND SIZE CLASS = 1. If less than 2/3 of the canopy cover is STAND SIZE CLASS = 1, classify as STAND SIZE CLASS = 2, 3, 4, or 5, based on which of these STAND SIZE CLASSES has the most canopy cover.

3.3 LIVE CANOPY COVER

Record the percentage of LIVE CANOPY COVER for the area visible from the plot. Include **live tally trees, saplings, and seedlings** that cover the sample area. LIVE CANOPY COVER is based on an ocular estimate. For LIVE CANOPY COVER <1 percent (trace), record 01.

When collected: All sampled plots (Plot Status 1 or 2)

Field width: 2 digits

Tolerance:

00 – 12% - No errors

13 – 20% - 10% error

21 – 100% - 25% error

MQO: At least 99% of the time

Values: 00 – 99 (where 99=99-100%)

3.4 REGENERATION STATUS (FIA NCFG § 2.5.5)

Record the code that best describes the artificial regeneration in the area visible from the plot.

When collected: All sampled plots (Plot Status 1 or 2)

Field width: 1 digit

Values:

- 0 Natural – present stand shows no clear evidence of artificial regeneration. Includes unplanted, recently cut lands
- 1 Artificial – present stand shows clear evidence of artificial regeneration

For an area to be classified as artificially regenerated, it must show distinct evidence of planting or seeding. If it is difficult to determine if a stand has been planted or seeded, then use code 0.

Note: Plot records or verbal evidence from landowner is acceptable for determining regeneration status.

3.4.1 ARTIFICIAL REGENERATION SPECIES

Record the species code of the predominant tree species for which evidence exists of artificial regeneration.

When collected: All sampled plots (Plot Status 1 or 2) with evidence of artificial regeneration (REGENERATION STATUS = 1)

Field width: 3 digits

Values: See Appendix 3

3.5 DISTURBANCE 1

Record the code corresponding to the presence of the following disturbances. Disturbance can connote positive or negative effects. The area affected by any natural or human-caused disturbance must be at least 1.0 acre in size. Record up to three different disturbances from most important to least important.

For initial plot establishment (SAMPLE KIND =1 or 3), the disturbance must be within the last 5 years. For remeasured plots (SAMPLE KIND =2) recognize only those disturbances that have occurred since the previous inventory.

Disturbance codes require "significant threshold" damage, which implies mortality and/or damage to 25 percent of all trees in a stand or 50 percent of an individual species' count. Additionally, some disturbances affect land and/or vegetation, but initially may not affect vegetation growth or health (e.g., grazing, browsing, flooding, etc.). In these cases, a disturbance should be coded when at least 25 percent of the soil surface or understory vegetation has been affected.

When collected: All sampled plots (Plot Status 1 or 2)

Field width: 2 digits

Values:

- 00 None - no observable disturbance
- 10 Insect damage
- 11 Insect damage to understory vegetation
- 12 Insect damage to trees, including seedlings and saplings

- 20 Disease damage
- 21 Disease damage to understory vegetation
- 22 Disease damage to trees, including seedlings and saplings
- 30 Fire (from crown and ground fire, either prescribed or natural)
- 31 Ground fire
- 32 Crown fire
- 40 Animal damage
- 41 Beaver (includes flooding caused by beaver)
- 42 Porcupine
- 43 Deer/ungulate
- 44 Bear
- 45 Rabbit
- 46 Domestic animal/livestock (includes grazing)
- 50 Weather damage
- 51 Ice
- 52 Wind (includes hurricane, tornado)
- 53 Flooding (weather induced)
- 54 Drought
- 60 Vegetation (suppression, competition, vines)
- 70 Unknown/not sure/other (include in NOTES)
- 80 Human-caused damage – any significant threshold of human-caused damage not described in the DISTURBANCE codes listed or in the TREATMENT codes listed. Must include a note to describe further.
- 90 Geologic disturbances
- 91 Landslide
- 92 Avalanche track
- 93 Volcanic blast zone
- 94 Other geologic event
- 95 Earth movement/avalanches

3.5.1 DISTURBANCE YEAR 1

Record the year in which DISTURBANCE 1 occurred. If the disturbance occurs continuously over a period of time, record 9999.

When collected: When DISTURBANCE 1 > 00

Field width: 4 digits

Tolerance: +/- 1 year for measurement cycles of 5 years, +/- 2 years for measurement cycles of > 5 years

Values: Since the previous plot visit, or the past 5 years for plots visited for the first time; 9999

3.5.2 DISTURBANCE 2

Record the second disturbance here. See DISTURBANCE 1 for coding instructions.

3.5.3 DISTURBANCE YEAR 2

Record the year in which DISTURBANCE 2 occurred. See DISTURBANCE YEAR 1 for coding instructions.

3.6 TREATMENT 1

Forestry treatments are a form of disturbance. These human disturbances are recorded separately here for ease of coding and analysis. The term treatment further implies that a silvicultural prescription has been applied. This does not include occasional stumps of unknown origin or sparse removals for firewood, Christmas trees, or other miscellaneous purposes. The area affected by any treatment must be at least 1.0 acre in size. Record up to three different treatments from most important to least important as best as can be determined.

For initial plot establishment (SAMPLE KIND = 1 or 3), the treatment must be within the last 5 years. For remeasured plots (SAMPLE KIND = 2) recognize only those treatments that have occurred since the previous inventory.

When collected: All sampled plots (Plot Status 1 or 2)

Field width: 2 digits

Values:

- 00 None - No observable treatment.
- 10 Cutting - The removal of one or more trees from a stand.
- 20 Site preparation - Clearing, slash burning, chopping, disking, bedding, or other practices clearly intended to prepare a site for either natural or artificial regeneration.
- 30 Artificial regeneration - Following a disturbance or treatment (usually cutting), a new stand where at least 50% of the live trees present resulted from planting or direct seeding.
- 40 Natural regeneration - Following a disturbance or treatment (usually cutting), a new stand where at least 50% of the live trees present (of any size) were established through the growth of existing trees and/or natural seeding or sprouting.
- 50 Other silvicultural treatment - The use of fertilizers, herbicides, girdling, pruning, or other activities (not covered by codes 10-40) designed to improve the commercial value of the residual stand, or chaining, which is a practice used on woodlands to encourage wildlife forage.

3.6.1 TREATMENT YEAR 1

Record the year in which TREATMENT 1 occurred.

When collected: When TREATMENT 1 > 00

Field width: 4 digits

Tolerance: +/- 1 year for measurement cycles of 5 years

+/- 2 years for measurement cycles of > 5 years

Values: Since the previous plot visit, or the past 5 years for plots visited for the first time; 9999

3.6.2 TREATMENT 2

If a stand has experienced more than one treatment, record the second treatment here. See TREATMENT 1 for coding instructions; code 00 if none.

3.6.3 TREATMENT YEAR 2

Record the year in which TREATMENT 2 occurred. See TREATMENT YEAR 1 for coding instructions.

Record the year in which TREATMENT 3 occurred. See TREATMENT YEAR 1 for coding instructions.

4.0 REFERENCE TREE DATA

Select three live tally trees ≥ 5.0 in DBH per plot to serve as reference trees. Reference trees should appear healthy and relatively free of defect. Reference trees should be evenly spaced around plot center at least 90 degrees apart from one another. Reference trees will be marked with a nail, a metal tag or paint, as determined in consultation with the project lead and landowner. Only record azimuth and slope distance from plot center for reference trees. Do not record azimuth and distance for other tally trees on the plot that are not selected as reference trees. During plot re-measurement, if a plot center cannot be relocated, cruisers will use the azimuths and distances to reference trees to relocate plot center.

Record Tag # of reference tree

When Collected: Select live tally trees ≥ 5.0 in DBH

Field width: 3 digit

Values: 3 digit tree tag number

4.1 AZIMUTH

Record the AZIMUTH from the plot center, sight the center of the base of each reference tree with a compass. Record AZIMUTH to the nearest degree. Use 360 for north.

When Collected: Three reference trees per plot

Field width: 3 digits

Tolerance: ± 10 degrees

Values: 001 to 360

4.2 SLOPE DISTANCE

Record the measured SLOPE DISTANCE, to the nearest 0.1 foot, from the plot center to the reference tree nail.

When Collected: Three reference trees per plot

Field width: 3 digits (xx.y)

Tolerance:

Plot: ± 0.1 ft from 0.1 to 23.0 ft

Plot: ± 0.2 ft >23.1 ft

5.0 TREE AND SAPLING DATA (FIA NCFG § 5.0)

Trees at least 5.0 inches in diameter are sampled within the plot. ‘Tally trees’ are defined as all live and standing dead trees encountered on the plot the first time a plot is established, and all trees that grow into a plot thereafter. These data yield information on tree volume, growth, mortality, and removals; forest structure and composition; and carbon sequestration.

Trees with a diameter at least 1.0 inch but less than 5.0 inches, termed saplings, are sampled within the microplot. ‘Tally saplings’ are defined as all live saplings encountered the first time a microplot is established, and all saplings that grow into each microplot thereafter are included until they grow to 5.0 inches or larger, at which time they are tallied on the plot.

Trees are alive if they have any living parts (leaves, buds, cambium) at or above the point of diameter measurement. Trees that have been temporarily defoliated are still alive.

Once tallied, dead trees 5.0 inches and greater in diameter are tracked until they no longer qualify as standing dead. Working around dead trees is a safety hazard - *crews should exercise extreme caution!* Trees that are deemed unsafe to measure should be estimated ocularly.

To qualify as a standing dead tally tree, dead trees must be ≥ 5.0 inches in diameter, have a bole which has an unbroken TRUNCATED LENGTH of at least 15.0 feet, and lean less than 45 degrees from vertical.

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

The following apply at re-measurement:

- If at the previous visit a forked tree was recorded as two separate trees but should have been recorded as one tree, give one of the tree data lines a PRESENT TREE STATUS = 0, RECONCILE = 7 or 8, and a TREE NOTE. The remaining tree data line receives PRESENT TREE STATUS = 1 or 2 with DIAMETER CHECK = 2, and a TREE NOTE.
- If at the previous visit a forked tree was recorded as one tree but should have been recorded as two separate trees, correct the diameter for the remeasured tree to represent one tree, and add the other fork as a missed tree. Use the existing tree data line to represent one of the stems. PRESENT TREE STATUS = 1 or 2, DIAMETER CHECK = 2, and a TREE NOTE. The second stem would get PRESENT TREE STATUS = 1 or 2, RECONCILE 3 or 4, and a TREE NOTE.

Begin tallying trees at an azimuth of 001 degrees from plot center and continue clockwise around the plot. Repeat this sequence for trees on the microplot. Do not tag saplings.

5.1 TAG NUMBER (FIA NCF § 5.2)

Record a code to uniquely and permanently identify each tree on a given plot. The TAG NUMBERS must be unique within a plot – being unique is more important than being sequential. Tag the tree at the point where diameter was measured. In general, work clockwise from azimuth 001 to 360, and work outwards from plot center to plot perimeter. On remeasured plots, use the previously assigned tag number. Missed trees and ingrowth trees (trees that either grew over

the 1.0-inch threshold on the microplot or grew onto the plot) will be assigned the next available tree number. DO NOT renumber all plot trees in order to assign a more “correct” tag number to a missed tree. Numbers assigned to trees that are subsequently found to be extra will be dropped and not reused. Record TAG NUMBER for tally trees and leave the tag number column blank for micro plot trees. Record tally trees first, then microplot trees.

When Collected: All standing live tally trees ≥ 5.0 in DBH in standard plot. All standing dead tally trees ≥ 5.0 in DBH and ≥ 15.0 ft. tall in standard plot.

Field width: 4 digits

Values: 001 to 1000

5.2 PRESENT TREE STATUS (FIA NCF § 5.7 & 5.7.2)

Record a current PRESENT TREE STATUS for each tallied tree; this code is used to track the status of sample trees over time: as they first appear, as ingrowth, as they survive, and when they die or are removed. This information is needed to correctly assign the tree’s volume to the proper component of volume change.

- 0 No status – tree is not presently in the sample (re-measurement plots only). Tree was incorrectly tallied at the previous inventory, currently is not tallied due to definition or procedural change, or is not tallied due to natural causes. Requires RECONCILE code = 5-9.
- 1 Live tree – any standing live tree (new, remeasured or ingrowth)
- 2 Dead tree – any standing dead tree (new, remeasured, or ingrowth), regardless of cause of death.
- 3 Removed – a tree that has been cut and removed by direct human activity related to harvesting, silviculture or land clearing (re-measurement plots only). The tree is assumed to have been utilized.

To qualify as a standing dead tally tree, *dead trees must be at least 5.0 inches in diameter at the point of diameter measurement, have a bole which has an unbroken TRUNCATED LENGTH of at least 15.0 feet, and lean less than 45 degrees from vertical as measured from the base of the tree to the point of diameter measurement.* See Figure 5 below for example.

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.

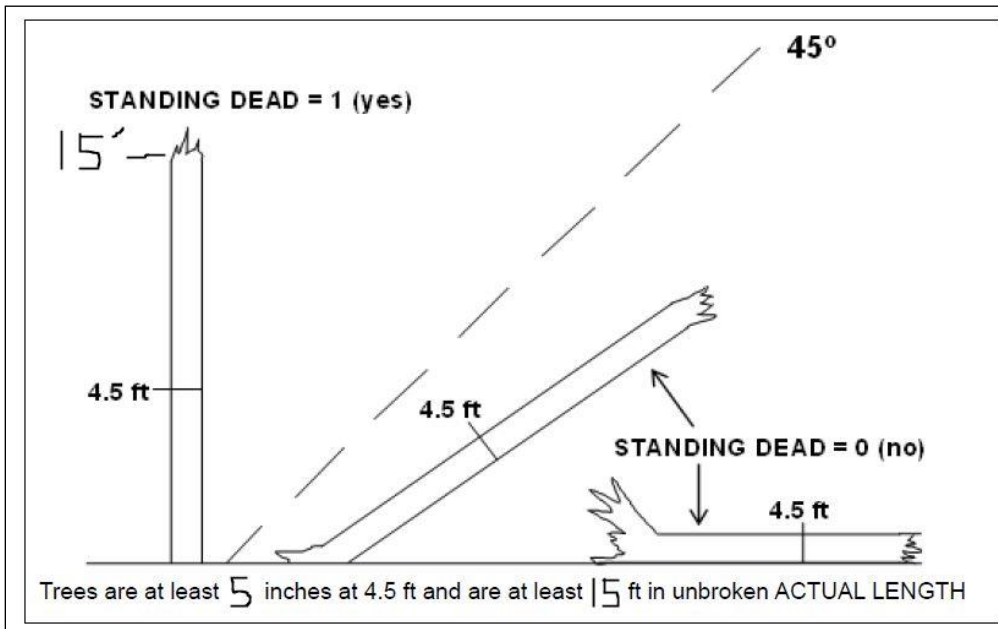


Figure 5. Standing dead examples, modified from FIA manual.

When Collected: All new live tally trees ≥ 1.0 in DBH, All new dead tally trees ≥ 5.0 in, On re-measurement plots, all previously tallied trees

Field width: 1 digit

Values: 0 to 3

Tolerance: No errors

5.3 SPECIES (FIA NCF § 5.8)

Record the appropriate SPECIES code from the list in Appendix 3. If the species cannot be determined in the field, tally the tree, but bring branch samples, foliage, cones, flowers, bark, etc. to the supervisor for identification. If possible, collect samples outside the plots from similar specimens and make a note to correct the SPECIES code later. Use code 0299 for unknown dead conifer, 0998 for unknown dead hardwood when the genus or species codes cannot be used, and 0999 for other or unknown live tree. The generic code should only be used when you are sure the species is on the species list, but you cannot differentiate among acceptable species. This is often the case with standing dead trees on newly established plots. In this case use the sample collections procedures described earlier in this paragraph. The species code list in Appendix 3 includes all tree species tallied in the Continental U.S., Alaska, and the Caribbean.

Species designated East/West are commonly found in those regions, although species designated for one region may occasionally be found in another.

When Collected: All trees

Field width: 4 digits

Values: See Appendix 3

MQO: At least 99% of the time for genus, At least 95% of the time for species

Tolerance: No errors

Common FIA Western Tree Species Codes

CODE	COMMON NAME	GENUS	SPECIES
15	white fir	Abies	concolor
17	grand fir	Abies	grandis
20	California/Shasta red fir	Abies	magnifica
312	bigleaf maple	Acer	macrophyllum
333	California buckeye	Aesculus	californica
351	red alder	Alnus	rubra
352	white alder	Alnus	rhombifolia
361	Pacific madrone	Arbutus	menziesii
431	golden chinkapin	Castanopsis	chrysophylla
41	Port-Orford-cedar	Chamaecyparis	lawsoniana
492	Pacific dogwood	Cornus	nuttallii
510	eucalyptus	Eucalyptus	sp.
542	Oregon ash	Fraxinus	latifolia
81	incense-cedar	Calocedrus	decurrens
631	tanoak	Notholithocarpus	densiflorus
98	Sitka spruce	Picea	sitchensis
103	knobcone pine	Pinus	attenuata
116	Jeffrey pine	Pinus	jeffreyi
117	Sugar pine	Pinus	lambertiana
122	ponderosa pine	Pinus	ponderosa
124	monterey pine	Pinus	radiata
127	ghost pine, gray pine	Pinus	sabiniana
747	black cottonwood	Populus	trichocarpa
202	Douglas-fir	Pseudotsuga	menziesii
801	coastal live oak, California live oak	Quercus	agrifolia
805	canyon live oak	Quercus	chrysolepsis
807	blue oak	Quercus	douglassi
815	Oregon white oak	Quercus	garryana
818	California black oak	Quercus	kelloggii
821	valley oak, California white oak	Quercus	lobata
839	interior live oak	Quercus	wislizenii
920	willow	Salix	sp.
211	redwood	Sequoia	sempervirens
231	Pacific yew	Taxus	brevifolia
242	western redcedar	Thuja	plicata
251	Nutmeg	Torreya	Californica
263	western hemlock	Tsuga	heterophylla
981	California bay laurel	Umbellularia	californica

5.4 DIAMETER (FIA NCF § 5.9)

Diameters are measured at breast height (DBH). Trees with diameters between 1.0- and 4.9-inches are measured on the microplot, those with diameters of 5.0-inches and larger are measured on the 20th acre plot.

In order to accurately remeasure diameter at the same point on the tree bole at successive visits, projects have the option of measuring and recording the distance from the ground to the point of diameter measurement (if other than 4.5 ft), or marking the point of measurement with a scribe, crayon, paint, or aluminum nail. When marking trees for the first time, measure the diameter after the mark is in place. Use caution to avoid damaging trees with scribes and nails. Do not scribe, tag or nail trees less than 5.0-inches in diameter, or species vulnerable to introduction of pathogens (e.g., aspen). Do not penetrate the cambium when using a bark scribe.

Pull the diameter tape tight, but not so tight that it squeezes the bark.

When remeasuring the diameter of a tree tallied at a previous survey, always take the measurement at the location monumented by the previous crew unless it is not physically possible (e.g., tree buried by mudslide), there is an abnormality at the previous DIAMETER measurement point, or the previous location is more than 12 inches beyond where the diameter should be measured according to current protocols (either because protocols have changed or the previous crew made a mistake). Assign a DIAMETER CHECK code of 2 whenever the point of measurement is moved.

When Collected: All live tally trees > 1.0 in DBH and standing dead tally trees > 5.0 in DBH

Field width: 4 digits (xx.y) record leading 0 for trees < 10"

MQO: At least 95% of the time.

Tolerance: Live trees and dead trees with DECAY CLASS 1, 2: +/- 0.1 inch per 10.0 inch increment of measured diameter up to 40 inches DBH. >40 inches DBH, +/- 1.0 inch. Standing dead trees with DECAY CLASS 3, 4, 5; +/- 1.0 inch per 20.0 inch increment of measured diameter.

Values: 001.0 to 999.9

5.4.1 DIAMETER AT BREAST HEIGHT (DBH) (FIA NCF § 5.9.2)

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:

- 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 below 1.0 foot are treated as distinctly separate trees (fig. 23). 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 microplot or 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 (fig. 26-E), the rules in the next paragraph apply.

- **Trees forked between 1.0 foot and 4.5 feet.** Trees forked between 1.0 foot and 4.5 feet are also counted as separate trees (see figure), 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 point for all forks--they are either all on, or all off the plot.

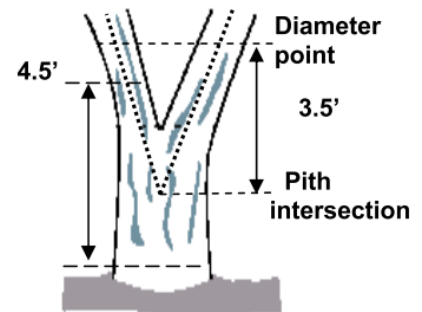


Figure 24. Forked between 1.0-4.5 ft.

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 just below the base of stem separation as shown in figure 26-E (i.e., do not move the point of diameter the entire 3.5 feet above the first fork).

If the cruiser cannot reach 3.5 above the fork, measure DBH at the highest point that can be reached.

- **Trees forked at or above 4.5 feet.** Trees forked at or above 4.5 feet count as one single tree (fig. 25). If a fork occurs at or immediately above 4.5 feet, measure diameter below the fork just beneath any swelling that would inflate DBH.

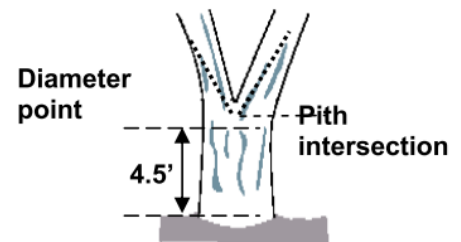


Figure 25. One tree.

- **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 feet above their point of occurrence.

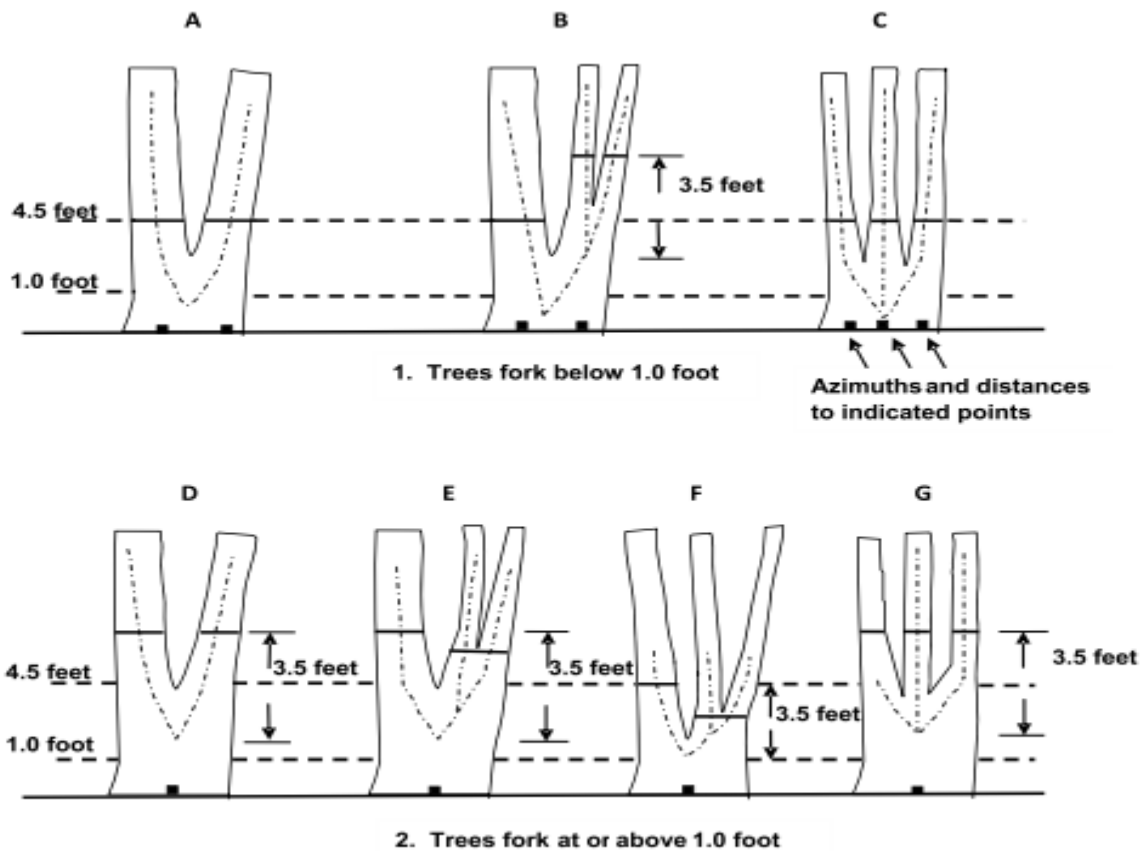


Figure 26. Summary of where to measure DBH, distance, and azimuth on forked trees.

Tree with butt-swell or bottleneck: Measure these trees 1.5 feet above the end of the swell or bottleneck if the swell or bottle neck extends 3.0 feet or more above the ground (fig. 27).

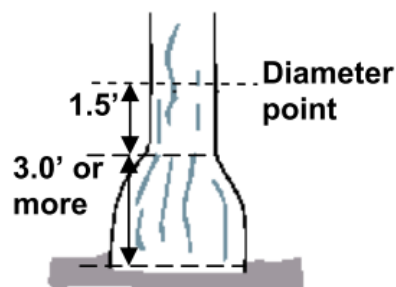


Figure 27. Bottleneck tree.

Tree with irregularities at DBH: On trees with swellings (fig. 28), bumps, and branches (fig. 29), or other irregularities at DBH that inflate the diameter if the tree, diameter will be measured in order to most accurately represent DBH.

Generally, this will be immediately above the irregularity at the place it ceases to affect normal stem form. When measuring immediately above the irregularity is not feasible (e.g., too high to reach on the trunk) or does not accurately represent DBH, DBH may be measured below the irregularity. Cat-faces and depressions do not count as irregularities. If raising the diameter above the irregularity makes the tree's diameter too small to qualify as a tally tree, paint a stripe at the point of measurement and do not tag or record the tree.

Where DBH is obstructed (e.g., a fallen trunk leaning against the tree), tag the tree as close to DBH as possible and use a Biltmore stick or other method to estimate diameter.

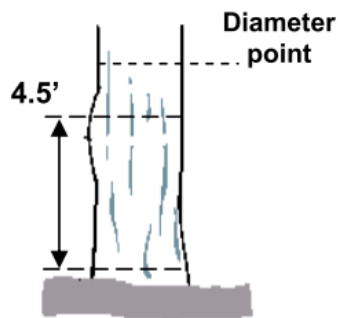


Figure 28. Tree with swelling.

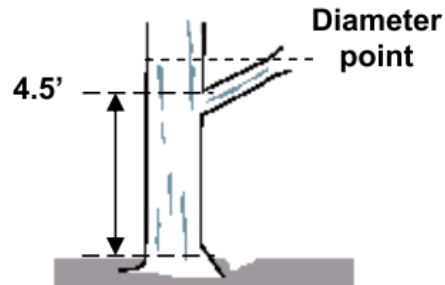


Figure 29. Tree with branch.

Tree on slope: Measure diameter at 4.5 feet from the ground along the bole on the uphill side of the tree (fig. 30).

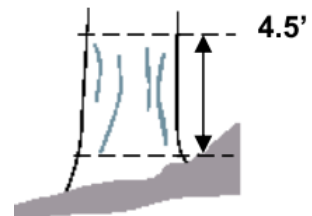


Figure 30. Tree on a slope.

Leaning tree on flat ground: 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 (fig. 31).

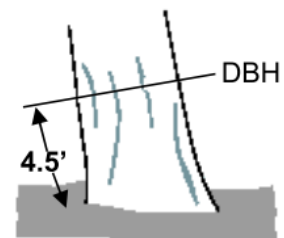


Figure 31. Leaning tree.

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. Set the “DIAMETER CHECK” code to 1, Estimate the diameter of each and explain the situation in the notes.

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 (fig. 32).

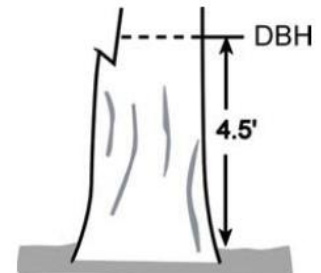


Figure 32. Tree with part of stem missing.

Live windthrown tree: Measure from the top of the root collar along the length to 4.5 feet (fig. 33).

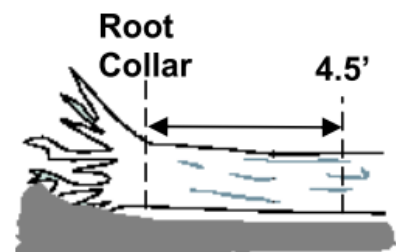


Figure 33. Tree on the ground.

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.

- 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 (fig. 34).
- 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 feet above the pith intersection for both the main bole and the tree-like branch.

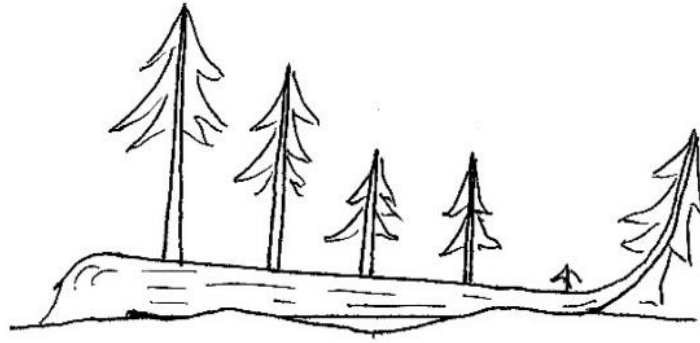


Figure 34. Down tree above duff.

- If the intersection between the main down bole and the tree-like branch occurs beyond the 4.5 feet 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 (fig. 35). 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.

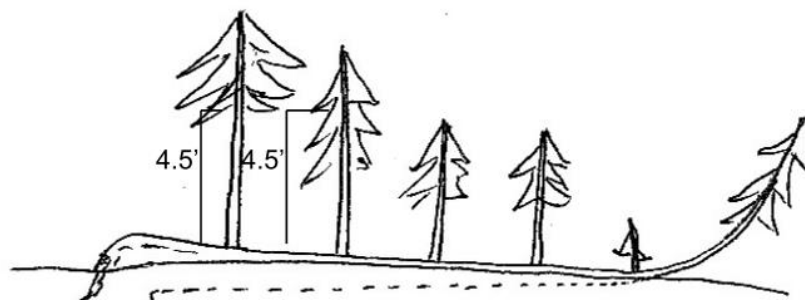


Figure 35. Down tree below duff.

Tree with curved bole (pistol butt tree): Measure along the bole on the uphill side (upper surface) of the tree (fig. 36).

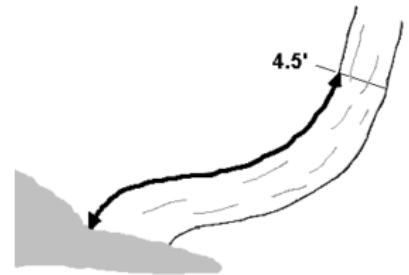


Figure 36. Tree with curved bole (pistol butt tree).

5.5 TOTAL LENGTH (FIA NCF § 5.14)

TOTAL LENGTH is the total length of the bole, recorded to the nearest 1.0 foot from the base of the tree to the tip of the apical meristem. If the tree has a detached top, the total length is an estimate of what the length would be if the tree was not broken. For trees with broken, but still attached full-length tops, total length is simply the sum of each piece of the bole, above and below the break. For all other broken top tree scenarios, the total length must be estimated. Forked trees should be treated the same as unforked trees. Total length is always recorded, even for trees where TRUNCATED LENGTH is also recorded.

The goal of the inventory is to record tree length measurements that reflects the actual length of the bole. However, due to terrain, brush etc, it is not always efficient or practical to adjust every tree height where height $\neq$ length. The most desirable scenario is when TOTAL LENGTH is measured with a laser and any lean >15 degrees is corrected for using trigonometry, slope correction, or the missing line function on the laser. This scenario is especially preferred for trees over 14" DBH. Alternatively, TOTAL length can be measured with the laser's Vertical Distance or HD HT function, measured in sections, or estimated entirely. This second scenario is considered a last resort for trees >14 " DBH and acceptable for trees <14 " DBH, particularly if similar sized trees on the plot have already been measured accurately with an instrument.

For trees where the tip is lower than a point along the bole ("U" shape) or other severely curved shape, estimate the length of the tree and record a length method of 3.

When using the laser's height routine function, stand far enough away from the tree such that the angle to the top of the tree is < 45 degrees.

Uncommon species should always be measured with an instrument. A species is deemed to be uncommon if it occurs on fewer than 10 percent of plots (1 in 10 plots).

When Collected: All live tally trees > 1.0 in DBH and all standing dead tally trees > 5.0 in DBH.

Field width: 3 digits

Tolerance: $\pm 10\%$ of true length

MQO: At least 90% of the time

Values: 005 to 400

5.6 TRUNCATED LENGTH (FIA NCF § 5.15)

The truncated length of the bole is the distance between the base of the tree and the point where the top is broken. The truncated length may or may not be recorded depending on if the tree is live, standing dead, and how much of the top is still attached.

Live trees	Top completely detached 	record the bole length to the break in TRUNCATED LENGTH
	Top broken, but still attached (1-100% attached) 	leave TRUNCATED LENGTH blank
Standing dead trees	Top completely detached 	record the bole length to the break in TRUNCATED LENGTH
	Top broken, mostly attached (50% to 100% attached) 	leave TRUNCATED LENGTH blank
	Top broken, mostly detached (1% to 49% attached) 	record the bole length to the break in TRUNCATED LENGTH

In addition, always record TOTAL LENGTH, even for trees where TRUNCATED LENGTH is recorded.

Trees with detached tops are considered recovered when a new leader (dead or alive) is 1/3 the diameter of the broken top at the point where the top was broken (not where the new leader originates from the trunk).

When Collected: All live tally trees with detached tops >1.0 in DBH and standing dead tally trees with detached tops > 5.0 in DBH

Field width: 3 digits

Tolerance: +/- 10% of true length

MQO: At least 90% of the time

Values: 005 to 400

5.6.1 DIAMETER INSIDE BARK AT BREAK

Record an estimate of diameter inside bark at break for trees where TRUNCATED LENGTH is recorded. This provides more options for the data analysis.

When collected: All where TRUNCATED LENGTH is recorded

Field width: 2 digits

Values: 00 to 99

5.7 LENGTH METHOD (FIA NCF § 5.16)

Record the code that indicates the method used to determine tree lengths.

When Collected: All live tally trees > 1.0 in DBH and all standing dead tally trees > 5.0 in DBH

Field width: 1 digit

Values:

- 1 Total and/or truncated lengths are field measured with a measurement instrument (e.g., clinometer, laser rangefinder, relascope, tape).
- 2 Total length is visually estimated, truncated length is measured with an instrument.
- 3 Total or truncated length is visually estimated.

5.8 CROWN CLASS (FIA NCF § 5.17)

Rate tree crowns in relation to the sunlight received and proximity to neighboring trees (fig. 38). Base the assessment on the position of the crown at the time of observation. Example: a formerly overtopped tree that is now dominant due to tree removal is classified as dominant. Crown classifications are easily applied in even-aged stands. Classifications are more difficult to assign in uneven-aged stands or in plots where more than one age/size class is present. In these situations, classify the tree based on its immediate environment. In other words, base your classification on how much light the tree's crown is receiving, not its position in the canopy. This data item is used to predict tree growth. The intermediate and overtopped crown classes are meant to include trees seriously affected by direct competition with adjacent trees.

Crown class describes a tree's "social" position in the stand and may indicate how well the tree is competing for light. For example, a young, vigorous tree that is considerably shorter than other trees in the stand – but that is not overtopped by other trees and that receives full light from above and partly from the side – is classified as dominant. The same principle applies to two-storied stands: understory trees should only be assigned subordinate crown classes if they are adjacent to overtopping trees. In plots with scattered residual overstory trees over younger trees, a considerable portion of the understory trees will be classified as dominant or codominant.

When Collected: All live tally trees > 1.0 in DBH

Field width: 1 digit

Values:

- 1 **Open Grown** – trees with crowns that received full light from above and from all sides throughout most of its life, particularly during its early developmental period.
- 2 **Dominant** – trees with crown extending above the general level of the crown canopy and receiving full light from above and partly from the sides. These trees are taller than the average trees in the stand and their crowns are well developed, but they could be somewhat crowded on the sides. Also, trees whose crowns have received full light from above and from all sides during early development and most of their life. Their crown form or shape appears to be free of influence from neighboring trees.
- 3 **Co-dominant** – trees with crowns at the general level of the crown canopy. Crowns receive full light from above but little direct sunlight penetrates their sides. Usually they have medium-sized crowns and are somewhat crowded from the sides. In stagnated stands, co-dominant trees have small-sized crowns and are crowded on the sides.
- 4 **Intermediate** – trees that are shorter than dominants and co-dominant, but their crowns extend into the canopy of co-dominant and dominant trees. They receive little direct light from above and none from the sides. As a result, intermediate trees usually have small crowns and are very crowded from the sides.
- 5 **Overtopped** – trees with crowns entirely below the general level of the crown canopy that receive no direct sunlight either from above or the sides.

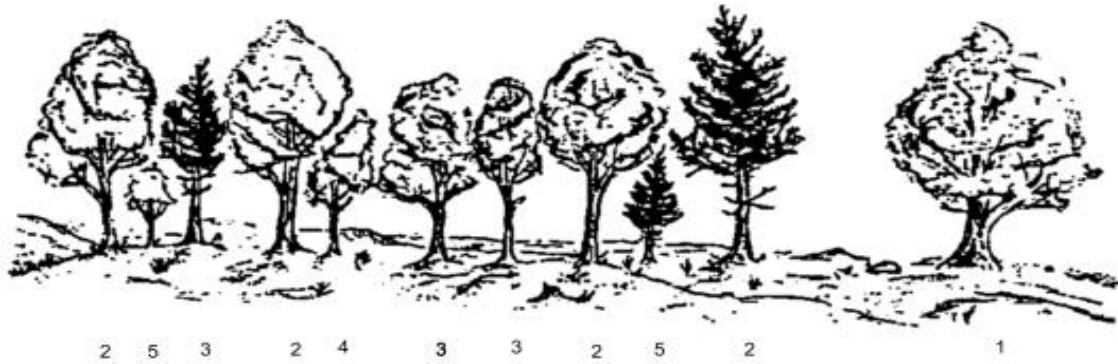


Figure 38. Examples of CROWN CLASS code definitions (numbers are the CROWN CLASS codes).

5.9 COMPACTED CROWN RATIO (FIA NCF § 5.18)

Record the COMPACTED CROWN RATIO for each live tally tree, 1.0 inch and larger, to the nearest one percent. COMPACTED CROWN RATIO is that portion of the tree supporting live foliage (or in the case of extreme defoliation should be supporting live foliage) and is expressed as a percentage of current tree length. To determine COMPACTED CROWN RATIO, ocularly transfer lower live branches to fill in large holes in the upper portion of the tree until a full, even crown is visualized.

Do not over-compact trees beyond their typical full crown situation. For example, if tree branches tend to average 2 feet between whorls, do not compact crowns any tighter than the 2-foot spacing (fig. 41). Figure 42 shows an example of COMPACTED CROWN RATIO on a leaning tree.

When Collected: All live tally trees > 1.0 in DBH

Field width: 2 digits

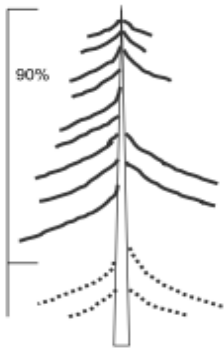
Tolerance: +/- 10%

MQO: At least 80% of the time

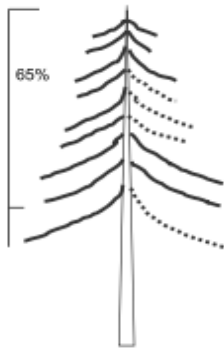
Values: 00 to 99

Open-crown conifer (e.g., ponderosa pine) –

Uncompacted:

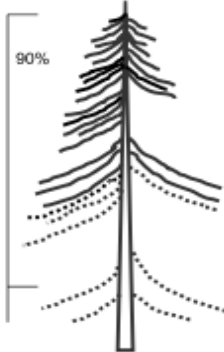


Compacted:



Dense-crown conifer (e.g., subalpine fir) –

Uncompacted:



Compacted:

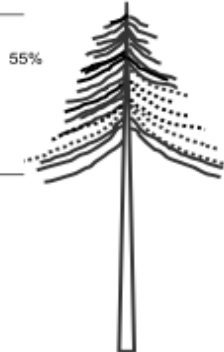
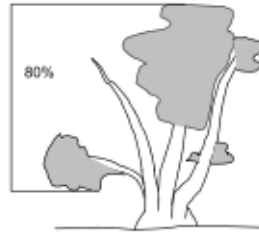


Figure 41. Examples of and comparison between COMPACTED CROWN RATIO and UNCOMPACTED LIVE CROWN RATIO of conifers.

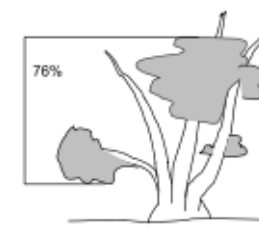
Uncompacted:



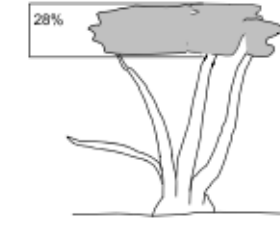
Compacted:



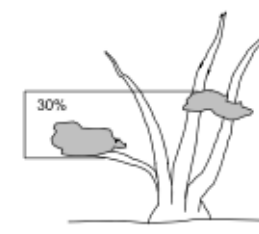
Uncompacted:



Compacted:



Uncompacted:



Compacted:

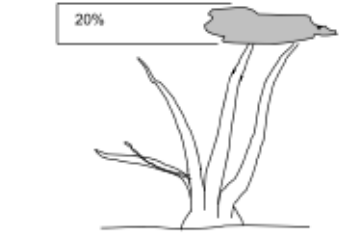


Figure 43. Examples of and comparison between COMPACTED CROWN RATIO and UNCOMPACTED LIVE CROWN RATIO of woodland species.

Sapling Crown Ratio

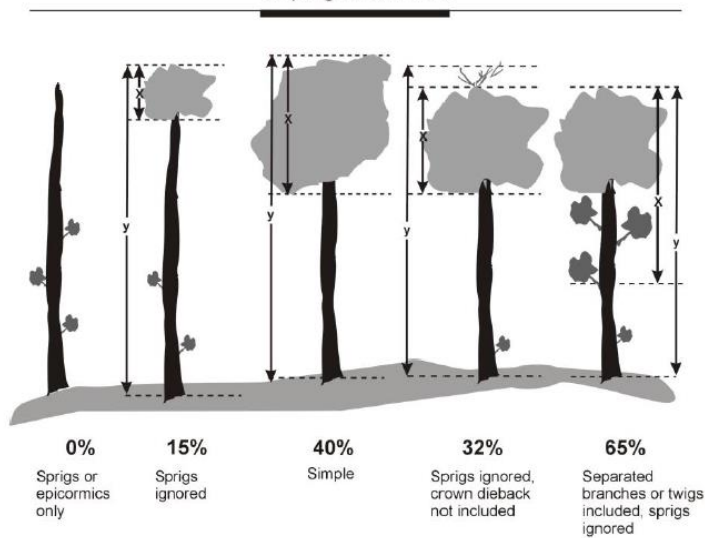


Figure 40. Sapling ratio determination examples.

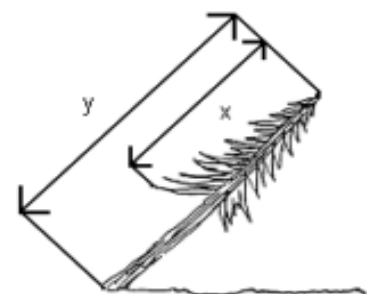


Figure 42. COMPACTED CROWN RATIO on a leaning tree. CROWN RATIO = $(x/y)100$.

5.10 TREE DAMAGE (FIA NCF § 5.20)

5.10.1 CUBIC FOOT % MISSING (FIA NCF § 5.13)

Record the percentage of *missing* wood in cubic-feet for all live and standing dead tally trees greater than or equal to 5.0 inches DBH.

Record to the nearest 5 percent. When estimating volume loss only consider missing wood on the bole of the tree. Do not include missing wood above TRUNCATED LENGTH in the cubic foot defect estimate.

When Collected: All live and standing dead tally trees ≥ 5.0 in DBH

Field width: 2 digits

Tolerance: +/- 10%

Values: 00 to 99

Units: percent cubic feet

5.10.2 BOARD FOOT DEFECT %

Record the percent of board-foot defect for tree stems greater than 10 inches DBH to a 6 inch top diameter that is defective (sweep, deformities, conks, etc.) and will not produce sawtimber. Minimum segment 16 feet. Do not include missing wood above TRUNCATED LENGTH in the board foot defect estimate. Only record for conifer species.

- Follow defect standards in the US Forest Service Timber Cruise Book (FSH 2409.12, R5-2400-28A)
- Trees that were open grown and have branch stubs 6 inches in diameter in the first two logs should be considered all defect.

3-digit Damage Code	Common Name
000 or Blank	No damage
BKT	Broken Top
ROT	Stem Rot
CNK	Conks
SWP	Sweep
DEF	Deformity
OTR	Other – please describe in NOTES

5.11 CAUSE OF DEATH (FIA NCF § 5.21)

Record a cause of death for all trees that have died or been cut since the previous survey – **only on remeasurement plots**. If cause of death cannot be reliably estimated, record unknown/not sure/other.

When Collected: SAMPLE KIND = 2 plots: all PREVIOUS TREE STATUS = 1 and PRESENT TREE STATUS = 2 or 3; or PRESENT TREE STATUS = 2 and RECONCILE = 1, 2, or 3

Field width: 2 digits

Values:

10 Insect

20 Disease

30 Fire

40 Animal

50 Weather

60 Vegetation(suppression, competition, vines/kudzu)

70 Unknown/not sure/other - includes death from human activity not related to silvicultural or land clearing activity (accidental, random, etc.). TREE NOTES required.

80 Silvicultural or land clearing activity (death caused by harvesting or other silvicultural activity, including girdling, chaining, etc., or to land clearing activity)

5.11.1 MORTALITY YEAR (FIA NCF § 5.22)

Applies to remeasurement plots only.

Record the estimated year that remeasured trees died or were cut. For each remeasured tree that has died or been cut since the previous inventory, record the 4-digit year in which the tree died. Mortality year is also recorded for trees on land that has been converted to a nonforest land use, if it can be determined that a tree died before the land was converted. The older the dead tree the less accurate this estimate will be. Unless specific information is available on when a harvest occurred, this estimate will be to the nearest 5 year category.

When Collected: Plots where SAMPLE KIND = 2: all PREVIOUS TREE STATUS = 1 and PRESENT TREE STATUS = 2 or 3; or PRESENT TREE STATUS = 2 and RECONCILE = 1, 2, or 3.

Field width: 4 digits

Tolerance: +/- 5 years for remeasurement cycles of 5 years

MQO: At least 70% of the time

Values: 2000 or higher

5.12 DECAY CLASS (FIA NCF § 5.23)

Record for each standing dead tally tree, 5.0 inches in diameter and larger and 15 feet in length or larger, the code indicating the tree's stage of decay.

Decay class stage (code)	Limbs and branches	Top	% Bark Remaining	Sapwood presence and condition *	Heartwood condition *
1	All present	Pointed	100	Intact; sound, incipient decay, hard, original color	Sound, hard, original color
2	Few limbs, no fine branches	May be broken	Variable	Sloughing; advanced decay, fibrous, firm to soft, light brown	Sound at base, incipient decay in outer edge of upper bole, hard, light to reddish brown
3	Limb stubs only	Broken	Variable	Sloughing; fibrous, soft, light to reddish brown	Incipient decay at base, advanced decay throughout upper bole, fibrous, hard to firm, reddish brown
4	Few or no stubs	Broken	Variable	Sloughing; cubical, soft, reddish to dark brown	Advanced decay at base, sloughing from upper bole, fibrous to cubical, soft, dark reddish brown
5	None	Broken	Less than 20	Gone	Sloughing, cubical, soft, dark brown, OR fibrous, very soft, dark reddish brown, encased in hardened shell

* Characteristics are for Douglas-fir. Dead trees of other species may vary somewhat. Use this only as a guide.

When Collected: All standing dead tally trees > 5.0 in DBH

Field width: 1 digit

Tolerance: +/- 1 class

MQO: At least 90% of the time

Values: Use the following table for guidelines:

5.13 TREE IS OUTSIDE PROJECT BOUNDARY

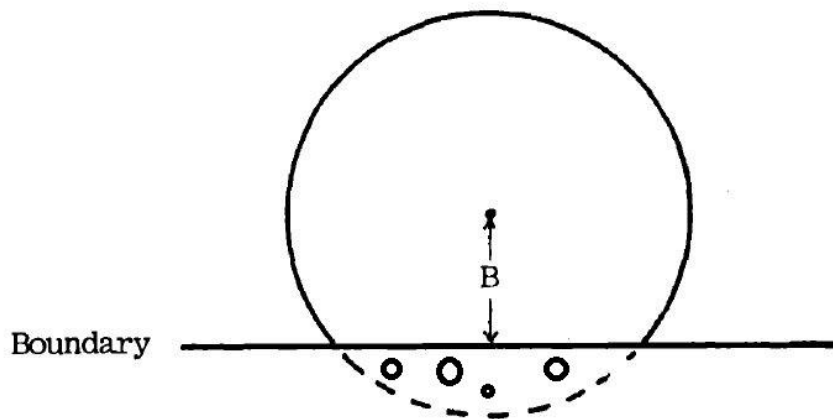
Where a plot overlaps a discernible project boundary, watercourse buffer, or road-related boundary, Sample **the entire plot** and record the code "1" for trees that are outside the project in the OUTSIDE PROJECT field.

Where a plot overlaps a clearly discernible property line, do not sample trees that are off the property. If the project boundary is not clearly discernible in the field, sample all trees on the plot and leave this section blank.

The direct weighting method used to account for boundary overlap assumes boundaries are straight lines. In the field streams and roads may curve slightly, however, the cruiser should attempt to flag a straight line through the plot to replicate the assumptions of the weighing method. Pin flags may be used to mark the boundary.

Where a plot overlaps a project area boundary that corresponds with a change in vegetation, the drip-line of the trees (rather than the stems) is used to divide vegetation types.

- | | |
|-------|--|
| 1 | Tree is outside the project boundary |
| Blank | Tree is not outside the project boundary |



Direct weighting method

THE DIRECT WEIGHTING METHOD, WHERE B IS THE DISTANCE TO BOUNDARY.

When collected: Plots that overlap project boundary, except property line boundaries.

Tolerance: +/- 2 feet of boundary

MQO: At least 90% of the time

Field width: 1 digit

Values: 1

5.14 TREE NOTES (FIA NCF § 5.27)

Record notes pertaining to an individual tree as called for to explain or describe another variable.

When collected: All trees

Field width: Alphanumeric character field

Values: English language words, phrases and numbers

6.0 SITE TREE DATA (FIA NCF § 7.0)

Site trees are a measure of site productivity expressed by the height to age relationship of dominant and co-dominant trees. If suitable site trees are available, site tree data are required for every 4th sampled plot with the objective of having at least 25 percent of the plots with site index data. Where NRCS soil-vegetation data is not available for a project then site tree data are required for every other sampled plot, with the objective of having at least 50 percent of the plots with site index data.

6.1 SITE TREE SELECTION (FIA NCF § 7.1)

Select at least one site tree for each sampled plot where site data is needed based on criteria in 5.0. It is best if the site tree also represents the overall age of the stand. The absence of site tree data may occur because:

- This is the first visit to the plot
- Site data is not needed for this plot
- On the previous visit no suitable site tree could be found
- Since the last visit there has been a change that renders the previous data incompatible with the current conditions

If a site tree is needed; select tree from a species common to the area being sampled, based on the criteria listed below. Select trees on the plot where possible; if not possible, select a suitable tree outside the plot, but as close to the plot as possible. Use only trees that have remained in a dominant or co-dominant crown position throughout their entire life span. If possible, trees should be 5.0 inches in diameter, or larger, and at least 20 years old. Trees that are visibly damaged, leaning more than 20 degrees from vertical, trees with ring patterns that exhibit signs of suppression, and trees with rotten cores should be rejected. Select site trees that reflect the site potential of the area. Do not select trees growing on top of springs or the fill slope of road cuts. If there are no acceptable site trees, record that in the SITE TREE NOTES.

6.2 SPECIES (FIA NCF § 7.2.2)

Western U.S.

Ideally, site trees in the western U.S. (Pacific Northwest and Mountain FIA) should be between 35-80 years old. If preferred trees cannot be found in this age range, expand the age range to 15-250 years. Reject trees outside the 15-250 year age range, trees that exhibit signs of damage, trees with ring patterns that show signs of suppression, trees less than 5.0 inches DBH, trees with abnormalities at DBH, trees leaning more than 20 degrees from vertical, and trees with rotten cores. The preferred species for site trees is Douglas-fir, but Redwood, ponderosa pine, Western hemlock, sugar pine, white fir and Sitka spruce are also acceptable.

When Collected: All site trees

Field width: 4 digits

Values: See Appendix 5.

6.3 DIAMETER (FIA NCF § 7.2.3)

Use the same procedures described in Section 5.4.

When Collected: All site trees

Field width: 4 digits (xxx.y)

Tolerance: +/- 0.1 in per 20.0 in increment of measured diameter on all live trees and dead trees with DECAY CLASS = 1,
2 +/- 1.0 in per 20.0 in increment of measured diameter on dead trees with DECAY CLASS = 3, 4, 5

MQO: At least 95% of the time. For example: a tree with a diameter of 41.0 in would have a tolerance of plus or minus 0.3 in. (Note: the MQO for point of measurement is +/- 0.2 in when the tree is first measured and within 1 ft of the location established by the previous crew when the tree is remeasured.)

Values: 001.0 to 999.9

6.4 SITE TREE LENGTH (FIA NCF § 7.2.4)

With a clinometer, laser rangefinder or other approved instrument, measure the total length of the site tree. Record to the nearest 1.0 foot. SITE TREE LENGTH must be measured; no estimates are permitted on site trees.

When Collected: All site trees

Field width: 3 digits

Tolerance: +/- 10% of true length

MQO: At least 90% of the time

Values: 005 to 999

6.5 TREE AGE AT DBH (FIA NCF § 7.2.3)

Record the tree age as determined by an increment sample. Bore the tree at the point of diameter measurement (DBH) with an increment borer. Count the rings between the outside edge of the core and the pith. Do not add years to get total age.

When Collected: All site trees

Field width: 3 digits

Tolerance: +/- 5 years

MQO: At least 95% of the time

Values: 001 to 999

7.0 CHANGE LOG

To be filled in once changes occur.

APPENDICES

- 1.Intentionally left bank
- 2.FIA Forest Type Codes
- 3.FIA Tree Species Codes
- 4.Intentionally left bank
- 5.Intentionally left bank
- 6.Glossary
- 7.Intentionally left bank
- 8.Tree Coding Guide
9. Boundary Plot Tree Weights
10. Slope Correction

APPENDIX 2. WHR TYPES OF CALIFORNIA

Habitat Classification Rules
California Wildlife Habitat Relationships System
 California Department of Fish and Game
 California Interagency Wildlife Task Group
 April, 2005

Structure	Composition	Geographic Region
Tree-Dominated ≥ 10% total cover by live vegetation in an overstory position; not a desert habitat (per those listed below)		Hardwood Defined by Region - Upland Generally, in non-coastal regions and dominated by montane hardwoods, with or without oaks, or in coastal regions with canyon live oak (<i>Quercus chrysolepis</i>), California black oak (<i>Q. kelloggii</i>) or Oregon white oak (<i>Q. garryana</i>) as the dominant oak. MHW Generally, in coastal regions with coast live oak (<i>Q. agrifolia</i>) or Englemann oak (<i>Q. engelmannii</i>) as the dominant oak. COW
Hardwood ≥ 50% relative overstory cover by hardwoods and < 25% relative overstory cover by conifers	Hardwood Defined by Species ASP, EUC, BOW, VOW	Hardwood Defined by Region - Riparian Generally, in montane regions, often intergrading with wet meadows, or in coastal and foothill regions along steep-gradient streams with black cottonwood (<i>Populus trichocarpa</i>) or bigleaf maple (<i>Acer macrophyllum</i>) dominating the overstory. May also be dominated by willows (<i>Salix</i> spp.) or alders (<i>Alnus</i> spp.) MRI Generally, in valley and foothill regions along low-gradient streams with Fremont cottonwood (<i>P. fremontii</i>), California Sycamore (<i>Platanus racemosa</i>) or Valley Oak (<i>Q. lobata</i>) dominating the overstory. May also be dominated by willows (<i>Salix</i> spp.) or alders (<i>Alnus</i> spp.) VRI (Note: If habitat is dominated by desert species or is in South-eastern Great Basin, Mojave, Sonoran or Colorado deserts, even if dominated by <i>P. fremontii</i> , see DRI under "Desert Tree/Shrub".)
Hardwood-Conifer ≥ 50% relative overstory cover by hardwoods and ≥ 25% relative overstory cover by conifers MHC, BOP (Rule exception: Stands dominated by foothill pine crosswalk into BOP.)		
Conifer > 50% relative overstory cover by conifers	Single Species Conifer 50% relative conifer cover by a single conifer species, regardless of the number of conifer species in the overstory (Note: If dominant conifer species does not have its own CWHR type, see Mixed Conifer below. Rule exception: Stands dominated by Western Hemlock, Grand Fir, and Sitka Spruce crosswalk into RDW.) RFR, LPN, WFR, DFR, JPN, RDW, JUN	Single Species Conifer Defined by Region On the west side of the Sierra Nevada. PPN In the Southern Cascades, Modoc Plateau and east side of the Sierra Nevada on coarse well-drained basaltic soils. EPN
	Mixed Conifer ≤ 50% relative conifer cover by a single conifer species with ≥ 5% cover by at least one other conifer species or > 50% relative conifer cover by a single conifer species that does not have its own CWHR type CPC, PJN	Mixed Conifer Defined by Region In the Klamath Mountains, on mid-elevation slopes. KMC In all other mountain ranges, on mid-elevation slopes. SMC In all mountain ranges at high elevations; characterized by open canopy and trees of low to medium stature. SCN

APPENDIX 3A. FIA WESTERN TREE SPECIES CODES IN NUMERIC ORDER

011	Pacific silver fir	Abies	amabilis	137	Washoe pine	Pinus	washoensis
014	Santa Lucia fir	Abies	bracteata	139	Torrey pine	Pinus	torreya
015	white fir	Abies	concolor	201	bigcone Douglas-fir	Pseudotsuga	macrocarpa
017	grand fir	Abies	grandis	202	Douglas-fir	Pseudotsuga	menziesii
019	subalpine fir	Abies	lasiocarpa	211	redwood	Sequoia	sempervirens
020	California/Shasta red	Abies	magnifica	212	giant sequoia	Sequoiadendron	giganteum
022	noble fir	Abies	procera	231	Pacific yew	Taxus	brevifolia
041	Port-Orford-cedar	Chamaecyparis	lawsoniana	242	western redcedar	Thuja	plicata
042	Alaska yellow-cedar	Chamaecyparis	nootkatensis	251	Nutmeg	Torreya	californica
050	cypress spp.	Cupressus	spp.	263	western hemlock	Tsuga	heterophylla
051	Arizona cypress	Cupressus	arizonica	264	mountain hemlock	Tsuga	mertensiana
052	Baker cypress,	Cupressus	bakeri	304	catclaw acacia	Acacia	greggii
053	tecate cypress	Cupressus	forbesii	312	bigleaf maple	Acer	macrophyllum
054	Monterey cypress	Cupressus	macrocarp	313	boxelder	Acer	negundo
055	Sargent's cypress	Cupressus	sargentii	330	California buckeye	Aesculus	californica
056	MacNab's cypress	Cupressus	macnabian	351	red alder	Alnus	rubra
060	Juniper, spp.	Juniperus	spp.	352	white alder	Alnus	rhombifolia
062	California juniper	Juniperus	californica	361	Pacific madrone	Arbutus	menziesii
063	alligator juniper	Juniperus	deppeana	492	Pacific dogwood	Cornus	nuttallii
064	western juniper	Juniperus	occidentali	500	hawthorn spp.	Crataegus	spp.
065	Utah juniper	Juniperus	osteosperm	510	eucalyptus spp.	Eucalyptus	spp.
066	Rocky mountain juniper	Juniperus	scopulorem	542	Oregon ash	Fraxinus	latifolia
069	oneseed juniper	Juniperus	monosperm	631	tanoak	Notholithos	densiflorus
081	incense-cedar	Calocedrus	decurrens	730	California sycamore	Platanus	racemosa
090	spruce spp.	Picea	spp.	740	cottonwood black	Populus	tricocarpa
092	Brewer spruce	Picea	breweriana	746	quaking aspen	Populus	tremuloides
093	Engelmann spruce	Picea	engelmann	800	oak spp.	Quercus	spp.
098	Sitka spruce	Picea	sitchensis	801	coast live oak	Quercus	agricola
100	pine spp.	Pinus	spp.	805	canyon live oak	Quercus	chrysolepis
101	whitebark pine	Pinus	albicaulis	807	blue oak	Quercus	douglasii
103	knobcone pine	Pinus	attenuata	811	Engelmann oak	Quercus	engelmannii
104	foxtail pine	Pinus	balfouriana	815	Oregon white oak	Quercus	garryana
108	lodgepole pine	Pinus	contorta	818	California black oak	Quercus	kelloggii
109	Coulter pine	Pinus	coulteri	821	valley oak	Quercus	lobata
116	Jeffrey pine	Pinus	jeffreyi	839	interior live oak	Quercus	wislizeni
117	sugar pine	Pinus	lambertiana	920	willow spp.	Salix	spp.
119	western white	Pinus	monticola	981	California bay laurel	Umbellularia	californica
120	bishop pine	Pinus	muricata	997	Russian-olive	Elaeagnus	angustifolia
122	ponderosa pine	Pinus	ponderosa	7211	avocado	Persea	americana
124	Monterey pine	Pinus	radiata				
127	gray pine,	Pinus	sabiniana				
133	singleleaf pinyon	Pinus	monophylla				

APPENDIX 3B. COMMON CALIFORNIA SPECIES, SORTED BY SPECIES CODE AND BY SPECIES COMMON NAME

	Sorted by Number				Sorted by common name		
015	white fir	Abies	concolor	312	bigleaf maple	Acer	macrophyllum
017	grand fir	Abies	grandis	120	bishop pine	Pinus	muricata
020	California/Shasta red	Abies	magnifica	807	blue oak	Quercus	douglasii
041	Port-Orford-cedar	Chamaecyparis	lawsoniana	981	California bay laurel	Umbellularia	californica
081	incense-cedar	Calocedrus	decurrens	818	California black oak	Quercus	kellooggii
098	Sitka spruce	Picea	sitchensis	020	California/Shasta red	Abies	magnifica
108	lodgepole pine	Pinus	contorta	805	canyon live oak	Quercus	chrysolepis
109	Coulter pine	Pinus	coulteri	801	coast live oak	Quercus	agricola
116	Jeffrey pine	Pinus	jeffreyi	109	Coulter pine	Pinus	coulteri
117	sugar pine	Pinus	lambertiana	202	Douglas-fir	Pseudotsuga	menziesii
119	western white pine	Pinus	monticola	811	Engelmann oak	Quercus	engelmannii
120	bishop pine	Pinus	muricata	212	giant sequoia	Sequoiadendron	giganteum
122	ponderosa pine	Pinus	ponderosa	017	grand fir	Abies	grandis
124	Monterey pine	Pinus	radiata	127	gray pine,	Pinus	sabiniana
127	gray pine,	Pinus	sabiniana	081	incense-cedar	Calocedrus	decurrens
202	Douglas-fir	Pseudotsuga	menziesii	839	interior live oak	Quercus	wislizeni
211	redwood	Sequoia	sempervirens	116	Jeffrey pine	Pinus	jeffreyi
212	giant sequoia	Sequoiadendron	giganteum	108	lodgepole pine	Pinus	contorta
231	Pacific yew	Taxus	brevifolia	124	Monterey pine	Pinus	radiata
242	western redcedar	Thuja	plicata	542	Oregon ash	Fraxinus	latifolia
263	western hemlock	Tsuga	heterophylla	815	Oregon white oak	Quercus	garryana
312	bigleaf maple	Acer	macrophyllum	492	Pacific dogwood	Cornus	nuttallii
351	red alder	Alnus	rubra	361	Pacific madrone	Arbutus	menziesii
361	Pacific madrone	Arbutus	menziesii	231	Pacific yew	Taxus	brevifolia
492	Pacific dogwood	Cornus	nuttallii	122	ponderosa pine	Pinus	ponderosa
542	Oregon ash	Fraxinus	latifolia	041	Port-Orford-cedar	Chamaecyparis	lawsoniana
631	tanoak	Notholithos	densiflorus	351	red alder	Alnus	rubra
801	coast live oak	Quercus	agricola	211	redwood	Sequoia	sempervirens
805	canyon live oak	Quercus	chrysolepis	098	Sitka spruce	Picea	sitchensis
807	blue oak	Quercus	douglasii	117	sugar pine	Pinus	lambertiana
811	Engelmann oak	Quercus	engelmannii	631	tanoak	Notholithos	densiflorus
815	Oregon white oak	Quercus	garryana	821	valley oak	Quercus	lobata
818	California black oak	Quercus	kellooggii	263	western hemlock	Tsuga	heterophylla
821	valley oak	Quercus	lobata	242	western redcedar	Thuja	plicata
839	interior live oak	Quercus	wislizeni	119	western white pine	Pinus	monticola
920	willow spp.	Salix	spp.	015	white fir	Abies	concolor
981	California bay laurel	Umbellularia	californica	920	willow spp.	Salix	spp.

APPENDIX 6. GLOSSARY

ARTIFICIAL REGENERATION SPECIES – Indicates the predominant species that is planted or seeded in an artificially regenerated condition.

Azimuth - is a determination of a direction with the use of a compass. The reference is North, which is 0 or 360 degrees. The compass user's direction is then measured in degrees, clockwise from zero or North.

Board foot - A volume measure of lumber 1-foot wide, 1-foot long, and 1 inch thick equal to 144 cubic inches.

Blind check – a re-installation of a production plot done by a qualified crew without production crew data on hand. A full re-installation of the plot is recommended for the purpose of obtaining a measure of uncertainty in the data. All plot-level information (e.g., boundary and condition information) will be collected on each blind check plot. The two data sets are maintained separately. Discrepancies between the two sets of data are not reconciled. Blind checks are done on production plots only.

Bole – The main stem of a tree, extending from one foot above the ground to the point on the tree where DOB reaches 4 inches.

CROWN CLASS – A classification of trees based on dominance in relation to adjacent trees within the stand as indicated by crown development and the amount of sunlight received from above and sides.

Crook - Abrupt bend in a tree or log (Helms 1998).

Cull – Portions of a tree that are unusable for industrial wood products because of rot, form, or other defect.

Declination - The azimuth correction used to adjust magnetic north to true north with a compass, measured in degrees.

Diameter at Breast Height (DBH) – The diameter of the bole of a tree at breast height (4.5 feet above the ground on the uphill side), measured outside of the bark.

Diameter Outside Bark (DOB) – A diameter that may be taken at various points on a tree, or log, **outside** of the bark. Diameter Outside Bark is often estimated.

Forest Trees – Plants having a well-developed, woody stem and usually more than 12 feet in height at maturity.

FOREST TYPE – A classification of forest land based upon the trees or tree communities that constitute the majority of stocking on the site.

GPS – Global Positioning System. Information from this system is collected and used to determine the latitude and longitude of each plot.

Hardwoods – Dicotyledonous trees, usually broad-leaved and deciduous.

Hot check - An inspection normally done as part of the training process. The inspector is present on the plot with the trainee and provides immediate feedback regarding data quality. Data errors are corrected. Hot checks can be done on training plots or production plots.

Improved road - Paved roads, gravel roads, or improved dirt roads regularly maintained for longterm continuing use by normal passenger vehicles. Generally constructed using machinery. The area where the original topography has been disturbed by cutbanks and fill is considered part of the road, if that area is maintained. Unimproved traces and roads created for skidding logs are not considered improved roads.

Inclusion – An area that would generally would be recognized as a separate condition, except that it is not large enough to qualify. For example, a ½ acre pond within a forested stand.

Inspection crew – a crew of qualified QC/QA individuals whose primary responsibility is the training, certification and inspection of production crews.

Krummholz - The shrubby, multi-stemmed form assumed by trees near treeline.

Live Tree - Trees are alive if they have any living parts (leaves, buds, cambium) at or above the point of diameter measurement, either diameter at breast height (DBH). Trees that have been temporarily defoliated are still alive.

Maintained Road – Any road, hard topped or other surfaces, that is plowed or graded periodically and capable of use by a large vehicle. Rights-of-way that are cut or treated to limit herbaceous growth are included in this area.

Marsh – Low, wet areas characterized by heavy growth of weeds and grasses and an absence of trees.

Measurement Quality Objective (MQO) – Describes the acceptable tolerance for each data element. MQOs consist of two parts: a statement of the tolerance and a percentage of time when the collected data are required to be within tolerance.

Merchantable Top – The point on the bole of trees above which merchantable material cannot be produced. Merchantable top is generally 1.5 inches for woodland species and 4.0 inches for all other species.

Microplot– A circular, fixed-radius plot with a radius of 8.33 feet that is used to sample trees less than 5.0 inches at DBH, as well as other vegetation.

Nonforest Land -- Land that does not support, or has never supported, forests, and lands formerly forested where use for timber management is precluded by development for other uses. Includes areas used for crops, improved pasture, residential areas, city parks, improved roads of any width and adjoining rights-of-way, power line clearings of any width, and noncensus water. If intermingled in forest areas, unimproved roads and nonforest strips must be more than 120.0 feet wide, and clearings, etc., more than one acre in size, to qualify as nonforest land.

Nonstockable– Areas of forest land that are not capable of supporting trees because of the presence of rock, water, etc.

Plot – A plot that samples a fixed area of approximately 1/10, 1/20 or 1/7 acre. Each plot has an associated microplot.

Plurality - An amount or group (as of stocking points) that is greater than any other amount or group within a total but that is not necessarily a majority (more than half).

Production crew – a crew containing at least one individual. The crew is involved in routine installation of plots.

Production plot – A plot measured by a production crew. These plots may also be used for training purposes.

REGENERATION STATUS – A stand descriptor that indicates whether a stand has been naturally or artificially regenerated.

Saplings – Live trees 1.0 to 4.9 inches DBH.

Seedlings – Conifer seedlings must be at least 6.0 inches in length and less than 1.0 inch at DBH in order to qualify for tallying. Hardwood seedlings must be at least 12.0 inches in length and less than 1.0 inch at DBH in order to qualify for tallying.

Site index - The average total height that dominant and co-dominant trees in fully stocked, even-aged stands will obtain at key ages, as determined by an equation.

Slope - Measure of change in surface value over distance, expressed as a percentage (Helms 1998).

Softwoods – Coniferous trees, usually evergreen having needles or scale-like leaves.

STAND AGE – A stand descriptor that indicates the average age of the live trees not overtopped in the predominant stand size-class.

Standing dead tree - A dead tree that must be at least 5.0 inches in diameter, have a bole which has an unbroken TRUNCATED LENGTH of at least 15 feet, and lean less than 45 degrees from vertical as measured from the base of the tree to the point of diameter measurement.

STAND DENSITY – A stand descriptor that indicates the relative tree density. The classification is based on the number of stems/unit area, basal area, tree cover, or stocking of all live trees in the area which are not overtopped, compared to any previously defined tree density.

STAND SIZE – A stand descriptor that indicates which size-class of trees that are not overtopped constitutes the majority of stocking in the stand.

Stocking – The relative degree of occupancy land by trees, measured as basal area or the number of trees in a stand by size or age and spacing, compared to the basal area or number of trees required to fully utilize the growth potential of the land; that is, the stocking standard.

Tally Tree - Tally trees are all live and standing dead trees encountered on the plot the first time a plot is established, and all trees that grow into a plot thereafter.

TOTAL LENGTH – Is the total length of the tree, recorded to the nearest 1.0 foot from the base of the tree to the tip of the apical meristem. If the tree has a detached top, the total length is an estimate of what the length would be if the tree was not broken. For trees with broken, but still attached full-length tops, total length is simply the sum of each

piece of the bole, above and below the break. For all other broken top tree scenarios, the length of the added top must be estimated. Forked trees should be treated the same as unforked trees.

Tree height - the vertical distance between the highest and lowest point of the tree, and not necessarily the length of the oblique/curved stem. (FAO)

Truncated length - The truncated length of the bole is the distance between the base of the tree and the point where the top is broken. The truncated length may or may not be recorded depending on if the tree is live, standing dead, and how much of the top is still attached.

Watercourse Transition Line - for a watercourse without a Channel Migration Zone, means the line defined by one or more the following features: 1) a change of vegetation from bare surfaces or annual water tolerant species to perennial water tolerant or upland species at least 25 years in age at breast height, 2) physical indicators of scour such as undercut banks, moss lines on rocks, the top of exposed roots along the channels, and 3) a change in the size distribution of surface sediments from gravel to fine sand. (Source: 2017 California Forest Practice Rules)

APPENDIX 8. TREE CODING GUIDE

APPENDIX 9. BOUNDARY PLOT TREE WEIGHTS

TABLE 2. Weighting factors¹ for the direct correction of boundary overlap with fixed-size circular plots having the given radius, R_i , assuming the distance from plot center to boundary, B , in feet, is within the cited range.

Use the following weight, W	If plot area = 1/4 acre i.e., R_i = 58.88 feet and B is within the range:	1/5 acre 52.66 feet	1/7 acre 44.51 feet	1/10 acre 37.24 feet	1/20 acre 26.33 feet
	----- Feet -----				
2.0	0–1.1	0–1.0	0–0.8	0–0.7	0–0.5
1.9	1.2–3.7	1.1–3.3	0.9–2.8	0.8–2.3	0.6–1.6
1.8	3.8–6.6	3.4–5.9	2.9–4.9	2.4–4.1	1.7–2.9
1.7	6.7–9.8	6.0–8.8	5.0–7.4	4.2–6.2	3.0–4.4
1.6	9.9–13.5	8.9–12.1	7.5–10.2	6.3–8.5	4.5–6.0
1.5	13.6–17.8	12.2–15.9	10.3–13.4	8.6–11.2	6.1–7.9
1.4	17.9–22.8	16.0–20.4	13.5–17.2	11.3–14.4	8.0–10.2
1.3	22.9–28.9	20.5–25.9	17.3–21.8	14.5–18.3	10.3–12.9
1.2	29.0–36.7	26.0–32.8	21.9–27.7	18.4–23.2	13.0–16.4
1.1	36.8–47.7	32.9–42.7	27.8–36.1	23.3–30.2	16.5–21.3
1.0	>47.7	>42.7	>36.1	>30.2	>21.3

¹ Calculation formula:

$$W = \frac{\text{uncorrected sample plot area in square feet}}{R_i^2 \left(\Pi - \text{Arc cos} \frac{B_j}{R_i} \right) + B_j \sqrt{R_i^2 - B_j^2}}, B_j \leq R_i$$

FIGURE 1. TREE WEIGHTING FACTORS FOR BOUNDARY PLOTS. FROM *PRACTICAL CORRECTION OF BOUNDARY OVERLAP*, BEERS (1977)

APPENDIX 10. SLOPE CORRECTION

Use the following table to correct for slope.

Slope %	Cor. Fact.	1/7th	1/10th	1/20th	1/100th	1/200th
0-10	1	44.51	37.24	26.33	11.8	8.33
10-17%	1.01	44.96	37.61	26.59	11.92	8.41
18-22	1.02	45.40	37.98	26.86	12.04	8.50
23-26	1.03	45.85	38.36	27.12	12.15	8.58
27-30	1.04	46.29	38.73	27.38	12.27	8.66
31-33	1.05	46.74	39.10	27.65	12.39	8.75
34-35	1.06	47.18	39.47	27.91	12.51	8.83
36-39	1.07	47.63	39.85	28.17	12.63	8.91
40-42	1.08	48.07	40.22	28.44	12.74	9.00
43-44	1.09	48.52	40.59	28.70	12.86	9.08
45-47	1.1	48.96	40.96	28.96	12.98	9.16
48-49	1.11	49.41	41.34	29.23	13.10	9.25
50-51	1.12	49.85	41.71	29.49	13.22	9.33
52-54	1.13	50.30	42.08	29.75	13.33	9.41
55-56	1.14	50.74	42.45	30.02	13.45	9.50
57-59	1.16	51.63	43.20	30.54	13.69	9.66
60-61	1.17	52.08	43.57	30.81	13.81	9.75
62-63	1.18	52.52	43.94	31.07	13.92	9.83
64-66	1.19	52.97	44.32	31.33	14.04	9.91
67-69	1.21	53.86	45.06	31.86	14.28	10.08
70-71	1.22	54.30	45.43	32.12	14.40	10.16
72-74	1.24	55.19	46.18	32.65	14.63	10.33
75-76	1.25	55.64	46.55	32.91	14.75	10.41
77-79	1.27	56.53	47.29	33.44	14.99	10.58
80-82	1.29	57.42	48.04	33.97	15.22	10.75
83-85	1.31	58.31	48.78	34.49	15.46	10.91
86-88	1.33	59.20	49.53	35.02	15.69	11.08
89-91	1.35	60.09	50.27	35.55	15.93	11.25
92-94	1.37	60.98	51.02	36.07	16.17	11.41
95-98	1.39	61.87	51.76	36.60	16.40	11.58
99-100	1.41	62.76	52.51	37.13	16.64	11.75
110	1.48	65.87	55.12	38.97	17.46	12.33
120	1.56	69.44	58.09	41.07	18.41	12.99
130	1.64	73.00	61.07	43.18	19.35	13.66
140	1.72	76.56	64.05	45.29	20.30	14.33
150	1.8	80.12	67.03	47.39	21.24	14.99

Slope distance & Correction Factor for plot radius