

ATTACHMENT L

USAL REDWOOD FOREST INVENTORY METHODOLOGY

This document contains specifications for the collection of data in the field for the Usal Redwood Forest Inventory, as well as the data to be collected and the standards for data collection and processing. The Usal Redwood Forest includes approximately 47,979 acres of timberland characterized by Redwood, Douglas-fir, Tanoak and associated hardwood species. The Usal Redwood Forest IFM Project Boundary includes the following GHG emission sources, GHG sinks, and GHG reservoirs (SSRs or Carbon Pools) as defined in table 5.1 of the Compliance Offset Protocol U.S. Forest Projects, November 14, 2014:

IFM-1	Standing live carbon (carbon in all portions of living trees)
IFM-3	Standing dead carbon (carbon in all portions of standing dead trees)
IFM-7	Carbon in in-use forest products IFM-8 Forest product carbon in landfills
IFM-14	Biological emissions/removals from changes in harvesting on forestlands outside the Project Area
IFM-17	Biological emissions from decomposition of forest products

The inventory data upon which the carbon stock estimates are based includes plot data to be collected in 2015 under the direction of Campbell Global Campbell Global. The standard procedures for collecting field measurements are generally aimed at the collection of tree data pertaining to the quantification of the IFM-1 and IFM-3 carbon pools and are detailed in the enclosed California North Coast Forest Data Collection Procedures and Standards v1.0 (FDCPS) document. Carbon in carbon pools IFM7, IFM-8, IFM-14, and IFM-17 are calculated as described in Section VII of the Listing Application.

Inventory Methodologies

The data collection procedures are described in detail in the attached Usal Redwood Forest, Carbon Inventory Data Collection Procedures and Standards document (Appendix B).

Calculation Methodologies

A description of the calculation methodologies used to determine metric tons per acre of each of the carbon pools listed above is included in Section VII of the Listing Application. Included are the analytic methods and biomass equation references used to translate field measurements into volume and biomass carbon estimates.

Data Management Systems and Data Processing

The inventory data gathered by this inventory methodology is entered into an Access database. Plot data within the database was extensively sorted and queried to look for data entry errors. This process resulted in a final data set for cruise processing. The Access database serves as the repository for inventory data and is accessed by the growth and yield model during growth and yield simulations.

The inventory database is utilized to process the inventory data through the growth and yield model FORSEE, and analyze the modeling outputs. The calculation of volume, biomass and the ultimate conversion to carbon utilizes the inventory data and growth and yield output data and applies the volume formulas and biomass conversion factors described in section VII of the Listing Application.

Stratification Methodology

Campbell Global provided plot and GIS stand boundary data for the majority of the Usal Redwood Forest IFM Project Area. There were 74 stands classified as “recent clearcuts” for which no inventory data had been collected. In order to supplement the inventory data, 10 of these uncruised stands were selected for sampling in 2014. This additional cruise data was collected under the direction of Campbell Global, and was incorporated into the final cruise database. Tree data had been grown forward to January 1, 2014 by Campbell Global. Using data from plots inventoried in all years and Campbell Global’s FORSEE tables, basal area by species was calculated for all stands in FORSEE. Equivalent megagrams of carbon dioxide (MgCO_{2e}) per acre were then calculated for all stands using the FORSEE carbon calculation script. Based on these basal areas, stands were classified as hardwood or conifer dominated. Stands were then stratified into four strata in hardwood dominated stands and four strata in conifer dominated stands, based on MgCO_{2e} per acre, from low to high.

Table 1a: Strata and Plot Summary used for the Start Date Stratification

Stand	Acres	Plots	Acres per Plot
Conifer High	1,625.07	284	5.72
Conifer Medium High	9,061.19	1307	6.93
Conifer Medium Low	12,860.22	2096	6.14
Conifer Low	4,187.87	1007	4.16
Hardwood High	2,151.84	297	7.25
Hardwood Medium High	7,558.64	810	9.33
Hardwood Medium Low	8,296.51	1246	6.66
Hardwood Low	2,237.89	449	4.98
Total	47,979.24	7496	6.40

The acres and plots by stratum were subsequently modified to reflect harvests in 2012-2014. These adjustments involved depletions by stand as described in the inventory update procedure below, and subsequent re-stratification of the harvested stands. Plots located within harvested areas were also removed from the active inventory database. The majority of the 2012 and 2013 harvest areas were recruited following harvest and as such any harvest is reflected in the active database. Table 1b below shows the stratum acreages and plot counts following the adjustments for harvest in 2012-2014.

Table 1b: Strata and Plot Summary for the Current Inventory Stratification

Stand	Acres	Plots	Acres per Plot
Conifer High	1,618.32	284	5.70
Conifer Medium High	8,686.20	1257	6.91
Conifer Medium Low	12,860.62	2048	6.28
Conifer Low	4,257.66	974	4.37
Hardwood High	2,151.84	297	7.25
Hardwood Medium High	7,558.64	810	9.33
Hardwood Medium Low	8,454.13	1247	6.78
Hardwood Low	2,391.82	453	5.28
Total	47,979.24	7370	6.51

Plots inventoried prior to 2010 were inventoried using a different specification and, therefore, were not assigned to strata. Plots were not assigned to strata based on their relationships to stands created by Campbell Global. Instead, plots were assigned to strata if they were spatially located within the boundaries of stands assigned to those strata. It is no longer necessary to use Campbell Global's plot assignments because each stratum is large enough to contain enough plots to be sufficiently representative of the stratum. These stratified plots were used to construct a table of all plots and trees in each stratum and were reorganized in new Access database files for processing with FORSEE.

Some stands on the property were not inventoried and, therefore, not stratified using the process described above. Out of two stands of manageable brush, one was small and assigned to the strata of the stand surrounding it. The other, viewed in an aerial photograph and found to have very little timber, was included in an "OUT" strata, indicating that it would not be included in the Project Area. The remainder of the un-inventoried stands had slope stability issues or were recently clearcut. The clearcut stands were assigned to one of the eight strata based on aerial photo interpretation. All of the un-inventoried stands with slope stability issues were assigned to the "OUT" strata. Some stands inventoried by Campbell Global included areas off of the property. These areas were removed from the Project Area and were also assigned to the "OUT" strata.

Gross acreage for each stand was calculated by geometry in ArcGIS. Road acreage, in each stand to be excluded from the Project acreage was calculated through a buffer analysis of the road layer. Road buffer with is based on road status and surface type. A description of the buffering assumptions provided by Campbell Global is included below as Appendix C. The resulting calculated road acreage for each stand was subtracted from the gross GIS acreage to arrive at the

timbered acreage net of roads for each timber stand. The total net acreage of each timber stratum was summed and input into the _Stands table in FORSEE for each timber stratum. The resulting database represented a stratified inventory of the Usal Redwood Forest IFM Project Area as of January 1, 2014. The modeling plan describes the process for updating the inventory to the Project's commencement date in 2007, and the end of the initial reporting period in 2014.

Quality Assurance/Quality Control (QA/QC)

Procedures for ensuring quality control are explained in section 7 (Inspections) of the attached FDCPS document. Procedures for verifying the integrity of inventory data are described next.

Updating the Inventory

As timber management activities take place on the Usal Redwood Forest IFM Project Area, or disturbances such as fire or mortality resulting from pathogens or other factors occur, plots installed in 2015 will be relocated and remeasured within areas that have been harvested, treated for hardwood reduction, or subject to disturbance. By 2027, all of the plots installed for the new inventory conducted in 2015 will have been remeasured regardless of whether or not the plot had been harvested, treated for hardwood reduction, or subject to other disturbance. On this basis, Usal Redwood Forest IFM will maintain a forest inventory system that will meet the inventory specifications and requirements contained in Appendix A of the Protocol, with plots which are no more than 12 years old.

Updating the Project's carbon stocks from year to year will involve the following steps:

1. Any newly installed inventory plots will be incorporated into the inventory estimate for the stratum in which they are located.
2. Existing inventory plots will be updated using FORSEE as described in the modeling plan.
3. Updating the forest inventory for harvests or disturbances that have occurred during the previous year through the installation of new plots, or adjustments to previous plot data.
4. Where necessary, the inventory update process may result in restratification of portions of the timber strata.
5. Inventory updates following harvest or disturbance will be re-measured within 12 months of the harvest or disturbance.
 - a. Partial harvests, such as selections and thinnings are updated in two phases:
 - i. Phase1: within one month of harvest completion, the inventory is depleted by modeling removals such that:
 1. The inventory forester selects one of the stands underlying the harvest unit to represent the new stand.
 2. The inventory plots from the selected are projected from time-of cruise to time-of-harvest.
 3. Based on the forester's prescription for the harvest, plots are 'thinned' by removing trees from the projected tree lists.
 4. The 'thinned' plots are aggregated to estimate a stand-level

- inventory for the thinned stand.
5. Based on the stand-level inventory estimate, the stand is evaluated against the stratification rules, and is assigned a strata.
- ii. Phase 2: within one year of completion, the stand is resampled. Resampling will include a random selection of plots within the harvested area.

Appendices:

- A. Inventory Change Log
- B. Usal Redwood Forest Carbon Inventory Data Collection Procedures and Standards
(**Proprietary**)
- C. Road Buffer Assumptions
- D. Plot and Strata Map (to be included in the OPDR)

Appendix A

Usal Redwood Forest Inventory Change Log

[illegible]

Usal Redwood Forest

Carbon Inventory Data Collection Procedures and Standards

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1 CRUISE UNIT TYPING

The Usal Redwood Forest carbon inventory, cruise units are the stratum developed from the larger operational inventory.

2 PLOT ESTABLISHMENT

2-1 Plot Layout

Plot locations have been determined from a random selection of plots from a 5 chain by 5 chain grid that uniformly covers the entire Project Area. Maps of these randomly selected plots shall be provided to the contract cruisers. Contract cruisers shall establish the plots as mapped.

2-2 Navigating To Plot Centers

2-2.1 REFERENCE POINT (RP)

The goal of navigating is to place plot centers without bias at their mapped location within the cruise unit of sample (stratum). Follow these guidelines to accomplish the objective.

Cruisers will primarily use GPS units to navigate to and establish plot centers. To establish a GPS RP, stand in an opening not under canopy at least a chain from the intended plot center. Wait for good signal and report that accuracy is within a few feet, then use the GPS unit's "Go To" function to find the direction and distance to plot center. The cruiser shall then measure the distance to the plot center using a hand compass and steel tape, hip chain or electronic device. To avoid bias due to canopy and other factors, NEVER "chase signal" once the plot center above is reached by using distance and bearing indicated above.

2-2.2 NAVIGATION ROUTE DOCUMENTATION

Cruise Maps will be provided for Contractor to use for submitting Navigation Route Documentation. For each plot or group of plots cruised, Contractor shall notate on the Cruise Map:

1. Navigation routes with directional arrows.
2. Locations of plots exceeding a chain from their intended, mapped locations.
3. Cruiser initials.
4. Dates cruised.
5. Date submitted.

2-2.3 HAZARDOUS PLOT LOCATIONS

Plots may occur on hazardous landscapes such as but not limited to: streams, cliffs, and slides. If a plot is judged too unsafe to sample, contractor shall offset the plot 33 feet in a cardinal direction (North-East-South-West) that allows for the plot to stay in the same strata as previously mapped and the location is deemed safe to cruise.

The contractor is required to take a GPS point at the offset plot location and record the latitude and longitude in the plot notes.

2-3 Monuments

2-3.1 MONUMENT MATERIALS

The supplies used in the monumentation of Work are specified in Table 2-1 below.

Table 2-1
Material Specifications for Monuments

Item	Specification	Suggested Supplier
Flagging	Striped red and black vinyl flagging	Pacforest Supply Company http://www.pacforestsupply.com/
Flagging	White vinyl flagging	Pacforest Supply Company http://www.pacforestsupply.com/
Wire Stake Flag	Fluorescent-pink, 15" long wire stake flag having a 2 1/2" x 3 1/2" flag size	Pacforest Supply Company http://www.pacforestsupply.com/
Rebar plot center Stake	3/8" Rebar stake at least 16" in length with the top 6" painted.	Supplied by Company
Plot Tags	Model 1E34 3" X 4" write-on aluminum tag	Loma Industries http://www.lomaindustries.com/tags.htm

Nails	Aluminum siding plain shank style nail having a 0.128" diameter shank and a 3/8" diameter head	Forestry Suppliers http://forestry-suppliers.com/
Marker used when writing on flagging and wire stake flags	Wide-tip or bullet-tip, black permanent marker	No suggestion
Paint	white paint	Supplied by Company

2-3.2 REFERENCE POINT (RP) MONUMENTS

Three flags hung high, apart, and easily seen from a distance will monument RPs of navigation routes (one white flag, two red and black striped flags). Record on the white flag: (1) the plot number being navigated to; (2) the direction and distance to get there; (3) the cruiser doing the work, and (4) that day's date.

2-3.3 PLOT CENTER MONUMENTS

2-3.3.a Inventory Cruise Plot Center Monuments

Plot Center

Monument plot center with a wire stake flag and 3/8" rebar stake. The rebar stake shall be hammered into the ground such that at least 10" of the stake is below ground, and the top 6" of the plot stake shall be painted.

Flagging

By plot center, and preferably on either side, hang two black and red striped flags high, long, and apart in a way easily seen from a distance. In addition, do the following in these special circumstances.

Failed Inspection. Sometimes work fails inspection and plots must be re-visited for correction. When plots are re-visited for correction, hang high and long an additional flag listing the following information: "RW" (meaning rework); the cruiser doing the work, and that day's date.

Plot Tag

Find an object to attach a plot tag. Prefer choosing an object in the order shown below.

1. Live, healthy, sampled tree at least 6" DBH in size.
2. Largest, live, healthy, sampled tree at least 3.6" DBH in size.
3. Any live, healthy tree near plot center following the 1 and 2 size and preference guidelines above.
4. Any reasonable, nearby object that can be tagged (a snag, a stump, a log) (do not tag brush).

5. If nothing reasonable is present that a tag can be attached to using a nail, do not install a tag. Instead, write tag information on one of the hung flags.

Choose a spot on the object to attach the tag in a location that is (1) facing plot center and (2) preferably below stump height or close to the ground. Determine the direction (azimuth) and horizontal distance (to the nearest 1/10 foot) from the chosen spot of the tag to the plot center then scribe on the tag the information listed below.

1. Eight-digit grid plot number. Plot numbers are shown on cruise maps and begin with a "C".
2. Azimuth (True) and horizontal distance (format example 275d 4.7ft).
3. Cruise date.
4. Cruiser's initials.
5. Optional note (e.g. PC is on stump).

Using a nail, attach the tag at the chosen spot. Allow for growth by sinking the nail only deep enough to secure the tag. When done, the plot tag and stake install should look similar to Figures 2-3.



Figure 2-3 Plot Tag. When attaching the plot tag, allow for growth by sinking the nail only deep enough to make the tag secure. The optional note is omitted from this example.

3 ***PLOT SAMPLING PROCEDURES***

3-1 **Inventory Cruising**

3-1.1 **TREES SAMPLED**

Trees that are sampled are described below.

1. Any live planted or seed-origin tree that has survived on-site at least 1.0" in diameter.
2. Any live stump sprout which is upright (not growing like a lateral branch) and is at least 1.0" in diameter.
3. Dead Trees which are at least 5.0" DBH and at least 15 feet tall.

Like dead trees, live trees have minimum DBH restrictions. See the "3-1.2 *Sample Design*" section below.

3-1.2 **SAMPLE DESIGN**

Nested, circular fixed area subplots are used when selecting trees. Nested means the different samples taken will all have a common plot (point) center.

Table 3-1
Sample Design for Nested Plot Sampling

Sample Design Code	Nested Subplot by DBH Range		
	Subplot 1 (1.0" – 3.5")	Subplot 2 (3.6" – 10.5")	Subplot 3 (>= 10.6")
1	1/100 Acre	1/50 Acre	1/10 Acre

3-1.3 **ORDER OF TALLY**

Follow these orders of tally instructions to speed inspections. Sample trees are recorded clockwise from north. Record any nested subplot 1 trees first, then record subplot 2 trees and finally subplot 3 trees. If trees are directly behind one another, start with the closest one from plot center and proceed outward. The contractor has the option to sample subplot 2 and 3 trees together if that process is easier for data collection.

3-1.4 SAMPLING EDGES OF CRUISE UNITS

Sometimes a plot center lands on or near a cruise unit border. Where trees on either side of the border area are clearly similar in size, stocking, spatial arrangement, and species composition (similar typing), tally all the trees within the nested subplots regardless of whether they lie within or outside the cruise unit. In simple words, sample a full plot.

When a nested subplot crosses over the cruise unit border and trees on either side of the border area are clearly not similar (typing is not the same), cruise trees using the walk-through method.

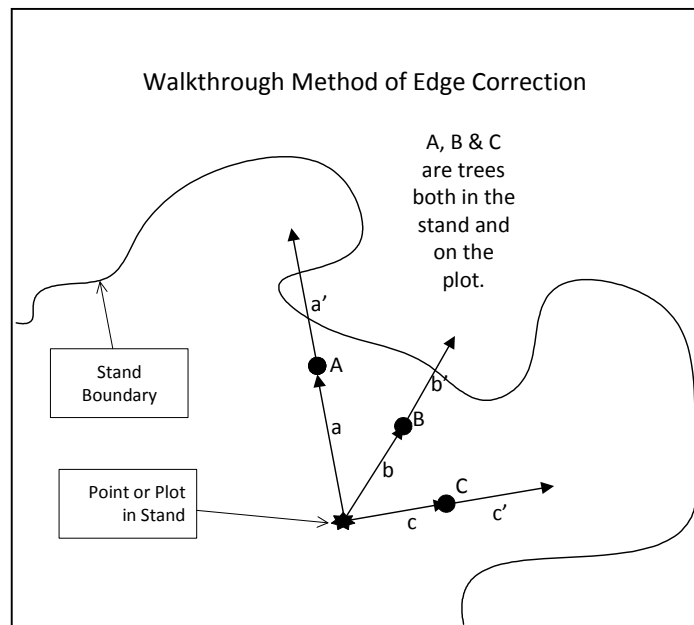
3-1.4.a Watercourses near a Cruise Unit Boundary

For stands whose boundary is a watercourse and a plot falls near the watercourse, cruise the plot as a normal plot so long as the plot coverage does not cross a property boundary.

3-1.4.b Walk-through Method

The walkthrough method has both the advantages of being unbiased in almost all cases and of accommodating uneven stand boundaries. The walkthrough method is simple to implement:

- Establish the point or plot where it falls, and record all 'in' trees within the stand.
- For each tree 'in' the point sample or on the fixed plot that falls between the point and the stand boundary, measure the horizontal distance from the point or plot center to the tree in question.
- Extend the line from the plot center through the tree by the same horizontal distance.
- If the end of the extended line is inside the stand, count the tree once. If the end of the extended line is outside the stand count the tree twice.



The accompanying figure illustrates the walkthrough method as described above. In this case trees A and C would be counted once and tree B will be counted twice.

3-1.4.c Roads

Cruise plots landing on unmapped (legacy) roads, abandoned roads, landings, and trails where they fall, for these components are a part of the unit of sample. Paved, rocked, or dirt roads as shown on the cruise maps are excluded from the Carbon Project Area, and as such are not sampled. Consider the road edges, defined as the top of the cut slope and where road grading ends on the fill slope, a cruise unit border.

Cruise plots having a plot center on the edge of a mapped, un-abandoned road (Figure 3-10). Get to the road edge to install plot center (see the edge definition above). Use an edge sampling method while ignoring trees located across the road.

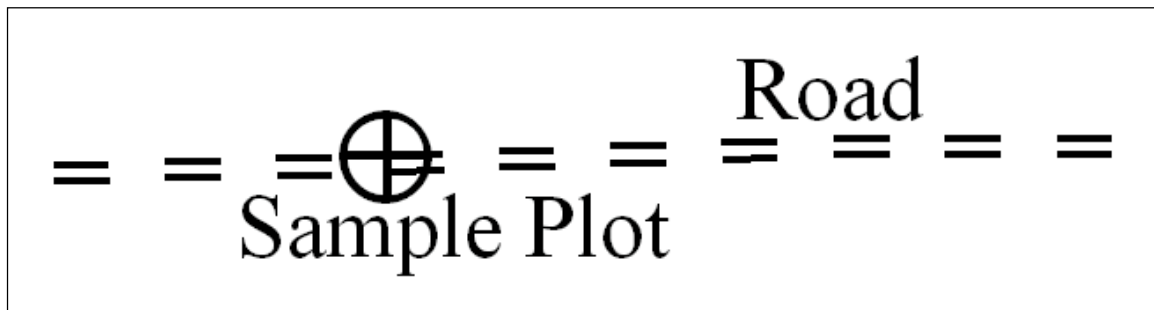


Figure 3-10 Non-Road Plot mapped on the edge of a road. *The plot center (the cross hairs of the sample plot) is on the mapped, un-abandoned, road-edge. Cruise the plot installing plot center at the road corridor edge defined as the top of the cut slope or where road grading ends on the fill slope.*

3-1.5 BORDERLINE CALLS

View trees whose boles of which have grown together as separate trees (do not group them together as one tree having fork damage). Likewise, view each fork emanating from a tree at or below breast height (BH) as a separate tree. BH is defined as the point on a tree's bole 4.5 feet distant from the ground line on the tree's uphill side, or, if a stump sprout, the point on a tree's bole 4.5 feet distant from the sprout's stump origin.

The sampling plane of fixed plots is ground line. Trees are tallied when their center or pith at ground line lies within (inside or on) the fixed plot circle. Where trees are growing off of stumps, the point of reference shall be the center of the tree where the tree is attached to the stump. Round computed fixed plot sizes to the nearest 1/100th foot. Table 3-2 lists the horizontal fixed plot sizes used for inventory cruising.

Table 3-2
Fixed Plot Sizes used for Inventory Cruising

Fixed Plot Size in Acres	Horizontal Plot Radius in Feet
1/100	11.78
1/50	16.65
1/10	37.24

It is important to get a tree's borderline call right, for missing or adding trees will cause an inspection to fail. When the horizontal distance of a tree candidate to plot center must be computed for comparison to a given plots radius, prefer computing the distance using the slope correction formula shown in Figure 3-11. Slope correction tables may also be used.

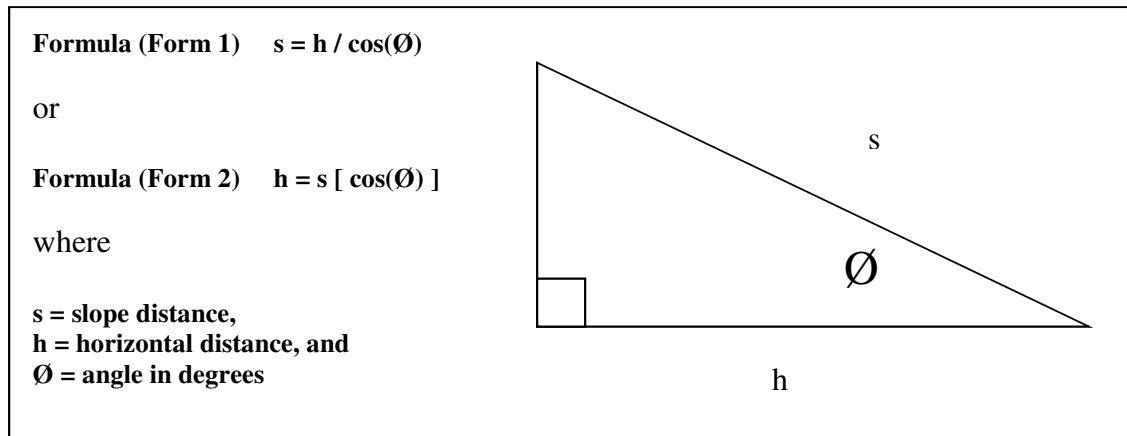


Figure 3-11 Horizontal Distance Formula. *Compute horizontal distance using the slope correction formula above.*

4 COLLECTED DATA

Figure 4-1 shows the cruise card with some sample data. Data recorded on the card are divided into the categories of “Stand”, “Plot”, and “Stem”. The cell where each data is recorded is bounded by the columns of its column heading.

CAMPBELL GLOBAL - CARBON TIMBER CRUISE CARD

Page 1

NAME OF CRUISE 2015 URF Carbon Cruise CRUISER AK

NOTES _____ DATE 1/15/15

"PLOT"	GRID PLOT NO.	DIR. TO PLOT N.E.S.W...	PLOT TYPE N.T.W.X	Plot Tag to PC		Off-plot Tag Tree Spp and DBH or Desc.	PLOT NOTES
				Dir.	H. Dist. (ft.)		
1. PLOT	C0780-B250		R	N	276	6.3	
2. 1	DF	1.6	8	90			GPS RP: 120'
3. 2	DF	2.3	13	80			188° to PC
4. 3	CR	1.2	9	80			(39.972911, -122.519531)
5. 4	CR	1.5	9	80			
6. 5	CR	3.4	21	70			BLI: HD=11.7'
7. 6	TO	2.9	15	50			
8. 7	CR	5.4	36	50			
9. 8	TO	7.5	30	40			
10. 9	TO	8.2	31	50	V	12	
11. 10	CR	10.2	111	70			
12. 11	CR	6.6	41	60			
13. 12	DF	4.5	28	30	C	5	
14. 13	CR	5.5	35	60			
15. 14	CR	26.0	135	70			
16. 15	CR	28.1	140	70			
17. 16	CR	15.6	101	60			BLI: HD=37.1'
18. 17	TO	18.1	65	50	U	35	
19. 18	TO	17.2	59	40	U	20	
20. 19	5 CR	40	18		U	65	
21. 20	TO	20.4	55	20	U		X also, heart not present
22. 21	3 TO	15.2	21		V	20	
23. 22	CR	20.6	82	40	T	10	12
24. 23	1 MA	25.1	64		U		40

* Default value. ** No. logs ht for defect trees w/o cruise tot ht. *** Log defect and notes can be on the same line.
Species shortcuts: D=DF, R=CR, T=TO. If left blank: Stem Count = 1, Status = Live Tree, Damage = N, Plot Type = N.

AK 1/15/15

Figure 4-1 Cruise Card with sample data. Campbell Global, Cruise Card

4-1 Plot Data

The Plot data precedes the Stem data collected on a plot. The recorded information is defined below.

1. **“PLOT”**. Write “PLOT” to identify the information written to the right as Plot data.
2. **Plot No.** Record the cruise plot number. This number will be shown on the provided cruise maps.
3. **Direction to Plot.** Record the cardinal direction, bearing, or azimuth used while navigating to plot center. This will be the bearing and distance reported by the GPS unit, prefix the direction with a “G” for GPS then suffix the direction with a period followed by the distance traveled in feet. Syntax examples are listed below. The examples use a distance of 99 feet (1.5 chains) for routes starting from the GPS RP.
 - a. Cardinal Direction. e.g. NE; GNE.99.
 - b. Bearing. e.g. N45E; GN45E.99.
 - c. Azimuth. e.g. 45, G45.99.
4. **Plot Type.** Following the order of prevailing entry listed in Table 4-1, enter the prevailing plot type code or description defining the plot sampled writing all remaining codes in Plot Notes. For example, a plot is a “Walkthrough” AND a “WLPZ” plot. Enter “T” or “Walkthrough” in Plot Type and “W” or “WLPZ” in Plot Notes.
5. **Plot Tag to PC.** These fields are applicable only to inventory cruising
 - a. Direction. Record in degrees the bearing or azimuth (e.g. N20W, 340) from the plot tag to the plot center).
 - b. Horizontal Distance. Record to tenths the horizontal distance from the point of attachment of the plot tag to the plot center.
6. **Off-plot Tag Description.** When the plot tag is not attached to a plot tree, record a description of the witness object that includes a reference to its size. Follow the syntax *<species> & <DBH> OR <object description> & <size>* (e.g. df9, crstump20in, log20ftlong36indiam). For witnesses that are also plot trees, see the “4.2.1.c Species” section.
7. **Plot Notes.** Enter pertinent notes about the plot. Separate notes by the semi-colon “;” delimiter (e.g. WLPZ; No Trees; on slide). Enclose critical notes in curly brackets (e.g. {bad typing, move plot to cruise unit 5132}).

Table 4-1
Plot Type Codes, Descriptions, and Definitions listed in Prevailing Order of Entry

Order of Prevailing Entry (Ascending)	Plot Type Code	Plot Type Description	Definition
1	T	Walkthrough	An edge sampling plot where some of the tallies may be doubled.
2	W	WLPZ	A plot falling within a Watercourse and Lake Protection Zone.
3	X	No Trees	A plot devoid of samples (can have off-plot site trees).
4	N	Normal	A plot not possessing any of the other plot types listed within the table. <u>This is the default plot type.</u> Leaving Plot Type empty (Null) defaults this value to Company systems. <u>No need to ever record "Normal" in Plot Notes.</u>

4-2 Stem Data

Stem data are a plot's sampled trees. The data immediately follows its Plot data. Kinds of data collected are divided into the categories of samples taken and subsamples taken.

4-2.1 SAMPLES TAKEN

The following data are collected for each tree on the plot.

1. **Stem No.** (Stem Number).
2. **Status.**
3. **Species.**
4. **DBH** (Diameter Breast Height).
5. **DBH Est.** (DBH Estimated).
6. **Total Height to Tip.**
7. **HT Est.** (Height Estimated).
8. **% Crown** (Percent Crown).
9. **Dam. Code** (Damage Code).
10. **% Total Defect – Carb.** (Carbon).
11. **Tree Notes.**

Instructions for their collection are given below.

4-2.1.a Stem

Stem Number is a tree's line (row) number of the plot; (see 3-1.3 *Order of Tally*). The stem number is painted onto trees on the 1/50th acre and 1/10th acre plots with white paint facing plot center. No need to paint tree numbers on 1/100th acre subplot; simply paint a dot a DBH where diameter measurement was taken. See the "4-2.1.d DBH (*Diameter Breast Height*)" section for a definition of DBH.

4-2.1.b Status

A tree's status refers to whether or not it is live or dead. The default status code for a tree is to have a blank status code (indicates a live tree). Dead trees are ranked by their hard to soft decay classⁱ (Table 4-3) and as such have a numeric status code entered.

For declining, live trees that have been girdled within the last three years of cruise, consider them dead even though they may still have green leaves. Record their status as "Snag Class 1". Trees with green leaves that were girdled longer than three years ago have survived the girdling and are recorded using a live status ranking.

Table 4-3
Dead Tree Status Codes, Descriptions, and Definitions

Code	Description	Description of Condition of Standing Dead Wood
1	Snag Class 1	All limbs and branches are present; the top of the crown is still present; all bark remains; sapwood is intact, with minimal decay; heartwood is sound and hard.
2	Snag Class 2	There are few limbs and no fine branches; the top may be broken; a variable amount of bark remains; sapwood is sloughing with advanced decay; heartwood is sound at base but beginning to decay in the outer part of the upper bole.
3	Snag Class 3	Only limb stubs exist; the top is broken; a variable amount of bark remains; sapwood is sloughing; heartwood has advanced decay in upper bole and is beginning at the base.
4	Snag Class 4	Few or no limb stubs remain; the top is broken; a variable amount of bark remains; sapwood is sloughing; heartwood has advanced decay at the base and is sloughing in the upper bole.
5	Snag Class 5	No evidence of branches remains; the top is broken; <20 percent of the bark remains; sapwood is gone;

		heartwood is sloughing throughout.
--	--	------------------------------------

Table 4-4
Species Codes and Description

Species Code	Species
BM	Bigleaf Maple
CQ	Chinkapin
CR	Coastal Redwood
CY	Canyon Live Oak
DF	Douglas-fir
EU	Eucalyptus
GF	Grand Fir
MA	Madrone
MY	Oregon Myrtle
NM	Nutmeg
OC	Other Conifer
OH	Other Hardwood
RA	Red Alder
TO	Tanoak
WH	Western Hemlock
WI	Willow Species

4-2.1.c Species

Enter a species code listed in Table 4-4. If the tree has a plot tag, circle it (Figure 4-1).

4-2.1.d DBH (Diameter Breast Height)

DBH is a tree's diameter at Breast Height (BH). See the "3-1.5 Borderline Calls" section for a definition of BH. DBH is recorded to the nearest 1/10th inch. Read the diameter tape by truncating the digits to the right of tenths place. For example, a tree's DBH is 2.59 inches. Read 2.5 and write the 1/10th-inch DBH as 2.5. The point where DBH is measured shall be marked with a stripe of white paint at least 4" in length. Please see Appendix B for special instructions regarding DBH measurements.

4-2.1.e DBH Est. (DBH Estimated)

Check the box if DBH is not measured with a diameter tape, or calipers but estimated using some other means (eye, relaskop, etc.).

4-2.1.f Total Height to Tip

Total height is the total length of bole including the stump. The dominant stem is measured for trees having a fork. For leaning trees, the measurement is made along the lean. If a live tree or snag is broken only measure to the existing tip unless the tree has a recovered leader, do not attempt to measure to the reconstructed top. Trees with previously broken 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). Forked trees should be treated the same as unforked trees.

4-2.1.h % Crown (Percent Crown)

Percent crown is sampled on all live trees sampled for total height. It is defined by the equation:

$$c = (b/t) 100$$

where

c = % Crown,

b = length of the visually balanced crown (if sparse, also compact the crown), and

t = total height (height is rebuilt to tip for broken top trees).

Visually estimate the % crown. Enter the estimate as a code as shown in Table 4-5.

Table 4-5
Percent Crown Codes

% Crown	
Code	% Crown
0	< 0
5	1 – 5
10	6 – 10
20	11 – 20
30	21 – 30
40	31 – 40
50	41 – 50
60	51 – 60

70	61 – 70
80	71 – 80
90	81 – 90
100	91 – 100

4-2.1.i Dam. Code (Damage Code)

For all live and dead trees and following the order of prevailing entry listed in Table 4-6 enter damage when present. Leaving the cell empty defaults the entry to “N” meaning “No Damage”. The prevailing order of entry is based upon desirable wildlife features and favors listing cavity and agents leading to cavity first before considering other damages. For hardwoods, do not bother recording “Crook/Sweep” or “Fork” damage, for most local hardwood have these features. For this same reason, do not record broken top for hardwoods unless the top is completely sheared off. If a tree is subject to multiple damage codes insert the predominant code in the Damage Code field and write the additional damage codes in the Tree Notes.

Table 4-6
Damage Codes, Descriptions, and Definitions listed in Prevailing Order of Entry

Order of Prevailing Entry (Ascending)	Damage Code	Plot Type Description	Comments
1	U	Basal Cavity	
2	V	Cavity (not basal)	
3	X	Dead Top	
4	T	Broken Top	Generally not recorded for hardwoods.
7	N	No Damage	<u>This is the default damage.</u> Leaving damage empty (Null) defaults this value to Company systems.

Crack. Deduct 30% volume loss for each straight crack occurring by 16-foot log segment. 3 cracks cull a log. Cull a log having spiral crack.

Broken Top. Determine the percent volume loss of the log where the break occurs. Determine the percent volume loss of additional missing, 16-foot log segments above the break. Sum the values to determine the deduction.

Rot, Conks, Punk Knots. Follow the guidelines of Table 4-7 when estimating missing volume of 16-foot log segments for rot, conks, and punk knots.

4-2.1.k % Total Defect – Carb. (Carbon)

Total percent carbon defect is defined as the total percent cubic foot defect of a bole both inside and outside the board foot scaling cylinder from and including the stump to the tip. Record the estimate to the nearest whole percent for all live and dead trees (both conifers and hardwoods). There are differences between live trees and dead trees in how carbon defect is estimated; see below.

Carbon Defect for Live Trees. Using a rebuilt top if broken, record the total percent carbon defect due to missing portions of bole for live trees using Table 4-8 (conifers) or Table 4-9 (hardwoods) as a guide.

Damages affecting volume loss are basal cavity, cavity, heart rot, root rot, cracks, fire, mechanical, and broken tops. Damages *not* affecting volume loss are sweep, crook, fork, dead top, insects and browse.

Burnt and rotten wood are not as dense (lighter) and therefore have less carbon than solid wood. Because both carbon and biomass are sold by weight, when estimating loss due to rot or charcoal, imagine the airspace created (wood missing) if the defected wood were compressed to a solid composition. Defect according to how much airspace is produced.

Table 4-8
Conifer – Percent of Total Stem Volume Above Ground
by 1/3 of Total Height (includes stump)

Total Height (ft)	% of Total Stem Cubic Volume		
	Bottom 1/3	Middle 1/3	Top 1/3
<= 4	Treat as 1 piece		
5 to 10	55%	40%	5%
11 to 20	65%	30%	5%
21 to 130	62%	30%	8%
Redwood >131	64%	29%	7%
Other Conifers > 131	66%	28%	6%

Table 4-9

**Hardwood – Percent of Total Stem Volume Above Ground
by 1/3 of Total Height (includes stump)**

Total Height (ft)	% of Total Stem Cubic Volume		
	Bottom 1/3	Middle 1/3	Top 1/3
<= 20	Treat as 1 piece		
21 to 30	72%	23%	5%
>= 31 to 20	65%	30%	5%

Carbon Defect for Dead Trees. Considering the snag only to its actual height (only to the broken top if the tip is gone) as the entire piece (100% of the volume), in percent volume record an ocular, cubic-foot estimate of missing wood (pieces, chunks, slabs, hollows) to the actual height. Company systems will, based upon the actual height of the snag, determine whether the top is broken to compute a volume loss of the missing top.

Do not consider rot as defect as is done with live trees. Rot is quantified by the dead tree's status (see *Table 4-3*) that describes its density degradation from solid wood. Figures 4-5 and 4-6 are examples how to estimate carbon defect for dead trees.

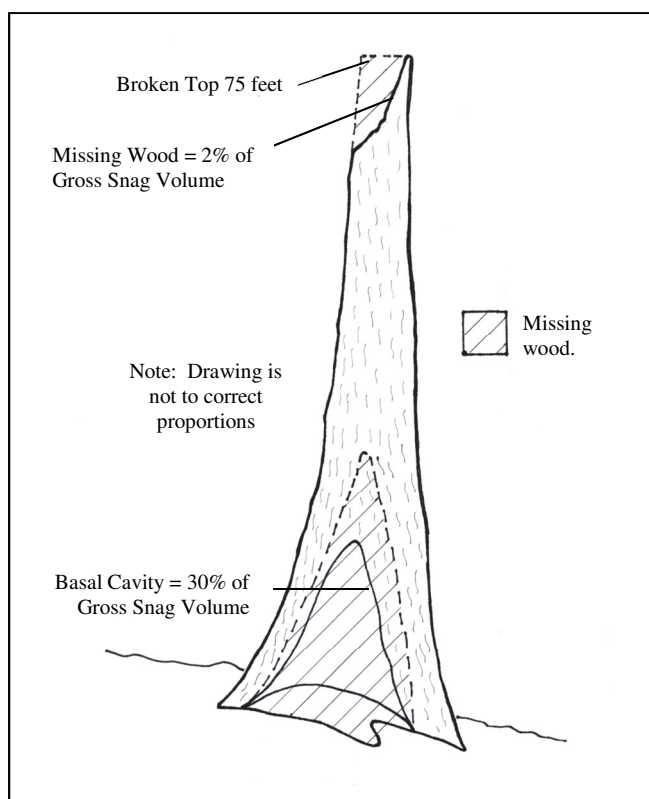


Figure 4-5 Snag Percent Carbon Defect
Example 1. Snag Height = 75 feet; Defect = U (Basal Cavity); Carbon Percent Defect = 32%

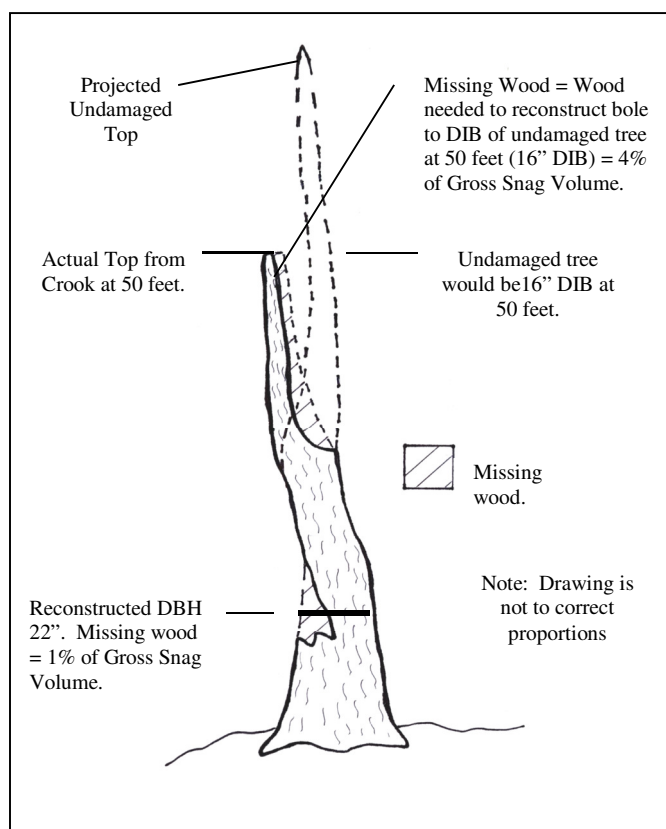


Figure 4-6 Snag Percent Carbon Defect
Example 2. Snag Height = 50 feet; Defect = C (Crook); Carbon Percent Defect = 5% (4% + 1%).

4-2.1.1 Tree Notes

Record any pertinent notes about the tree (if not recorded under *Dam. Code*) and borderline “IN/OUT” measurements. For these common notes, use the shorthand syntax listed below.

1. **bli.** Border Line In.
2. **blo species DBH.** Border Line Out – Species Code – DBH to tenths (e.g. blo df 10.2).
3. **sd feet.** Slope distance to hundredths from the tree’s center to plot center (e.g. sd 25.32).
4. **hd feet** Horizontal distance to hundredths from the tree’s center to plot center (e.g. hd 20.25).
5. **x%.** Slope in percent used to compute horizontal distance from a tree’s center to plot center (e.g. 25%).
6. **s.** Age estimated from a nearby stump ring count.
7. **w.** Age estimated from a whorl count.
8. **#x.** Stem Number (e.g. behind #6).

Separate groups of notes by the semi-colon “;” text delimiter. Following are examples of notes using the shorthand syntax.

1. bli; GROUND BEES AT BASE!
2. blo cr 26.9 hd 35.90; M
3. blo df 5.2 sd 10.62 35%; bear damage; behind #3

5 SUBMITTING WORK

Consultant shall submit completed Work at least bi-monthly to Company. The submitted Work shall be called a Block. A Block is comprised of (1) Work cruise data, (2) Work cruise maps, and (3) Data cards, if they were used for data collection. All Block items must be submitted for inspections to start and they must meet the work's submitted tolerances in Table 5-1.

Table 5-1
Work Submittal Tolerances

Work Submittals	
Item	Tolerance
Hand Writing, Printing, and Sketches	Legible and can be reproduced with a copy machine.
Electronic Data	Readable by Company computers and software.
Electronic/Paper Forms and Maps	All required forms and maps are submitted. All required fields are entered.
Company Provided Data	Correctly transferred to submitted forms.
Collected Data	Data content and syntax appear correct.

5-1 Work Cruise Data

There are three forms to Work cruise data:

1. Raw Data.
2. Inspection Data
3. Clean Data.

Consultant shall submit Raw Data and Clean Data to Company and may be required by Company to submit Inspection Data as explained below.

5-1.1 RAW DATA

Raw Data is the original cruise data as collected in the field on electronic, magnetic tape or paper media not altered or edited in any way.

When paper is the media, Company cruise unit data cards shall be used. See Figure 4-1 for an example. Cards will be supplied to the contractor by Company.

Company shall determine whether the submitted Raw Data qualifies to be considered as Inspection Data; (see *5-1.2 Inspection Data*). If the Raw Data does not qualify as Inspection Data, Contractor will be notified by Company and Contractor shall bring the data up to Inspection Data standards and submit Inspection Data.

5-1.2 INSPECTION DATA

Inspection Data is data that does not have any major problems that would prevent the data from being used for the inspection of Work. Inspection Data results from Raw Data. Its form must be electronically entered to the Excel workbook that is supplied by company OR, if agreed to by Company, entered to a different electronic format proposed by Consultant. Company shall use Inspection Data for inspections when making determinations of acceptable Work; (see *6 – Inspections*). Hot Check Data is Inspection Data from the first day or two of cruising. If the data is being recorded onto paper data cards in the field, then the Hot Check Data may be submitted as the original data cards which will be returned to Contractor.

5-1.3 CLEAN DATA

Clean Data is data that is free of errors. Contractor is required to generate the Clean Data. Generally within four days of raw data submission, Company will process the data and notify the contractor of any deficiencies.. Generating Clean Data may include additional field work when submitted data is found to be deficient for reasons such as, but not limited to: (1) not meeting cruise targets or (2) incomplete data.

5-2 Work Cruise Maps, and Cruise Data Cards

Submit to Company:

1. Either the originals or legible copies of pertinent cruise maps showing all navigation route documentation; (see *2-2.2 Navigation Route Documentation*).
2. If the data was recorded onto paper cards in the field, submit copies of the cards. Company will make one copy of the cruise cards at no cost to the contractor if the originals are brought to the company office.

6 INSPECTIONS

Pursuant to the “*Inspection of Premises and Work*” section of the Agreement, Company reserves the right to inspect Blocks (see 5 – *Submitting Work*) to determine compliance with the cruise procedures and standards. For reasons of efficiencies, Company may combine Blocks in the inspection process.

6-1 Conditions of Inspection

Standard. If Company chooses to inspect Blocks for compliance with procedures and standards, the Company representative or designee shall inspect. The Company representative’s findings shall be the STANDARD and shall be conclusive for determining compliance to procedures and standards.

Failed Block. Consultant shall rework a failed Block until it complies with procedures and standards at no expense to Company. Issues causing rework shall be corrected across all failed plots of a Block or as directed by the Company representative.

Withholding Payment. A Block must be inspected to determine compliance if Company desires to withhold payment and require rework because Company believes the Block is not in compliance with procedures and standards.

The Inspection. When Company chooses to inspect, the inspection shall be done utilizing: (1) an office review and (2) a field review.

6-2 Inspection Procedures

Inspection consists of three parts:

1. Clean Data Inspection. Generally within four days of data submission, Company will process the submitted data and notify contractor....send the resulting. Contractor is responsible for cleaning the submitted data with edits to resolve problems. More than one round of data fixes may be required to completely clean the data. This may require one or more trips to the field by Contractor to collect the necessary data. Clean data as determined by Company constitutes passing the Clean Data Inspection.
2. Field Inspection. A field inspection will be carried out for an inspection block of 50 plots or all plots in a cruise, whichever is smaller. If data submissions are for less than a full field inspection block, Company has the right to accumulate submitted data and wait to inspect until a full field inspection block is available.

The field review is a by-cruiser, random inspection of navigation, monumentation, plot location, and data collection. Work shall comply with the tolerances set forth in Table 6-1 and Table 6-2. Data measurements shall be scored using a Check Cruise Score Card. The inspection intensity of plots shall be: 10% for all cruisers. Company reserves the right to expand any inspection to

more than 10% for any reason. A score of 94% on the Inspection Scorecard and adherence to the cruise design constitutes passing the Field Inspection.

If the field review of any cruiser fails, the failed portion of the inspection batch shall be returned to the Contractor for rework.

3. Keypunch Inspection. If at any time Company suspects there are keypunch errors in any submitted data (not just the most recent data submission), Company can require Contractor to verify all keypunching. Keypunch errors are usually detected during Field Inspection. On rare occasions, keypunch errors are detected later when the data is being processed for the timberland inventory; this can be several months after the data was submitted. All data is assumed to provisionally pass the Keypunch Inspection. Final determination of passing the Keypunch Inspection occurs after all data has been submitted and is processed for the inventory.

Table 6-1
Navigation, Monumentation, and Data Collection Tolerances

Navigation and Monumentation		
Item		Tolerance
Plot Center Location		Plot centers are within the intended cruise unit, are reasonably close to their mapped location, and bias is not evident.
Flagging Monuments		Correctly hung and labeled most of the time. Referenced items may be located and identified despite labeling errors.
Plot Tag	Object	Correctly selected as stated in the procedures.
	Attachment	Correctly attached to the object as stated in the procedures.
	Horizontal Distance	Within +/- 3/10 th s foot most of the time.
	Direction to Plot Center	Within 2 ½ degrees most of the time.
	Label	Correctly labeled most of the time.
Data Collection		
Data Codes		Correct.
Data Measurements		Random sample of the Block's plots (10% sample) achieves a check cruise score of at least 94%.

Table 6-2
Check Cruise Score Card Tolerances

Check Cruise Score Card Tolerances	
Stem Count	1. No trees missing on 1/10 th or 1/50 th acre plots, and TPA within 30% tolerance for the 1/100 th acre plot.
Diameter Breast Height (DBH)	Within +/- 2% for trees less than 24 inches DBH and within +/- 3% for larger trees.
Species	Correct
Total Height to Tip	Height samples within the lesser of +/- 10% or 10ft.
Status	Correct
Damage Code	Correctly chosen as stated in the procedures.
Percent Crown	Within +/- 1 Crown Code
Percent Total Defect (Carbon)	Within +/- 10%.

7 INVOICING

Submitted Block(s) (see 5 – *Submitting Work*) forms the basis of payment and may be invoiced per the “*Compensation*” section of the Agreement. Invoices shall clearly show the information listed below.

1. Invoice number.
2. Consultant’s business name.
3. Business address.
4. Business phone number.
5. Business fax number.
6. Business e-mail.
7. Company’s name and address.
8. Agreement number.
9. Exhibit label.
10. Computer filenames of the Work cruise data.
11. A reasonable detail listing describing the items invoiced.
12. Dollars/item invoiced.
13. Total dollars charged.

7-1 Invoice Approval

Invoices for Submitted Plots. Company has two weeks to approve the invoice once plots pass the Clean Data Inspection, Field Data Inspection and Key punch Inspection.

7-2 Invoice payment

Payment of invoices by Company generally occurs within two weeks of invoice approval.

APPENDIX A - HARVEST PLAN FLAGGING & PAINT COLORS WITH DEFINITIONS

As of May 14th, 2010

Table A-1. Flagging

Flagging Color/Combination	Meaning
Red 'PROPERTY LINE'	Property Line – Do NOT cross unless directed by RPF
Pink 'THP BOUNDARY'	Boundary of THP. – Don't fell trees outside except for safety.
Lime Glo 'SILVICULTURE'	Silviculture Boundary – may be coincident with WLPZ or Yarding Method.
Yellow/Black Stripe	Yarding Method Boundary.
Blue/White Stripe	Class I and II centerlines. <i>May not be flagged where obvious.</i>
Blue/White 'LAKE AND WATERCOURSE PROTECTION ZONE'	Watercourse and Lake Protection Zones, Canopy Retention Zones for Springs. May indicate silviculture boundary as well.
White w/Blue Polka Dots	Class III centerline. Triple flag denotes end of segment. May also serve as perimeter of a wet area.
White w/Blue Polka Dots with Solid Red	Wet Area Equipment Limitation Zone
Red	Tractor Stop Lines, Equipment Limitation Zones, Equipment Exclusion Zones.
Yellow 'SKID TRAIL'	Pre-flagged tractor road. Triple flag denotes end of trail.
Orange/White Stripe 'SPECIAL TREATMENT ZONE'	Special Treatment Zone for Wildlife Protection Zones, Archaeological Protection Zones, unstable areas, botanical protection areas.
Blue	Centerline of proposed roads. May also be present on existing roads which are very brushy.
Orange	Variety, primarily Logging road grades and Cable corridor roads
Blue and Orange hung together	Proposed and/or existing landing in brushy area. May also denote limits of use for existing WLPZ landings.
Orange/White or Green/White Stripe	Older inventory cruisers flagging, not THP related.
Pink/Black Stripe (may have Lime Glo)	Used by Wildlife Crews, not THP related.
Orange with White	Map Points, Instructions
Yellow with White	Road Maintenance Activities
Red with White	RPF message flagging.
White	Reconnaissance flagging, not THP related
Purple	Inventory or Aquatic Monitoring flags, not THP related.

Table A-2. Paint

Paint Color	Meaning
Blue	Harvest Tree, Labels
Orange	Retention Tree, Labels
Yellow	Property Line Blaze, Labels
RETAIN ANY TREE MARKED “NO” IN ANY COLOR PAINT	
CUT ANY TREE MARKED “CUT” IN ANY COLOR PAINT	

APPENDIX B – SPECIAL INSTRUCTIONS FOR DBH MEASUREMENTS

The attached special instructions for DBH measurement are taken from the FIA National Core Field Guide, Version 6.1 dated October, 2014 section 5.9.2. Not all instructions apply to the Usal Redwood Forest Carbon Inventory. For example, where the special instructions refer to multi-stemmed woodland species, no such species as defined in Appendix 3 of the Core Field Guide are found on the Usal Redwood Forest Project Area, and as such, references to multi-stemmed woodland species can be ignored.

5.9.2 DIAMETER AT BREAST HEIGHT (DBH)

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

Special DBH situations:

1. **Forked tree:** In order to qualify as a fork, the stem in question must be at least 1/3 the diameter of the main stem and must branch out from the main stem at an angle of 45 degrees or less. Forks originate at the point on the bole where the piths intersect. Forked trees are handled differently depending on whether the fork originates below 1.0 foot, between 1.0 and 4.5 feet, or above 4.5 feet.
 - **Trees forked below 1.0 foot.** Trees forked below 1.0 foot are treated as distinctly separate trees (fig. 23). Distances and azimuths are measured individually to the center of each stem where it splits from the stump (fig. 26 A-C). 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 subplot, 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 (fig. 24), but only one distance and azimuth (to the central stump) is recorded for each stem (fig. 26 D-F). Although a single azimuth and distance applies to all, multiple stems should be recorded as they occur in clockwise order (from front to back when one stem is directly in front of another). The DBH of each fork is measured at a point 3.5 feet above the pith intersection. When forks originate from pith intersections between 1.0 and 4.5 feet, the limiting distance is the same for all forks—they are either all on, or all off the plot.

Multiple forks are possible if they all originate from approximately the same point on the main stem. In such cases, measure DBH on all stems at 3.5 feet above the common pith intersection (fig. 26-F).

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).

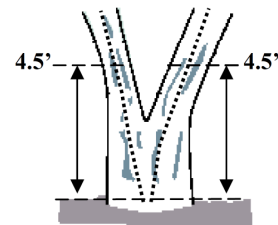


Figure 23. Forked below 1.0 ft.

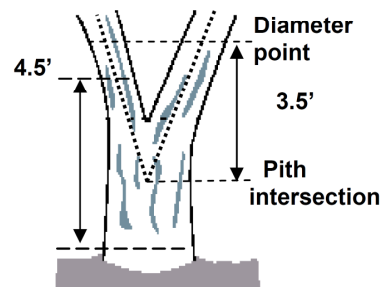


Figure 24. Forked between 1.0-4.5 ft.

- 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.

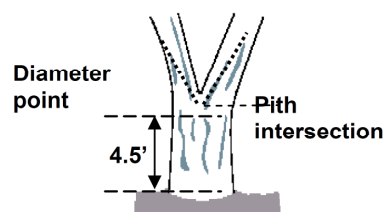


Figure 25. One tree.

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

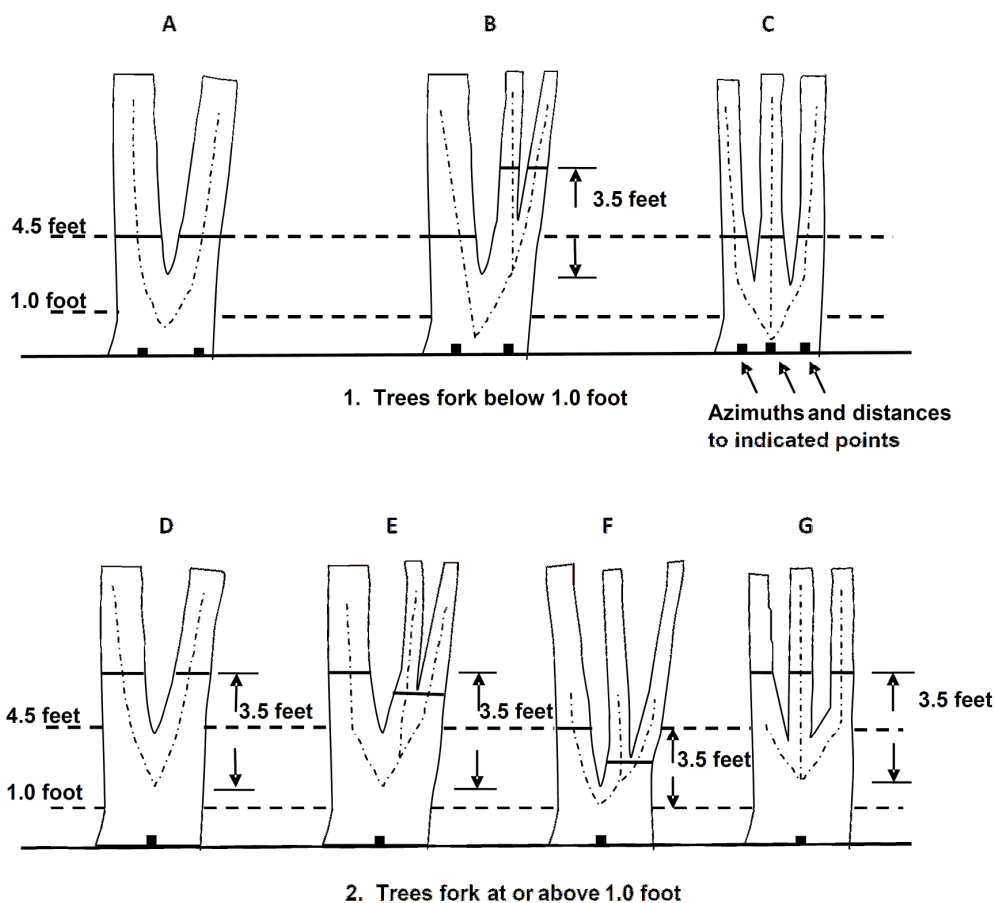


Figure 26. Summary of where to measure DBH, distance, and azimuth on forked trees.

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

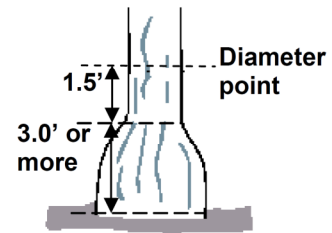


Figure 27. Bottleneck tree.

4. Tree with irregularities at DBH: On trees with swellings (fig. 28), bumps, depressions, and branches (fig. 29) at DBH, diameter will be measured immediately above the irregularity at the place it ceases to affect normal stem form.

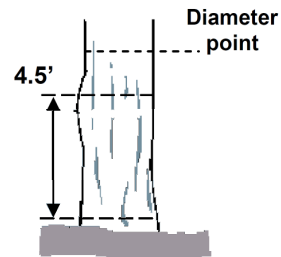


Figure 28. Tree with swelling.

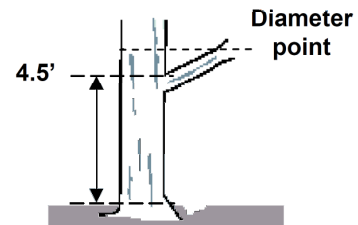


Figure 29. Tree with branch.

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

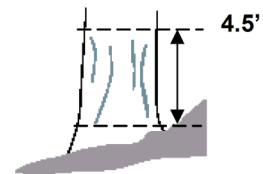


Figure 30. Tree on a slope.

6. Leaning tree: Measure diameter at 4.5 feet from the ground along the bole. The 4.5-foot distance is measured along the underside face of the bole (fig. 31).

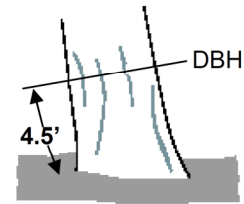


Figure 31. Leaning tree.

8. Independent trees that grow together: If two or more independent stems have grown together at or above the point of DBH, continue to treat them as separate trees. Estimate the diameter of each, set the "DIAMETER CHECK" code to 1, and explain the situation in the notes.

In this situation use the "half-DBH" method. Take a half tree diameter by estimating two point opposite each other on the stem at the DBH point. Measure the distance between the two marks and double the measurement to determine DBH. Either paint the location of the two marks, or set an aluminum nail at each point. Make a note that the DBH was measured using the "half-DBH" method.

9. Missing wood or bark: Do not reconstruct the DBH of a tree that is missing wood or bark at the point of measurement. Record the diameter, to the nearest 0.1 inch, of the wood and bark that is still attached to the tree (fig. 32). If a tree has a localized abnormality (gouge, depression, etc.) at the point of DBH, apply the procedure described for trees with irregularities at DBH (figs. 28 and 29).

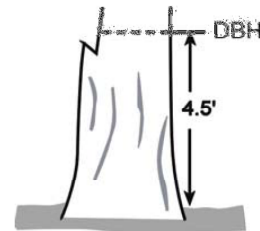


Figure 32. Tree with part of stem missing.

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

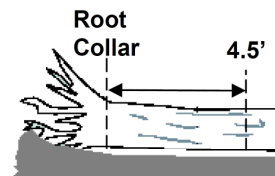


Figure 33. Tree on the ground.

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

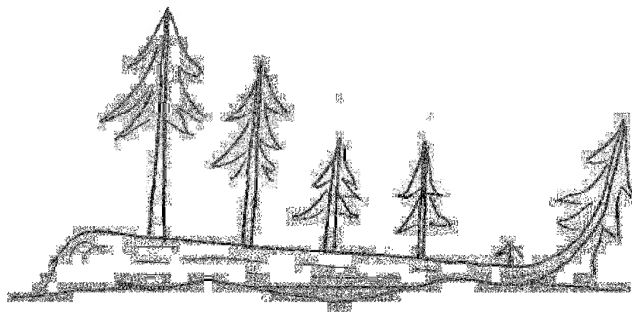


Figure 34. Down tree above duff.

- 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.

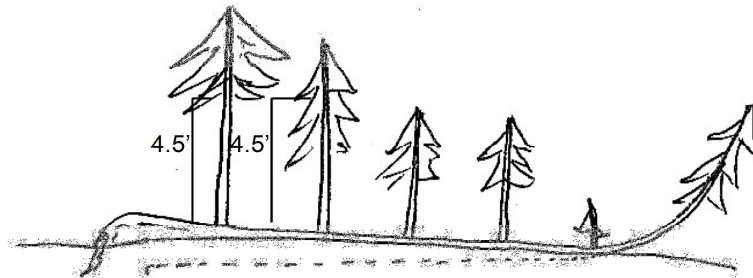


Figure 35. Down tree below duff.

12. 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).

REFERENCES

ⁱ Harmon, Mark E.; Woodall, Christopher W.; Fasth, Becky; Sexton, Jay; Yatkov, Misha. 2011. Differences between standing and downed dead tree wood density reduction factors: A comparison across decay classes and tree species. Res. Pap. NRS-15. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 40 p.

Appendix C

Road Buffer Assumptions

The Road buffer algorithm uses the WIDTH_SURFACE field in the road layer to buffer the roads for our analytic road buffer layer in SDE. The value is assumed to be the entire width of the treeless surface, so the value is halved.

If no value exists in the WIDTH_SURFACE field, an assumption of width will be applied based on the ROAD_TYPE attribute. If there isn't information for road type, the SURFACE field is used.

Assumptions for all northwest properties are:

Road Type	Width
Highway/State/County/City	50
Mainline	40
Mainline (dirt)	24
Secondary/Spur	24
Paved	40
Rocked	30
Dirt	24

Things that *do not* get buffered, based on the ROAD_TYPE and STATUS field:

ROAD_TYPE: 4WD, Trail

STATUS: Unknown, Legacy, Abandoned

Appendix D

Plot and Strata Map