

U.S. FOREST OFFSET PROJECT DATA REPORT INITIAL REPORTING PERIOD - IMPROVED FOREST MANAGEMENT				
<i>OPR Staff Use Only</i>	Date Report Received:	OPR Tracking Number:	Date Report Reviewed:	<i>OPR Staff Use Only</i>
<i>Entities submitting the project's first Offset Project Data Report must submit the information requested in both Initial Reporting Period and the Annual Reporting forms to the appropriate Offset Project Registry. For every reporting year thereafter, submit only the information requested in the Annual Reporting form.</i>				
PART I. ENTITY SUBMITTING REPORT				
Is this form being submitted by the Offset Project Operator (OPO) or by the Authorized Project Designee (APD)? <i>Note: The person completing this form should be an OPO/APD employee.</i>				<input type="checkbox"/> OPO <input checked="" type="checkbox"/> APD
Name of Person Completing Form:		Organization, if applicable:		
James D. Clark		NCRM, Inc.		
Date Form Completed:	Phone Number:	Email Address:		
6/13/2016	707-485-7211	jimclark@ncrm.com		
PART II. OFFSET PROJECT INFORMATION				
Offset Project Name:		OPR Project ID#:	ARB Project ID# (if known):	
Brush Creek		ACR200	CAFR5200	
Offset Project Commencement Date:	First Reporting Period Start Date:	First Reporting Period End Date:		
December 10, 2013	December 10, 2013	June 30, 2015		
Provide an explanation and justification for the commencement date. Specify the action(s) that identify the offset project commencement date. The date that the offset project listing information was submitted to the Offset Project Registry is the offset project commencement date.				
Optional: Provide the nearest town/city to the Project Area: Point Arena, CA				
PART III. OPO/APD INFORMATION				
A. OPO				
OPO Name:			OPO's CITSS ID#:	
Steve Miller and Florence Miller Co-Trustees of the Edward Miller Trust			CA 1557	
Mailing Address:		City:	State:	Zip:
PO Box 1818		Healdsburg	CA	95548
Contact Person:	Phone Number:	Email Address:		
Steve Miller	(707) 953-4584	murphybs@sonic.net		
B. APD (if applicable)				<input type="checkbox"/> No APD/Not Applicable
APD Name:			APD's CITSS ID#:	
James D. Clark			CA 1569	
Mailing Address:		City:	State:	Zip:
PO Box 435		Calpella	CA	95418
Contact Person:	Phone Number:	Email Address:		
James D. Clark	707-485-7211	jimclark@ncrm.com		
PART IV. LAND OWNERSHIP				
A. Is the Offset Project Operator (OPO) the owner in fee for the Project Area? <i>Further documentation is required for all projects. Submit as attachment labeled "Attachment A." See Part X of this OPDR document for more information.</i> If "no," explain how the entity identified as the OPO has the right to undertake and list the project.				<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

B. Optional: List all Forest Owners. This includes owners in fee as well as third parties with existing property interests within the Project Area that affect the trees and standing timber located in the Project Area (e.g. mineral rights, timber rights, easements, rights of way, leases, etc.). See Addendum to OPDR IV.B.		
C. Does the offset project occur on public or private lands? <i>If the project occurs on public lands, proceed to questions C1 and C2. Otherwise, skip to question D. Further documentation is required if project occurs on public lands. Submit copies of documentation demonstrating explicit approval of the project's management activities and baseline, as well as the public vetting process used; attachment should be labeled "Attachment B." See Part X of this document for more information.</i>		<input checked="" type="checkbox"/> Private <input type="checkbox"/> Public
1. Describe the public process that was used to evaluate the forest management activities and policy decisions concerning the offset project. N/A		
2. Describe the explicit approval process used by the public entity to initiate and maintain this offset project, including the offset project's management activities and baseline. N/A		
D. Does the project employ a Qualified Conservation Easement (QCE)? <i>If employing a QCE, proceed to questions D1, D2, and D3. Otherwise, skip to question E. Supporting documentation for a QCE is required. Submit as attachment labeled "Attachment C." See Part X of this document for more information.</i>		<input type="checkbox"/> QCE <input type="checkbox"/> Public Ownership <input checked="" type="checkbox"/> N/A
1. Date that the QCE was recorded.		
2. Optional: Is the project located in a state that requires third-party beneficiaries to sign the easement (i.e., to "accept and record that acceptance"), such as Arizona, Pennsylvania, or West Virginia?		<input type="checkbox"/> Yes <input type="checkbox"/> No
3. Provide the terms within the easement that affect forest management. N/A		
E. Does the offset project occur on any of the following categories of land? (check all that apply) <input type="checkbox"/> Land that is owned by, or subject to, an ownership of possessory interest of a Tribe <input type="checkbox"/> Land that is "Indian lands" of a Tribe as defined by 25 U.S.C. §81(a)(1) <input type="checkbox"/> Land that is owned by any person, entity, or Tribe, within the external borders of such Indian lands <input checked="" type="checkbox"/> None of the above <i>If "none of the above," skip to Part V. Otherwise, proceed to Optional questions E1 and E2. Further documentation is required for projects occurring on land listed in the first three categories. Submit supporting documents as attachments labeled "Attachment D." See Part X of this document for more information.</i>		
1. Optional: Does a limited waiver of sovereign immunity between ARB and the governing body of the Tribe exist?		<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A
2. Optional: Provide a description of land ownership within the Project Area. N/A		
PART V. OFFSET PROJECT AREA		
Maps depicting specific elements of the Project Area are required for all projects. <i>Submit supporting documentation as attachments labeled "Attachment E." See Part X of this document for more information.</i>		
Latitude of Offset Project Location: 38.962359	Longitude of Offset Project Location: 123.584898	Project Area Total Acreage: 1,763.41
A. Identify the assessment area (or assessment areas, if project crosses more than one) that contain Project Area lands and list the acreage of project lands within each assessment area. See Addendum to OPDR V.A.		
B. Identify and describe the governing jurisdiction(s) applicable to the Project Area. The Project Area is subject to the governing jurisdiction of the County of Mendocino, the State of California, and the United States of America.		
C. Describe how the Project Area was determined. See Addendum to OPDR V.C.		
D. Describe the existing land cover, and land use of the Project Area. See Addendum to OPDR V.D.		

E. Describe the forest vegetation types within the Project Area boundary. See Addendum to OPDR V.E.	
F. Describe the site classes within the Project Area boundary. See Addendum to OPDR V.F.	
G. Describe the land pressures and climate zone/classification applicable to the Project Area. See Addendum to OPDR V.G.	
H. Describe the historical land uses, current zoning, and projected land use within the Project Area and surrounding areas. See Addendum to OPDR V.H.	
I. Describe the forest conditions within the Project Area, including species composition, age class distribution, and management history. See Addendum to OPDR V.I.	
PART VI. OFFSET PROJECT ELIGIBILITY	
A. Does the Project Area have a canopy cover that is greater than 10 percent? <i>Supporting documentation is required. Submit as attachment labeled "Attachment F." See Part X of this document for more information.</i> See Addendum to OPDR VI.A.	<input checked="checked" type="checkbox"/> Yes <input type="checkbox"/> No
B. Optional: Are the associated project lands currently in compliance with all local, state, and federal regulatory requirements?	<input checked="checked" type="checkbox"/> Yes <input type="checkbox"/> No
Optional: If no, provide an explanation of the non-compliance. N/A	
C. Does the entity submitting this report declare that the offset project <u>has not</u> and <u>does not</u> employ broadcast fertilization?	<input checked="checked" type="checkbox"/> Yes <input type="checkbox"/> No
D. Indicate how the offset project meets the definition of Natural Forest Management per Table 3.2 in the Compliance Offset Protocol US Forest Offset Projects, October 20, 2011:	
1. Native species: a) Does the project consist of at least 95% native species based on the estimated sum of carbon in the standing live carbon pool? Improved Forest Management Projects are assessed using estimates of basal area per acre. <i>If "no," proceed to question 1b. Otherwise, skip to question D2.</i> See Addendum to OPDR VI.D.1.	<input checked="checked" type="checkbox"/> Yes <input type="checkbox"/> No
b) Describe how the project will meet this requirement.	
2. Composition of native species: a) Does the Project Area naturally consist of a mixed species distribution where no single species' prevalence, measured as the percent of basal area of all live trees in the Project Area, exceeds the percentage value of standing live carbon shown under the heading 'Species Diversity Index' in the Assessment Area Data File? <i>If "no," proceed to questions 2b and 2c. Otherwise skip to question D3.</i> See Addendum to OPDR VI.D.2	<input checked="checked" type="checkbox"/> Yes <input type="checkbox"/> No
b) Explain how the project will demonstrate a trend toward achieving the Species Diversity Index of native species and meet this requirement within 25 years. N/A	
c) If the Project Area does not naturally consist of a mixed species distribution: Will or have you provided a written statement from the government agency in charge of forestry regulation in the state where the project is located stipulating that the Project site is not capable of meeting the requirement of mixed species distribution?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="checked" type="checkbox"/> N/A

3. Distribution of age classes/sustainable management:

- a) Indicate how the project will meet the requirement for sustainable management if regeneration or commercial harvesting is either planned or initiated within the Project Area demonstrating sustainable long-term harvesting practices. This applies to all forest landholdings of the Forest Owner(s) (check one of the boxes).

- ☐ Not applicable; no commercial harvesting is occurring within the Project Area.
- ☒ Third party certification under the Forest Stewardship Council, Sustainable Forestry Initiative, or Tree Farm System, whose certification standards require adherence to and verification of harvest levels which can be permanently sustained over time.
- ☐ Adherence to a renewable long-term management plan that demonstrates harvest levels which can be permanently sustained over time and that is sanctioned and monitored by a state or federal agency.
- ☐ Employ uneven-aged silvicultural practices and maintain canopy retention averaging at least 40% across the forest, as measured on any 20 acres within the entire forestland owned by the Forest Owner, including land within and outside of the Project Area (areas impacted by Significant Disturbance may be excluded from this test).

See Addendum to OPDR VI.D.3.

- b) On a watershed scale up to 10,000 acres (or the Project Area, whichever is smaller), projects must maintain, or make progress toward maintaining, a maximum of 40% of the project's forest lands in ages that are less than 20 years old. (Areas impacted by Significant Disturbance are exempt from this test until 20 years after reforestation of such areas.) Does the acreage within this project meet this requirement?

☒ Yes
☐ No

If "no," proceed to question 3c. Otherwise, skip to question D4.

See Addendum to OPDR VI.D.3.

- c) If the project does not meet the age class requirement at this time, explain how the project intends to demonstrate progress to meet this requirement over time; such that forest lands in ages less than 20 years old are reduced and make up no more than 40% of the Project Area.

N/A

4. Structural elements (standing and lying dead wood):

How does the project ensure that structural elements are retained in sufficient quantities throughout the project life?

See Addendum to OPDR VI.D.4.

- E. Describe the management activities that will result in increased carbon stocks in the Project Area, compared to the baseline.

See Addendum to OPDR VI.E.

- F. Is this project being implemented and conducted as the result of any law, statute, regulation, court order, or other legally binding mandate?

If "yes," explain:

☐ Yes
☒ No

- G. Does the offset project take place on land that was part of a previously listed and registered Forest Offset Project?

This question is applicable to both voluntary and compliance markets. If "yes" proceed to questions G1 and G2. Otherwise, skip to Part VII.

☐ Yes
☒ No

1. **Optional:** Was the previous Forest Offset Project terminated due to an Unintentional Reversal?

☐ Yes
☒ No

2. **Optional:** Is the project transitioning to the Compliance Offset Protocol U.S. Forest Projects, October 20, 2011, after previously being listed as an early action offset project?

☐ Yes
☒ No

PART VII. CARBON STOCK INVENTORY

- A. Provide a description of the inventory methodology used to quantify carbon stocks for each required carbon pool in the forest project's offset boundary. The inventory methodology must describe the information required in Appendix A.3 of the Compliance Offset Protocol U.S. Forest Projects, October 20, 2011.

IFM-1 Standing Live: See Addendum to OPDR VII.A.

IFM-3 Standing Dead: See Addendum to OPDR VII.A.

IFM-6 Soil (if applicable): See Addendum to OPDR VII.A.

IFM-7 Carbon in in-use forest products: See Addendum to OPDR VII.A.

IFM-8 Forest product carbon in landfills (if applicable): See Addendum to OPDR VII.A.

IFM- 9 Biological emissions from site preparation: See Addendum to OPDR VII.A.

IFM-14 Biological emissions/removals from change in harvesting on forestland outside project area: See Addendum to OPDR VII.A.

IFM-17 Biological emissions from decomposition of forest products: See Addendum to OPDR VII.A.

- B. Describe the calculation methodologies used to determine metric tons per acre for each of the carbon pools included in the Offset Project Data Report.

IFM-1 Standing Live: See Addendum to OPDR VII.B.

IFM-3 Standing Dead: See Addendum to OPDR VII.B.

IFM-6 Soil (if applicable): See Addendum to OPDR VII.B.

IFM-7 Carbon in in-use forest products: See Addendum to OPDR VII.B.

IFM-8 Forest product carbon in landfills (if applicable): See Addendum to OPDR VII.B.

IFM- 9 Biological emissions from site preparation: See Addendum to OPDR VII.B.

IFM-14 Biological emissions/removals from change in harvesting on forestland outside project area: See Addendum to OPDR VII.B.

IFM-17 Biological emissions from decomposition of forest products: See Addendum to OPDR VII.B.

- C. Provide a summary of the inventory of carbon stocks for each carbon pool (or approach used, if inventory is not applicable).

IFM-1 Standing Live: See Addendum to OPDR VII.C.

IFM-3 Standing Dead: See Addendum to OPDR VII.C.

IFM-6 Soil (if applicable): See Addendum to OPDR VII.C.

IFM-7 Carbon in in-use forest products: See Addendum to OPDR VII.C.

IFM-8 Forest product carbon in landfills (if applicable): See Addendum to OPDR VII.C.

IFM- 9 Biological emissions from site preparation: See Addendum to OPDR VII.C.

IFM-14 Biological emissions/removals from change in harvesting on forestland outside project area: See Addendum to OPDR VII.C.

IFM-17 Biological emissions from decomposition of forest products: See Addendum to OPDR VII.C.

- D. Provide a summary of inventory confidence statistics.
See Addendum to OPDR VII.D.

- E. Provide the calculation of the offset project's reversal risk rating and contribution to the Forest Buffer Account.
See Addendum to OPDR VII.E.

PART VIII. OFFSET PROJECT BASELINE

A. Required for ALL Improved Forest Management Projects

1. Describe the project's modeling plan, following the requirements and methods in Appendix B, Section B.3 of the Compliance Offset Protocol U.S. Forest Projects, October 20, 2011.

Please see the Modeling Plan included as Attachment K.

2. Describe and estimate the project's baseline onsite carbon stocks. Explain any annual changes in baseline carbon stocks over time.

A graph of the baseline onsite carbon stocks, labeled "Attachment G," must be portrayed depicting time on the x-axis and metric tons CO₂-e on the y-axis. Include a written characterization describing any annual change in baseline carbon stocks over time. See Part X of this document for more information. A diagram of the baseline incorporating all required carbon stocks, labeled "Attachment H," is also required.

This information is contained in the Modeling Plan included as Attachment K. Table 8 in Attachment K shows an estimated baseline of 208.85 Mg CO₂e per acre.

3. **Optional:** Identify the approved growth model that will be used for the project.
FORSEE

4. Harvest Planning

- a. Is harvesting planned in the Project Area?

If "yes," proceed to question 4b. Otherwise, skip to question A5.

☒ Yes
☐ No

- b. **Optional:** Does the project use a harvest schedule model?

If "yes," proceed to question 4c. Otherwise, skip to question A5.

☐ Yes
☒ No

c. Optional: Explain how you are addressing age class and stratification as part of your harvest scheduling? N/A	
5. Provide an estimate of carbon that will be stored long-term in harvested wood products in the baseline. See Addendum to OPDR VIII.A.5.	
6. Provide a projection of baseline and actual harvesting volumes from the Project Area over 100 years. <i>A projection may be provided in an attachment, labeled "Attachment I". Include a narrative with a clear explanation of how the OPO/APD arrived at the baseline and actual harvest volumes is determined</i> See Addendum to OPDR VIII.A.6.	
B. Required for Improved Forest Management Projects on Private Lands ONLY	
1. Provide the initial above ground standing live carbon stock (per acre) for the project. 189.17 MgCO ₂ e per acre.	
2. Provide the Common Practice statistic (per acre) associated with the Project Area. 165.50 MgCO ₂ e per acre.	
3. Summarize how the Project's initial above-ground standing live carbon stock compares to Common Practice. The Project's initial above-ground standing live carbon stocks are above the common practice statistic listed in VIII.B.2 above. Are the initial above-ground standing live carbon stocks above or below Common Practice? If below Common Practice, what is the High Stocking Reference for the Project Area? Describe the Project Area's live tree carbon stocks over the previous 10 years. <i>Further documentation is required if project is below Common Practice. Submit supporting documents as attachments labeled "Attachment I." See Part X of this document for more information. An affidavit must be submitted testifying that the inventory depicted over the past 10 years is reasonably accurate.</i> N/A	<input checked="" type="checkbox"/> Above <input type="checkbox"/> Below
4. Optional: Does the Forest Owner(s) and its affiliate(s) own land in fee or hold timber rights on land outside the Project Area? If "no," skip to question B.5.	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Optional: If "yes" does the Protocol require the use of a weighted average carbon stock on lands in the same Logical Management Unit (LMU, as defined in Section 6.2.1.1)? If "no," skip to question B.5.	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Optional: If "yes," is inventory data available for the LMU or will the OPO use a stratified vegetation analysis? If "no," skip to question B.5. Although the OPO owns land outside of the Project Area but within the same Logical Management Unit (LMU), the Project Area's initial above ground standing live carbon stocks are above Common Practice. The minimum baseline level (MBL) for the Project is determined through the use of equation 6.5 with does not require the calculation of the Project's weighted average above-ground standing live carbon stocks (WCS) within the LMU. No calculation of WCS will be performed.	<input type="checkbox"/> Data available for LMU <input type="checkbox"/> Stratified Vegetation Analysis <input checked="" type="checkbox"/> N/A
Optional: Identify the Minimum Baseline Level for above-ground standing live carbon stocks for the Project Area:	
5. Provide a description of any and all legal constraints affecting forest management activities in the Project Area. Include documentation of legal constraints and a description of each constraint (referring to Section 6.2.1.2); for each constraint provide a narrative that constraint has on forest management. <i>Submit supporting documents as attachment labeled "Attachment J". See Part X of this reporting document for more information.</i> This information is included in the Modeling Plan included as Attachment K.	
6. Provide a description of the modeling techniques used to simulate the effect of any constraints on carbon stocks. This information is included in the Modeling Plan included as Attachment K. Optional: Provide a description of the modeling techniques used to simulate forest management activities that may affect carbon stocks.	

7. How will the OPO demonstrate financial feasibility of the growth and harvesting regime assumed for the baseline?

(check one of the boxes)

- ☒ Conducting a financial analysis of the anticipated growth and harvesting regime that captures all relevant costs and returns, taking into consideration all legal, physical, and biological constraints, using regional norms or documented costs and returns for the project area or other properties in the Forest Project's Assessment Area
- ☐ Providing evidence that activities similar to the proposed baseline growth and harvesting regime have taken place on other properties within the Forest Project's Assessment Area within the past 15 years

See Addendum to OPDR VIII.B.7.

C. Required for Improved Forest Management Projects on Public Lands ONLY

1. Provide a projection of future changes to Project Area forest carbon stocks extrapolating from historical trends.

N/A

2. Explain how current public policy affects onsite carbon stocks and how the baseline modeling incorporates constraints imposed by all applicable statutes, regulations, policies, plans, and activity-based funding.

N/A

3. Have carbon stocks in the Project Area been increasing or declining over the preceding ten-year period?

- ☐ Increasing
☐ Declining
☒ N/A

PART IX. OTHER OFFSET PROGRAMS

- A. Have any GHG reductions or GHG removal enhancements associated with the Project Lands ever been listed or registered with, or otherwise claimed by, another registry or program, or sold to a third party prior to listing?

- ☐ Yes
☒ No

If "yes," identify the registry or program and provide details on the issued credits below.

- B. Have any lands within the Project Area ever been listed or registered with an offset project registry or program in the past?

- ☐ Yes
☒ No

If "yes," identify the registry or program and provide details on the issued credits below.

- C. Have greenhouse gas emission reductions or removal enhancements associated with lands within the Project Area been credited or claimed for the purpose of greenhouse gas mitigation or reduction goals, whether in a voluntary or regulatory context?

- ☐ Yes
☒ No

If "yes," identify the goal(s) and provide details on the reductions and removal enhancements (under "Number of Credits Issued") below.

Registry/Program/Goal(s): N/A	Reporting Period(s): N/A	Vintage(s): N/A	Number of Credits Issued: N/A
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PART X. ATTACHMENTS

- A. If the answer to Part IV.A is "yes," provide documentation (e.g., deed of trust, title report, etc.) showing the OPO's ownership interest in the property and its interest in the trees and standing timber on the property. If the answer to Part IV.A is "no," provide documentation supporting the explanation of the OPO's right to undertake and list the project.
- B. If the answer to Part IV.C is "public," provide documentation demonstrating explicit approval of the offset project's management activities and baseline including any public vetting processes necessary to evaluate management and policy decisions concerning the offset project. If the project is a private lands project, mark "N/A" in the box below. The OPO may provide an "Attachment B" page with a "This Page Left Intentionally Blank - Private Lands Project" notation on the page. ☒ N/A
- C. If a Qualified Conservation Easement (QCE) has been recorded, provide a copy. The information contained in this form and the documents attached to it will be submitted to ARB so submitting a copy of the QCE as an attachment to this document fulfills the requirement in 9.1.1.1(18)(a) of the Compliance Offset Protocol U.S. Forest Projects, October 20, 2011 to provide ARB with a copy. ☒ N/A
- D. If the project is located on one of the categories of Tribal land listed in Part IV.E, provide documentation demonstrating that the land within the Project Area is owned by a tribe or private entity. Also provide documentation that demonstrates the existence of a limited waiver of sovereign immunity between ARB and the governing body of the Tribe entered into pursuant to section 95975(I) of the Cap-and-Trade Regulation. ☒ N/A
- E. Attach map(s) of the Project Area including:
1. Public and private roads
 2. Towns
 3. Major watercourses (4th order or greater), water bodies, and watersheds
 4. Topography
 5. Townships, ranges, and sections or latitude and longitude
 6. Existing land cover and land use (optional)
 7. Forest vegetation types (optional)
 8. Site classes (optional)
 9. Land pressures and climate zone/classification (optional)
 10. Historical land uses, current zoning, and projected land use within the Project Area (optional)
 11. A georeferenced shape file (or other electronic file that can be read in a geographic information system) that clearly identifies the Project Area and boundaries. *Note that the georeferenced shape file may constitute the required map if it includes the required map information listed above.*
- F. Provide supporting documentation demonstrating that the offset project takes places on land that has greater than 10 percent tree canopy cover.
- G. Attach a graph portraying the baseline onsite carbon stocks with time depicted on the x-axis and metric tons CO₂e depicted on the y-axis.
- H. Attach a diagram of the final baseline incorporating all required carbon stocks.
- I. For IFM projects on private lands ONLY: If the Project Area's initial above-ground standing live carbon stocks are below Common Practice, submit an affidavit testifying that the inventory depicted over the past 10 years (used to determine the High Stocking Reference for the Project Area) is reasonably accurate. Also include a summary of volume harvested over the past 10 years. ☒ N/A
- J. Attach supporting documentation identifying the legal constraints within the Project Area. A 'constraints' table with the following categories may be provided for simplicity with the following information: narrative of legal constraint, identification of specific governing law guiding the constraint, acreage, silviculture method, retention strategy. See Attachment J for a general list of legal constraints. An explanation of how these constraints were modeled is included in the Modeling Plan included as Attachment K.

PART XI. OPO/APD SIGNATURE

Note: The person signing this Initial Reporting Period report should be the same person signing the accompanying U.S. Forest Offset Project Data Report Annual Reporting Period – All Project Types report.

In signing this form, I certify under penalty of perjury of the laws of California that the information contained in this form is true, accurate, and complete. I further certify that I am an Account Representative of the Offset Project Operator (OPO).

SIGNATURE:



PRINTED NAME:

James D. Clark

TITLE:

APD

DATE:

6/13/2016

Background for U.S. Forest Offset Project Data Report Initial Reporting Period – Improved Forest Management

Section 95976(d) of the Cap-and-Trade Regulation specifies reporting requirements for offset projects participating in the Compliance Offset Program. Offset Project Operators (OPO) or Authorized Project Designees (APD) are required to submit an Offset Project Data Report (OPDR) within four months of the end of each (annual) Reporting Period. The Compliance Offset Protocol U.S. Forest Projects, October 20, 2011, requires additional information to be included with the initial OPDR. This form is designed to help OPOs and APDs provide the extra information required for an initial OPDR by offset projects using Compliance Offset Protocol U.S. Forest Projects, October 20, 2011. This information is submitted to the approved Offset Project Registry that is listing the offset project and should also be provided to the ARB-accredited verification body that will be verifying the Offset Project Data Report.

The information to be provided in this form closely mirrors information provided in the application for listing an offset project using the Compliance Offset Protocol U.S. Forest Projects, October 20, 2011. OPOs and APDs may wish to copy the information in their project's application for listing to the extent that the information provided at the time of that application has not changed.

Where to Submit Information Contained in This Form

Please complete the information on the form using your computer. Then print, sign, and scan the form. The completed and signed information and all supporting documentation should be submitted to the appropriate [Offset Project Registry](#).

Copies of this form can be downloaded from the ARB website at:
<http://www.arb.ca.gov/cc/capandtrade/offsets/forms/forms.htm>

Detailed Instructions for U.S. Forest Offset Project Data Report Initial Reporting Period – Improved Forest Management

This form is protected with restricted editing to facilitate completing the form. If the applicant wishes to unprotect the form, the password is "form".

Part I. Entity Submitting Report:

- Indicate whether the Offset Project Operator (OPO) or Authorized Project Designee (APD) is submitting the Offset Project Data Report.
- List the name, organization, phone number, and email address of the person submitting the information. This person should be an employee of the OPO or APD, whichever entity is making the submission. The person submitting the information need not be the same person as the contact person listed for the OPO or APD in Part III and also need not be the person signing the form in Part XI.
- The person submitting the information should indicate the date the form is completed.

Part II. Offset Project Information:

- Provide the name for the offset project. Also provide the project's identification number from the approved Offset Project Registry listing the project. The ARB project identification number may also be provided if known.
- Indicate the offset project commencement date and the start and end dates of the first reporting period. Unlike with the listing form, approximations are no longer acceptable for these dates since precise dates should be known.
- Project commencement for an Improved Forest Management Project must be linked to a discrete, verifiable action that delineates a change in practice that increases sequestration and/or decreases emissions relative to the forest project's baseline. This date could be triggered by the transfer of property ownership, recordation of a conservation easement on the Project Area, or when submitting the offset project listing information.

Part III. OPO/APD Information:

- Enter contact information for the OPO and APD submitting the report. Every offset project will have an OPO. If an offset project does not have an APD, please mark the box indicating the Offset Project does not have an APD and leave the remaining fields blank.

- For both the OPO and, if applicable, the APD, enter the entity's name, its mailing address, and the name, phone number, and email address of a contact person for the entity. Also include its CITSS ID number. The CITSS ID is six characters in length, with two letters followed by four numbers (e.g., "CA1234"). **DO NOT PROVIDE THE CONFIDENTIAL CITSS ACCOUNT NUMBER**, which begins with the CITSS ID number followed by a hyphen and more numbers.

Part IV. Land Ownership:

- This part includes questions regarding land ownership and property interests.
- Further documentation is required based on the responses to some questions. See Part X of this report for more information on the precise requirements.

Part V. Offset Project Area:

- This part asks for qualitative descriptions of the offset Project Area.
- Maps are required to complement the descriptions provided in this part. See Part X of this report for more information on the precise requirements.
- The Project Area should be determined following the requirements of Section 4 of the Compliance Offset Protocol U.S. Forest Projects, October 20, 2011.
- Assessment areas shall be determined by referencing the Assessment Area Data File available at: <http://www.arb.ca.gov/cc/capandtrade/protocols/usforestprojects.htm>

Part VI. Offset Project Eligibility:

- The questions in this part are designed to facilitate the determination of project eligibility for Improved Forest Management Projects.
- Further documentation is required based on the responses to some questions. See Part X of this report for more information on the precise requirements.
- Details on the eligibility requirements for Improved Forest Management Projects can be found in Sections 2.1.2, 3.1, and 3.8 of the Compliance Offset Protocol U.S. Forest Project, October 20, 2011.
- Details on the Natural Forest Management criteria can be found in Table 3.2 in the Compliance Offset Protocol U.S. Forest Project, October 20, 2011.

Part VII. Carbon Stock Inventory:

- Projects are required to have completed a full carbon stock inventory for the initial Offset Project Data Report. Unlike the inventory provided at the time of listing, a general description of the project's inventory methods with preliminary best estimates is no longer sufficient to meet the regulatory requirements. If the project's inventory methodology changed between the time of listing and submission of the initial OPDR, this change should be reported as a change to the information submitted at project listing when submitting the first OPDR.
- Section 6.2 of the Compliance Offset Protocol U.S. Forest Projects, October 20, 2011 outlines the approved quantification methodologies for Improved Forest Management Projects. Further details on completing a forest project carbon inventory can be found in Appendix A of the Protocol.
- Follow the steps in Appendix D of the Compliance Offset Protocol U.S. Forest Projects, October 20, 2011 to quantify the project's reversal risk rating.
- The project's expected contribution to the Forest Buffer Account is determined annually based upon the project's risk of reversal and is calculated by multiplying the project specific reversal risk rating by the total net GHG reductions/removals achieved by the project. Unlike the listing application, for this OPDR an approximation of the contribution to the Forest Buffer Account is not acceptable.

Part VIII. Offset Project Baseline:

- For this OPDR, unlike the project listing application, projects are required to have a finalized baseline. A modeling plan with preliminary best estimates is no longer sufficient to meet the regulatory requirements. If the project's modeling plan or baseline estimates changed between the time of listing and submission of the initial OPDR, this change should be reported as a change to the information submitted at project listing when submitting the first OPDR.
- Note that IFM projects located on public land must present documentation demonstrating explicit approval of the offset project's management activities and baseline. These projects may report changes to the baseline within the initial OPDR if the changes have gone through a public review process and meet the Protocol requirements regarding explicit approval of the project's baseline.
- This part is divided into three sections: questions required for all Improved Forest Management Projects; questions for Improved Forest Management Projects on private lands; and questions for Improved Forest Management Projects on public lands. Answer the questions applicable to the project.

- A diagram and graph are required to complement the descriptions provided in this part. See Part X of this report for more information on the precise requirements.
- Section 6.2 of the Compliance Offset Protocol U.S. Forest Projects, October 20, 2011 outlines the approved quantification methodologies for Improved Forest Management Projects. Instructions for considering legal and financial constraints can be found in Sections 6.2.1.2 and 6.2.1.3, respectively. Further details on modeling carbon stocks can be found in Appendix B of the Protocol.
- ARB approved growth models can be found in Appendix B, Section B.1 of the Compliance Offset Protocol U.S. Forest Projects, October 20, 2011.

Part IX. Other Offset Programs:

- Answer all questions. If the answer to any question is “yes,” identify the registry or program and provide details on the issued credits in the space provided.

Part X. Attachments:

- Provide each attachment on a separate sheet of paper and submit along with the completed Initial Reporting Period-Offset Project Data Reporting Form.
- To aid with tracking each attachment, it is recommended that the attachments are labeled to correspond with the letter in Part X that they refer to (e.g. “Attachment B”).
- When an attachment is not applicable to the project being listed, please select the “N/A” (Not Applicable) checkbox next to the requirement so that it is clear that the attachment was not inadvertently left off.

Part XI. OPO/APD Signature:

- The individual signing the document must be registered in CITSS as the OPO’s Primary Account Representative or Alternate Account Representative for the entity submitting the information. The individual signing the document may be an APD employee and/or representative; but to sign the document, the individual must be an Account Representative on the OPO’s CITSS account.
- Please provide the individual’s signature, printed name, corporate title, and date signed.
- There are no attestations for this report. The attestations required for the Offset Project Data Report are included in the form U.S. Forest Offset Project Data Report Annual Reporting Period – All Project Types.

Please contact your Offset Project Registry with any questions regarding the OPDR.



BRUSH CREEK

ACR200, CAFR5200

Addendum to OPDR for the Initial Reporting Period Form

Under

Air Resources Board

Compliance Offset Protocol – U.S. Forest Projects

Adopted: October 20, 2011

Prepared June 13, 2016

Offset Project Operator	Authorized Project Designee
Steve Miller and Florence Miller Co-Trustees of the Edward Miller Trust PO Box 1818 Healdsburg, CA 95548 (707) 953-4584	James D. Clark PO Box 435 Calpella, CA 95418 (707) 485-7211

Reporting Period

The reporting period for this Offset Project Data Report is from 12/10/2013 to 6/30/2015.

Protocol Version

Air Resources Board

Compliance Offset Protocol – U.S. forest Projects

Adopted: October 20, 2011

The OPDR and all other project documentation and reports that reference carbon stocks have been prepared and submitted by James D. Clark, California Registered Professional Forester (No. 2528).

Introduction

Brush Creek is an Improved Forest Management (IFM) Project that is seeking registration under the California Air Resources Board Compliance Offset Protocol – U.S. Forest Projects Adopted: October 20, 2011. The Brush Creek Project is owned by Steve Miller and Florence Miller Co-Trustees of the Edward Miller Trust, who have created a permanent conservation easement on the property for the purpose of preserving the property as a small working forest in perpetuity. The Project Area is approximately 1,760 acres in size.

IV.B.

The OPO is the only Forest Owner with property interests within the Project Area that affect the trees and standing timber located on the Project Area. All mineral rights associated with the Project Area are owned by the OPO.

V.A.

The Project is located entirely within the Northern California Coast Supersection, and within the Coast Redwood/Douglas-fir Mixed Conifer Assessment Area and is classified as low (site class III and IV) to high site class (site class II)timberland and as such is within both the “High” and “Low” “Site Class” portions of the Assessment Area.

Supersection	Assessment Area	Site Class	Acres
Northern California Coast	Coast Redwood Douglas-fir Mixed Conifer	High	37.97
	Coast Redwood Douglas-fir Mixed Conifer	Low	1,725.44
Total Acres			1,763.41

V.C.

The Project Area has been determined based on the best available data representing the legal description described in the title report included as Attachment A. The Project Area boundary

is described and represented by the map included as Attachment E. The Mendocino County Assessor's office list the Property acreage as 2,050; however, for the purpose of calculating carbon stocks, the Project Area acreage is 1,763.41 acres taken from the Project's GIS data.

V.D.

The Brush Creek Project Area supports a healthy, diverse forest community comprised of redwood, Douglas-fir, tanoak, pacific madrone, California bay laurel, sugar pine, red alder, and assorted native hardwoods and is bordered by properties containing similar forest communities. Across the Property, the ecological community shifts with aspect, transitioning from red alder-rich shaded riparian areas to Redwood and Douglas-fir groves.

V.E.

Habitat types on the Brush Creek Property, according to the California Wildlife Habitat Relationship (WHR) system, include Redwood, Douglas-fir, Montane Hardwoods Conifer, Coast Oak Woodland, and Valley Foothill Riparian habitats. The Project Area is composed of a diverse mosaic of topography and habitat types. Plant diversity is relatively high on the Property due to convergence of many different habitat types that results from the Property's topographic and geologic heterogeneity.

V.F.

The Project Area is classified as site class IV to site class II timberland. The modelling plan included as Attachment K provides a description of the methodology employed in the calculation of site index for the Project Area.

V.G.

The Property, as well as the general region, is characterized by a rural forest landscape with large and small private timber holdings, as well as individual rural residential lots. Properties in the general vicinity are zoned by Mendocino County as Timber Production Zone (TPZ),

Commercial Agriculture (CA), and Unclassified. The Brush Creek Property borders agricultural and private timber holdings. Approximately 3 miles to the west, Brush Creek, itself, passes through Manchester State Park.

The Brush Creek Project Area consists of both Maritime & Mediterranean climates influenced by the proximity to the Pacific Ocean and topography. Summers are mild and winters are mild and wet. Temperatures range from an average low of 45 degrees F in December to an average high of 75 degrees F in July. Average annual rainfall for the property is approximately 40-50 inches per year.

V.H.

Before European-Americans began to settle this region, places including the present Brush Creek Property were inhabited by Native Americans. In the 1800's, the area surrounding and including the Brush Creek Project Area was split by several homesteads under patent parcels filed at the local land office. Later in the early 1900's the patent parcels were combined to form a larger property configuration. The property has been managed for timber production since Edward Miller purchased a large portion of it in the 1950's.

The current landowners, Steve Miller and Florence Miller, acquired a majority of the Property from the estate trust of Mr. Edward Miller, who passed away in 1971. In 1990, the Miller Trust applied for and was granted certificates of compliance across the Brush Creek Property creating a number of 160 acre or larger parcels. In 1991, the Trust utilized the certificated parcels to create clustered development of smaller parcels along Mountain View Road, while at the same time creating a single TPZ zoned parcel represented by the current Brush Creek property configuration. The clustered development agreement with Mendocino County required that the Brush Creek property remain as open space for 20 years without the potential for subdivision. Given the expiration of the 20-year restriction on development, the Brush Creek parcel is capable of being subdivided into 12 conforming legal parcels under TPZ zoning. To

prevent further subdivision, the Miller Trust recorded a Conservation Easement on September 28, 2015¹ to protect the open space values, riparian zones, and other areas of special biological concern and to conserve the Brush Creek Property as a viable small working forest in perpetuity.

The entire Property is comprised of fifteen Assessor's Parcels and is zoned Timber Production Zone (TPZ). The TPZ ordinance is an agricultural designation, intended primarily for timber production. The Property contains one certified legal parcel.

V.I.

The Brush Creek Project Area is characterized by a mix of redwood, Douglas-fir and other conifers, tanoak, madrone, and other native hardwoods. The Project Area is composed of approximately 32% Douglas-fir, 21% redwood, 4% other conifers, 36 %tanoak, and 9% other hardwoods by basal area. As these figures show, the property contains a significant hardwood comonent. Brush Creek intends to manage the timber stands to reduce the hardwood component and increase the component of conifers.

Several age classes of timber stands exist across the Project Area as the result of past land management activities with age classes ranging from 80 years to 20 years.

There has been one timber harvest plan on the Brush Creek Property in the past 15 years. This plan was approximately 128 acres in size. Forest uses on the Property have traditionally been focused on redwood and Douglas-fir. Presently, the Property does not have any active harvest plans.

¹ Deed of Conservation Easement, dated July 17, 2015, recorded September 28, 2015 as 2015-13163, Official Records, Mendocino County California.

VI.A.

The Brush Creek Project Area meets condition 1 under section 2.1.2 (page 10) of the Compliance Offset Protocol by maintaining greater than 10% tree canopy cover. Compliance is substantiated by the Orthophoto map of the Project site, that may be found in Attachment F, clearly showing canopy closure for the Project Area and, will be substantiated by the results of the carbon stock inventory.

VI.D.1.

The Brush Creek Project Area is characterized by a mix of redwood, Douglas-fir, tanoak, pacific madrone, California bay laurel, sugar pine, red alder, and assorted native hardwoods. 100% of the Project's biomass is in native species and thus the Project meets the 95% criteria for carbon in native species.

VI.D.2.

The Brush Creek Project Area is characterized by a mix of redwood, Douglas-fir, tanoak, pacific madrone, tanoak, California bay laurel, sugar pine, red alder, and assorted native hardwoods. It is estimated that the Project Area is composed of approximately 21% redwood, 32% Douglas-fir, 4% other conifers, 36 % tanoak, and 9% other hardwoods by basal area. The Miller Land Trust intends to manage the timber stands to maintain or increase conifer stocking, ensuring that the Project continues to meet the requirements for composition of native species under Table 3.2 (page 20) of the Compliance Offset Protocol by maintaining species' basal area percentage below 65% , the Species Diversity Index from the Assessment Area Data File.

VI.D.3.

- (a) Brush Creek meets condition 1 under Section 3.8.1 (page 18) of the Compliance Offset Protocol by being certified under the American Forest Foundation Tree Farm System certification program as project ID CA-393, with the Brush Creek property

being CA-393A. With the exception of approximately 190 acres recently acquired in 2015, all of the Miller Trust's timberlands are included in the American Tree Farm System under the above listed project ID. The Miller properties were recertified in 2012 and is due for its next recertification in 2017. Certification under the American Forest Foundation satisfies condition 1 by requiring adherence to, and verification of, sustainable harvesting practices.

- (b) There are currently no immediate plans to harvest timber on the Brush Creek Project Area. In the future, Brush Creek may employ uneven-aged management practices which meet the sustainable management requirements under Table 3.2 (page 21) of the Compliance Offset Protocol by maintaining less than 40% of the Project's forested acreage in ages less than 20 years. Present conditions for the Project site already satisfy these requirements.

VI.D.4.

Brush Creek does not actively remove lying dead wood as a part of its stand management activities. It is expected that the accumulation of lying dead wood will be commensurate with recruitment from standing dead trees. Brush Creek is committed to maintaining if not increasing, the number of standing dead trees within the Project Area as a component of its forest management objectives. Brush Creek does not currently, nor does it intend in the future to actively pursue salvage operations on its timberlands. Brush Creek has a policy of allowing standing dead trees to remain and recruiting large specimen trees across its ownership as components of its overall timber management strategy.

The Brush Creek Project Area has not recently undergone any salvage harvesting. Therefore, all that must be demonstrated is that the greater of one metric ton of carbon per acre or 1% of standing live carbon stocks is present in standing dead wood, or that progress towards these

targets is ongoing. The project currently contains an average of 1.08 Mg C per acre and 1.6% of standing live carbon stocks in standing dead wood. Therefore, the project currently meets the aforementioned standing dead wood target.

VI.E.

The OPO intends to allow conifer stocking levels to develop on the Project Area in excess of the minimum requirements of the California Forest Practice Rules. Riparian areas will be subject to increased protection measures.

At a minimum, management activities conducted on the Project Area must exceed the minimum standards which define the baseline, while also conforming to specific requirements of the Forest Project Protocol. Changes in Project carbon stocks over time will also be governed by economic decisions such that more or less carbon may be sequestered over any given period. Therefore, a combination of economic decisions by the forest owner as to whether or not to commercially harvest the Project Area combined with the constraints imposed by the California Forest Practice Rules, specific terms of the Forest Project Protocol, and the terms of the recently recorded Conservation Easement will guide carbon stock levels over time.

VII.A.

IFM-1 Standing Live:

Standing live carbon was inventoried based on sample plots installed in the spring and fall of 2014. The inventory specifications are included as Attachment L. The cruise design consists of the installation of sample points on a systematic grid 8 chains by 8 chains in size anchored with a random starting location.

The sample design included the installation of fixed area plots to measure both live and dead conifers and hardwoods. A 1/100th acre fixed area plot was installed at each sample point to sample trees ≥ 0.5 " DBH and less than 3.6" DBH, a 1/50th acre fixed area plot was

installed at each sample point to sample trees >3.6" DBH and less than 11.6" DBH, and a 1/10th acre fixed area plot was installed at each sample point to sample trees >=11.6" DBH.

Attachment L describes the procedures for collecting field measurements, specific criteria pertaining to data collection, stratification rules, and documentation on quality assurance and quality control. Documentation of analytic methods and biomass equations used to translate field measurements into volume or biomass carbon estimates are included in part B below.

Cruise data from field cards was reviewed for completeness and 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 will serve as the repository for inventory data and is accessed by the growth and yield model during growth and yield simulations.

Inventory monitoring and update procedures are described in Attachment L.

IFM-3 Standing Dead:

As described above, and in Attachment L, standing dead trees were sampled in conjunction with standing live trees.

IFM-6 Soil (if applicable):

Excluded because the conditions in Table 5.2 of the protocol that would require inclusion of this pool (site preparation involving deep ripping, furrowing, or plowing where soil disturbance exceeds 25 percent of the Project Area over the Project Life, or mechanical site preparation activities not conducted on contours) are not planned.

IFM-7 Carbon in in-use forest products:

Carbon in in-use forest products has not been generated by the Project as no harvesting is planned during the initial reporting period. Part B below will include documentation of analytic methods and biomass equations used to translate future harvest volumes delivered to the mill into appropriate carbon in in-use forest products values.

IFM-8 Forest product carbon in landfills (if applicable):

Carbon in landfills is a component of carbon related to forest products. No forest products will be generated by the Project as no harvesting is planned during the initial reporting period. Part B below will include documentation of analytic methods and biomass equations used to translate future harvest volumes delivered to the mill into appropriate forest products carbon in landfill values.

IFM-9 Biological emissions from site preparation:

As IFM-6 is an excluded carbon pool, IFM-9 is also an excluded pool.

IFM-14 Biological emissions/removals from change in harvesting on forestland outside Project Area:

Part B below includes documentation of analytic methods and biomass equations used to translate future harvest volumes delivered to the mill into appropriate values for the calculation of this carbon pool.

IFM-17 Biological emissions from decomposition of forest products:

This is quantified as a component of IFM-7 and IFM-8 per Appendix C of the Protocol.

VII.B.

IFM-1 Standing Live:

Above-ground standing live carbon in trees 1" DBH and larger was calculated using the appropriate biomass equation by species taken from the Compliance Offset Protocol U.S.

Forest Offset Projects page on ARB's website

(<http://www.arb.ca.gov/cc/capandtrade/protocols/usforestprojects.htm>). The current biomass equation documentation provided by ARB is included as Attachment M. The equations referenced below are not reproduced here for the sake of minimizing redundancy. These equations are used to generate biomass estimates for the above-ground portion of standing live trees, and hard snags. These equations will be referred to as the "FIA equations" herein.

Each species can have as many as three FIA equations in order to calculate tree biomass.

The FIA equations used by species are as follows:

Species	Bole Cubic Ft Volume	Bark Biomass	Live Crown Biomass
Redwood	Equation 24	Equation 17	Equation 10
Douglas-fir	Equation 3	Equation 8	Equation 6
Grand fir	Equation 23	Equation 2	Equation 1
Western Hemlock	Equation 6	Equation 15	Equation 12
Ponderosa Pine	Equation 5	Equation 9	Equation 7
Sugar Pine	Equation 20	Equation 10	Equation 8
Other Conifer	Equation 17	Equation 21	Equation 17
Nutmeg	Equation 8	Equation 13	Equation 10
Tanoak	Equation 34	None	None
Pacific madrone	Equation 40	None	None
Live oak	Equation 43	None	None
California laurel	Equation 33	None	None
Red Alder	Equation 26	Equation 20	Equation 16
Golden chinkapin	Equation 32	None	None
Bigleaf maple	Equation 37	None	None
Willow	Equation 40		
Other Hardwood	Equation 41	Equation 20	Equation 16

Tonnes of standing live biomass per sample plot are calculated as follows:

For equations that use total tree height in meters, tree height is calculated by multiplying the trees total height in feet by 0.3048. Trees per hectare are calculated by multiplying trees per acre by 2.471. Tree diameter at breast height ("DBH") in centimeters (cm) is calculated by multiplying its DBH by 2.54.

Bole Biomass:

The Cubic foot volume of each tree is calculated as the volume of the total stem from ground to tip (includes the top and stump). FIA refers to this value as CVTS. Bole biomass is calculated by multiplying the cubic volume by the wood density, and then dividing by 2.20462 to calculate weight in kilograms (kg). Above-ground biomass in kilograms (Kg) per acre is calculated by multiplying the FIA calculated kg per tree by each tree's per acre value.

Bark and Live Branches Biomass:

The above referenced FIA equations produce biomass in kg for the various parts of the above-ground portion of each tree. Above-ground biomass in kilograms (Kg) per acre is calculated by multiplying the FIA calculated kg per tree by each trees per acre value.

Missing volume of each tree is recorded as a percentage missing by 1/3rd segment of the tree (top, middle, bottom) as adapted from the Climate Action Reserve's "Quantification Guidance for Use with Forest Carbon Projects" dated November 15, 2012. The total heights of trees with broken tops were calculated from their measured top heights using FORSEE. If 1/3rd of the calculated tree height was less than the measured top height, then the break was assumed to be above the bottom 3rd of the tree. Likewise, if 2/3rds of the calculated tree height was less than the measured tree height, the break was assumed to be in the top 3rd of the tree.

Missing volumes of damaged trees recorded in the field was added to the estimated volume missing if there was a broken top. The total missing percentage of each tree is calculated based on 65% of the trees biomass being in the bottom 1/3rd , 25% in the middle 1/3rd , and 10% in the top 1/3rd. The total percentage of the tree that is missing is then

calculated and multiplied by various biomass components of the tree as calculated above to calculate the net biomass of each component.

The net Kg per acre value of each tree on the plot is summed to derive above-ground live biomass Kg per acre for the plot. This value is used to calculate the respective below-ground live biomass component for the plot.

Below-ground live carbon is calculated at the plot level using the model provided by Cairns et. al. specified on page 86 of Appendix A of the protocol. The formula has as its input, above-ground live biomass in Mg per hectare, and outputs below-ground biomass in Mg per hectare. Total net above-ground live carbon in Kg per acre for each plot is converted to Mg of biomass per hectare by multiplying by 2.471, and then dividing by 1000. After calculating the below ground component in Mg per hectare using the Cairns model, the results are converted to Kg per acre by multiplying by 1000 and dividing by 2.471.

Total standing live biomass for each plot is the sum of the above-ground and below-ground live biomass Kg per acre. Mg of carbon (Mg C) per acre per plot is then calculated by multiplying by 0.5 to estimate carbon biomass. Mg C per acre is converted to CO₂-equivalent by multiplying by 3.664.

IFM-3 Standing Dead:

Data on standing dead trees was collected as a part of the Brush Creek inventory. In general, the amount of carbon stored in a standing dead tree is based on the proportion of the tree remaining standing, and the condition of the tree, or its decay class. The standing dead carbon pool includes trees 5" DBH and larger, with a minimum height of 15'.

Standing dead trees from the inventory data are classified into six decay classes based on descriptions contained on page 12 of General Technical Report NRS-29 (Harmon et al, 2008)(the numbering of decay classes is modified below to 1-6 as opposed to 0-5 in Harmond). These decay classes are generally described as follows:

- Class 1 Tree has recently died with leaves intact.
- Class 2 Leaves mostly still attached, intact bark, fine twigs, and branches.
- Class 3 Leaves mostly gone, fine branches mostly gone, bark loose and starting to fall off.
- Class 4 A few large branches or stubs remain, bark falling off in large patches, softwood sloughing is evident.
- Class 5 Highly decomposed, no branches, little bark, broken off top.
- Class 6 Mostly decomposed, no branches, very little bark, broken off close to the ground.

Biomass for standing dead trees includes the bole and bark components calculated using the FIA biomass equations described above and following the same procedures as for live trees other than the manner in which missing volume is calculated. Standing dead trees with decay class 5 and 6 are considered "highly decayed", and bark biomass is excluded from the biomass calculation for these trees.

Missing volume of each tree is recorded as a percentage missing by 1/3rd segment of the tree (top, middle, bottom) as adapted from the Climate Action Reserve's "Quantification

Guidance for Use with Forest Carbon Projects" dated November 15, 2012. The total heights of trees with broken tops are calculated from their measured top heights using FORSEE. If $1/3^{\text{rd}}$ of the calculated tree height is less than the measured top height, then the break is assumed to be above the bottom 3^{rd} of the tree. Likewise, if $2/3^{\text{rds}}$ of the calculated tree height is less than the measured tree height, the break is assumed to be in the top 3^{rd} of the tree.

Missing volumes of damaged trees that are recorded in the field are then added to the estimated volume missing if there was a broken top. The total missing percentage of each tree is calculated based on 65% of the trees biomass being in the bottom $1/3^{\text{rd}}$, 25% in the middle $1/3^{\text{rd}}$, and 10% in the top $1/3^{\text{rd}}$. The total percentage of the tree that is missing is then calculated and multiplied by various biomass components of the tree as calculated above to calculate the net biomass of each component.

Once the net biomass of each tree has been calculated, a relative density is applied by species and decay class. The relative density is in relation to the green density of sound wood, or the tree's wood density. The table below lists the relative densities applied by species and decay class taken from General Technical Report NRS-29 (Harmon et al, 2008).

Relative Density by Species and Decay Class:

	Decay Class (DC)					
Species	DC1	DC2	DC3	DC4	DC5	DC6
Douglas-fir Coastal	1	0.858	0.723	0.444	0.305	0.329
Grand fir	1	0.974	0.84	0.643	0.404	0.309
Ponderosa pine	1	0.889	0.876	0.868	0.339	0.495
Redwood	1	0.956	0.827	0.678	0.426	0.366
Sugar Pine	1	1	0.788	0.553	0.364	0.407
Western hemlock	1	0.89	0.767	0.636	0.425	0.332
California Nutmeg	1	0.956	0.827	0.678	0.426	0.366
Bigleaf maple	1	0.941	0.709	0.533	0.317	0.241
California-laurel	1	0.944	0.734	0.583	0.37	0.282
Golden chinkapin	1	0.944	0.734	0.583	0.37	0.282
California live oak	1	0.981	0.779	0.665	0.416	0.428
Pacific madrone	1	0.944	0.734	0.583	0.37	0.282
Other Coastal Hardwoods	1	0.981	0.779	0.665	0.416	0.428
Red alder	1	0.99	0.836	0.505	0.277	0.3
Tanoak	1	0.944	0.734	0.583	0.37	0.282

Below-ground standing dead carbon is calculated at the plot level using the model provided by Cairns et. al. specified on page 86 of Appendix A of the protocol. The formula has as its input, above-ground biomass in Mg per hectare, and outputs below-ground biomass in Mg per hectare.

Total standing dead biomass for each plot is the sum of the above-ground and below-ground standing dead biomass Mg per acre. Mg of carbon (Mg C) per acre per plot is then calculated by multiplying by 0.5 to estimate carbon biomass. Mg C per acre is converted to CO₂- equivalent by multiplying by 3.664.

IFM-6 Soil (if applicable):

Excluded because the conditions in Table 5.2 of the protocol that would require inclusion of this pool (site preparation involving deep ripping, furrowing, or plowing where soil

disturbance exceeds 25 percent of the Project Area over the Project Life, or mechanical site preparation activities not conducted on contours) are not planned.

IFM-7 Carbon in in-use forest products:

Wood products delivered to the mill in any period is calculated beginning with the cubic volume of harvested conifer trees 10" DBH and larger. Conifers smaller than 10" DBH are not included as they are too small to be delivered to the mill. The dry weight of wood products in pounds is calculated by multiplying the wood density in lbs/cubic foot by the cubic volume for each softwood species harvested based on the CVTS values derived from the FIA equations listed above. Bark and branch biomass are not included in the volume harvested. The wood densities utilized are those for the Redwood forest type and are included in Table C.1 of Appendix C of the Protocol. The dry weight is multiplied by 0.5 to convert the weight to carbon weight only. The weight of carbon in lbs is divided by 2,204.6 to get the carbon weight in metric tonnes (Mg).

Mg of carbon is then multiplied by 0.675 to account for mill efficiencies, taken from the Compliance Offset Protocol U.S. Forest Offset Projects page on ARB's website (<http://www.arb.ca.gov/cc/capandtrade/protocols/usforestprojects.htm>).

The resulting Mg carbon value after accounting for milling efficiencies is then passed to the wood products worksheets for calculating long-term in-use wood products storage. The wood products carbon is separated into product classes and multiplied by the respective 100-year average storage factor. The tables below list the assignment of wood products by class per the most current Assessment Area Data File taken from the Compliance Offset Protocol U.S. Forest Offset Projects page on ARB's website (<http://www.arb.ca.gov/cc/capandtrade/protocols/usforestprojects.htm>), as well as the 100-year average storage factors applied to each wood product class per table C.2 of Appendix C of the protocol.

Wood Products by Class

% Softwood Lumber	97.067%
% Hardwood lumber	0.002%
% Softwood Plywood	1.874%
% Oriented Strandboard	0.000%
% Non Structural Panels	0.244%
% Miscellaneous Products	0.095%
% Paper	0.717%

100-year Storage Rates Average Values from Appendix C, In-Use Table C.2

Softwood Lumber	0.463
Hardwood lumber	0.250
Softwood Plywood	0.484
Oriented Strandboard	0.582
Non Structural Panels	0.380
Miscellaneous Products	0.176
Paper	0.058
Weighted Average	0.310

Average carbon stored in in-use wood products is calculated annually using equation C.1. Carbon is converted to CO₂-equivalent by multiplying by 3.67. This value is combined with IFM-8 using equation C.3 to represent $WP_{total, y}$ for the reporting period.

$WP_{total, y}$ for the reporting period represents $AC_{wp, y}$ in equation 6.1. Average in-use wood products produced by the baseline analysis ($BC_{wp, y}$) are deducted from actual wood products produced each reporting period ($AC_{wp, y}$) in equation 6.1 and the resulting calculation is multiplied by 80% to account for the “Market Response”.

IFM-8 Forest product carbon in landfills (if applicable):

Wood products delivered to the mill in any period is calculated beginning with the cubic volume of harvested conifer trees 10" DBH and larger. Conifers smaller than 10" DBH are not included as they are too small to be delivered to the mill. The dry weight of wood products in pounds is calculated by multiplying the wood density in lbs/cubic foot by the cubic volume for each softwood species harvested. The wood densities utilized are those for the Redwood forest type and are included in Table C.1 of Appendix C of the Protocol. The dry weight is multiplied by 0.5 to convert the weight to carbon weight only. The weight of carbon in lbs is divided by 2,204.6 to get the carbon weight in metric tonnes (Mg).

Mg of carbon is then multiplied by 0.675 to account for mill efficiencies, taken from the Compliance Offset Protocol U.S. Forest Offset Projects page on ARB's website (<http://www.arb.ca.gov/cc/capandtrade/protocols/usforestprojects.htm>).

The resulting Mg carbon value after accounting for milling efficiencies is then passed to the wood products worksheets for calculating long-term landfill wood products storage. The wood products carbon is separated into product classes and multiplied by the respective 100-year average storage factor. The tables below list the assignment of wood products by class per the most current Assessment Area Data File taken from the Compliance Offset Protocol U.S. Forest Offset Projects page on ARB's website, (<http://www.arb.ca.gov/cc/capandtrade/protocols/usforestprojects.htm>), as well as the 100-year average storage factors applied to each wood product class per table C.3 of Appendix C of the protocol.

Wood Products by Class

% Softwood Lumber	97.067%
% Hardwood lumber	0.002%
% Softwood Plywood	1.874%
% Oriented Strandboard	0.000%
% Non Structural Panels	0.244%
% Miscellaneous Products	0.095%
% Paper	0.717%

100-year Storage Rates Average Values from Appendix C, In Landfill Table C.3

Softwood Lumber	0.298
Hardwood lumber	0.414
Softwood Plywood	0.287
Oriented Strandboard	0.233
Non Structural Panels	0.344
Miscellaneous Products	0.454
Paper	0.178
Weighted Average	0.199

Average wood products carbon stored in landfills is calculated using equation C.2. Carbon is converted to CO₂-equivalent by multiplying by 3.67 This value is combined with IFM-7 using equation C.3 to represent $WP_{total, y}$ for the reporting period.

$WP_{total, y}$ for the reporting period represents $AC_{wp, y}$ in equation 6.1. Average in-use wood products produced by the baseline analysis ($BC_{wp, y}$) are deducted from actual wood products produced each reporting period ($AC_{wp, y}$) in equation 6.1 and the resulting calculation is multiplied by 80% to account for the “Market Response”.

IFM-9 Biological emissions from site preparation:

As IFM-6 is an excluded carbon pool, IFM-9 is also an excluded pool.

IFM-14 Biological emissions/removals from change in harvesting on forestland outside Project Area:

The Protocol refers to this carbon pool as Secondary Effects which are calculated using equation 6.10 of the Protocol. Secondary Effects of harvesting less than the average wood products produced by the baseline growth and yield analysis are calculated by subtracting the average carbon in harvested trees prior to delivery to a mill (PDM) generated by the baseline analysis from the actual carbon in harvested trees prior to delivery to a mill, and then multiplying the difference by 20%. As Secondary Effects are only calculated in years when actual wood products produced are less than the annual average under the baseline analysis, the resulting calculation is either zero, or a negative number.

The PDM calculation each annual reporting period will be calculated based on a ratio between the average volume of wood delivered to the mill generated by the baseline analysis, and the average PDM value generated by the baseline analysis. Each reporting period, this ratio will be applied to the actual volume of wood delivered to a mill.

IFM-17 Biological emissions from decomposition of forest products:

This is quantified as a component of IFM-7 and IFM-8 as described above.

VII.C.

All stocks reported here are as of the end of the reporting period.

IFM-1 Standing Live: 433,297 MgCO₂e.

IFM-3 Standing Dead: 6,956 MgCO₂e.

IFM-6 Soil (if applicable): N/A

IFM-7 Carbon in in-use forest products: This carbon pool will be calculated each year as described in parts A and B above. No harvesting has occurred during the initial reporting period.

IFM-8 Forest product carbon in landfills (if applicable): This carbon pool will be calculated each year as described in parts A and B above. No harvesting has occurred during the initial reporting period.

IFM-9 Biological emissions from site preparation: N/A

IFM-14 Biological emissions/removals from change in harvesting on forestland outside Project Area: This carbon pool is calculated each year as described in parts A and B above. No harvesting has occurred during the initial reporting period, and as such this pool is calculated as -2,213 MgCO₂e for the initial reporting period.

IFM-17 Biological emissions from decomposition of forest products: This is quantified as a component of IFM-7 and IFM-8 as described above.

VII.D.

Stratified random sampling formulas taken from Shiver and Borders (1996) were used to calculate the sampling error for the Brush Creek Forest once mean standing live and standing dead pools have been determined. The inventory confidence statistics are as follows:

Mean standing live and standing dead pools	68.14	Mg C per acre
SE of mean	2.30	Mg C per acre
SE of mean as %	3.37 %	$2.30 \div 68.14$
Sampling Error of 90% CI	5.5 %	$(3.37 \%) * 1.645$
Inventory Confidence Deduction	0.5%	5.5% - 5.0%

VII.E.

The risk ratings shown below assume that the Project will not employ a Qualified Conservation Easement.

Project Area Reversal Risk Rating:

Risk Category	Contribution to Reversal
	Risk Rating
Financial Failure	5.0%
Conversion	2.0%
Over-harvesting	2.0%
Social	2.0%
Wildfire	4.0%
Disease/Insect	3.0%
Other Catastrophic	3.0%
Total Buffer Pool Contribution	19.2%

The Project's reversal risk rating is calculated as follows:

$$100\% - (((1-0.05)*(1-0.02)*(1-0.02)*(1-0.02)*(1-0.04)*(1-0.03)*(1-0.03)*100)) = 19.2\%$$

The contribution to the Forest Buffer Account during the initial reporting period is estimated to be **12,635** ROCs.

VIII.A.5.

Following the calculation methodologies described in section VII B above, the baseline modeling presented in the Modeling Plan (Attachment K) generates an average annual value for each of the above described wood products carbon pools. Actual wood products values for In-use, Landfill, and Prior to Delivery to the Mill ("PDM") are calculated based on a flow of wood products over the 100-year planning period. The table below presents the average wood products that will be stored long-term generated by the baseline analysis.

Woods Products Class	Mg C/ acre	Total Mg CO2e
Average Annual Carbon 100-year In-Use	0.149	964.69
Average Annual Carbon 100-year Landfill	0.096	623.25
Average Annual Carbon in Harvested Trees Prior to Delivery to the Mill	1.101	7,122.63

VIII.A.6

Per section 9.2.1 of the protocol, the following table represents the projected actual harvesting volumes from the Project Area over 100 years.

Elapsed Time (Years)	Average Decadal Harvest (Board feet per acre)
10	300
20	400
30	500
40	600
50	600
60	600
70	600
80	600
90	600
100	600

The baseline projection is provided in the Modeling Plan included as Attachment K.

VIII.B.7.

In modeling the baseline for standing live carbon stocks, the Forest Owner must incorporate financial constraints that could affect baseline growth and harvesting scenarios. The Compliance Offset Protocol provides two means by which the Forest Owner may demonstrate that the growth and harvesting regime assumed for the baseline is financially feasible. The first approach involves a financial analysis of the growth and harvesting regime, while the second approach provides evidence that activities similar to the assumed baseline growth and harvest scenario have taken place on other properties within the Forest Project's Assessment Area

within the past 15 years and that harvesting activities have taken place on sites comparable to the Project Area. Brush Creek will demonstrate financial feasibility using the first approach under section 6.2.1.3 (page 52).

A financial analysis of the baseline harvesting regime that captures all relevant costs and returns, taking into account all legal, physical, and biological constraints is included as Attachment N. Cost and revenue variables included in the financial analysis are based on documented costs and returns for the Project Area, and on other properties in the Assessment Area. This financial analysis illustrates that the baseline harvest scenario is financially feasible.

X Attachments

The following attachments are included as a part of this OPDR:

Attachment A - Title Report.

Attachment E – Maps of the Project Area, including an ESRI Geodatabase that represents the Project Area.

Attachment F – Orthophoto map of the Project Area.

Attachment G – A graph portraying the baseline.

Attachment H – A diagram of the baseline.

Attachment J – Legal Constraints Affecting Forest Management Activities in the Project Area.

Attachment K – Modeling Plan.

Attachment L – Inventory Specification.

Attachment M – Volume and Biomass Equations.

Attachment N – Financial Analysis of Baseline Scenario

ATTACHMENT A



Redwood Empire Title Company of Mendocino County

**405 S. Orchard Avenue, P. O. Box 238
Ukiah, CA 95482
Phone: (707)462-8666 • Fax: (707)462-5010**

**Our No.: 01301607RB
Your No.:
Seller: Florence Miller and Steven Miller, as
successor co-trustees of trust
established under the last will and
testament of Edward Miller deceased**

**When replying Please Contact:
ESCROW OFFICER: Rosanne Burlesci
rburlesci@redwoodtitle.com**

Updated PRELIMINARY REPORT

Property Address: Unincorporated Area, Mendocino County, CA

In response to the above referenced application for a policy of title insurance, **Redwood Empire Title Company of Mendocino County** hereby reports that it is prepared to issue, or cause to be issued, as of the date hereof, a Policy or Policies of Title Insurance describing the land and the estate or interest therein hereinafter set forth, insuring against loss which may be sustained by reason of any defect, lien or encumbrance not shown or referred to as an Exception below or not excluded from coverage pursuant to the printed Schedules, Conditions and Stipulations of said Policy forms.

The printed Exceptions and Exclusions from the coverage and Limitations on Covered Risks of said Policy or Policies are set forth in Exhibit A attached. Copies of the Policy forms should be read. They are available from the office which issued this report.

Please read the exceptions shown or referred to below and the exceptions and exclusions set forth in Exhibit A of this report carefully. The exceptions and exclusions are meant to provide you with notice of matters which are not covered under the terms of the title insurance policy and should be carefully considered.

It is important to note that this preliminary report is not a written representation as to the condition of title and may not list all liens, defects and encumbrances affecting title to the land.

This report (and any supplements or amendments hereto) is issued solely for the purpose of facilitating the issuance of a policy of title insurance and no liability is assumed hereby. If it is desired that liability be assumed prior to the issuance of a policy of title insurance, a Binder or Commitment should be requested.

Dated as of September 28, 2015 at 10:33 AM.

John Baron
Chief Title Officer

jbaron@redwoodtitle.com

The form of policy of title insurance contemplated by this report is:
CLTA Standard Policy
Underwritten by Old Republic National Title Insurance Company

SCHEDULE A

1. The estate or interest in the land hereinafter described or referred to covered by this Report is:
a Fee as to Tracts One and Two; an Easement as to Tracts Three, Four and Five
2. Title to said estate or interest at the date hereof is vested in:
Florence Miller and Steven Miller, as successor co-trustees of the trust established under the will of Edward Miller, deceased, by the Judgment of Distribution made by the Superior Court of the State of California, County of Contra Costa, Probate No. 39223 on April 26, 1976
3. The land referred to in this report is situated in the State of California, County of Mendocino and is described as follows:

See Exhibit A attached hereto and made a part hereof.

SCHEDULE B

At the date hereof exceptions to coverage in addition to the printed Exceptions and Exclusions in the said policy form would be as follows:

1. Taxes and assessments, general and special, for the fiscal year 2015 - 2016, a lien not yet due or ascertainable.
2. The lien of supplemental taxes, if any, assessed pursuant to the provisions of Section 75, et seq. of the Revenue and Taxation Code of the State of California.
3. Rights of the public, County and/or City, in and to that portion of said land lying within the lines of Mountain View Road.
4. Easement(s) for the purposes stated herein and incidental purposes as provided in the document:
Recorded: October 7, 1897 in Book 41 of Deeds, Page 443
For: road
In favor of: County of Mendocino
5. Terms, provisions and right of way contained in the document recorded April 26, 1898 in Book 74 of Deeds, Page 218.
6. The effect of fishing rights for the people of the State of California reserved in the patent recorded July 8, 1922 in Book 23 of Patents, Page 309, Mendocino County Records.
7. Easement(s) for the purposes stated herein and incidental purposes as provided in the document:
Recorded: February 25, 1957 in Book 454, Page 167 of Official Records
For: public utilities
In favor of: The Pacific Telephone and Telegraph Company
8. Easement(s) for the purposes stated herein and incidental purposes as provided in the document:
Recorded: September 25, 1957 Book 469, Page 286 of Official Records
For: public utilities
In favor of: Pacific Gas and Electric Company
9. Terms, provisions, covenants, restrictions and conditions contained in a document executed pursuant to the California Land Conservation Act of 1965 (Williamson Act) and recorded February 23, 1972 in Book 877, Page 429 of Official Records.
 - a. Notices of Non-renewal recorded February 24, 1978 in Book 1134, Page 520 of Official Records and April 7, 1992 in Book 1981, Page 118 of Official Records.
10. Any facts, rights, interests or claims that may exist or arise by reason of matters, if any, disclosed by that certain Record of Survey filed April 1, 1982 in Map Case 2, Drawer 39, Page 1; June 22, 1983 in Map Case 2, Drawer 40, Page 55; February 14, 1984 in Map Case 2, Drawer 42, Page 48; April 30, 1985 in Map Case 2, Drawer 43, Page 9; January 22, 1986 in Map Case 2, Drawer 43, Page 100; February 24, 1986 in Map Case 2, Drawer 44, Page 24 and September 4, 1991 in Map Case 2, Drawer 54, Page 10.
11. Terms and provisions as contained in an instrument,
Entitled : Easement Agreement
Recorded: September 8, 1983 in Book 1419, Pages 98, 103, 113 and 127 of Official Records
12. Easements, terms and provisions as contained in an instrument,
Entitled : Easement Agreement
Recorded: September 8, 1983 in Book 1419, Page 108 of Official Records

13. Easements, terms and provisions as contained in an instrument,
Entitled : Easement Agreement
Recorded: September 8, 1983 in Book 1419, Page 123 of Official Records
14. Terms and provisions as contained in an instrument,
Entitled : Boundary Line Agreement
Recorded: November 3, 1986 in Book 1588, Page 539 of Official Records
15. Covenants, Conditions and Restrictions, but omitting any covenants or restrictions if any, based upon race, color, religion, sex, handicap, familial status, or national origin unless and only to the extent that said covenant (a) is exempt under Title 42, Section 3607 of the United States Code or (b) relates to handicap but does not discriminate against handicapped persons, as provided in an instrument
Recorded: October 25, 1991 in Book 1943, Page 529 of Official Records
16. Easements, building setback lines, notations and/or recitals as shown or provided for on the map referred to in the legal description.
17. Easement(s) for the purposes stated herein and incidental purposes as provided in the document:
Recorded: January 30, 1992 in Book 1963, Page 267, Official Records
For: roadway, public utilities, water well and system, pump, electrical pipeline and exclusive sewer easement
Correction Deed recorded February 25, 1992 in Book 1969, Page 276, Official Records
18. Easement(s) for the purposes stated herein and incidental purposes as provided in the document:
Recorded: February 21, 1992 in Book 1968, Page 531 of Official Records
For: roadway and public utilities
19. Easement(s) for the purposes stated herein and incidental purposes as provided in the document:
Recorded: August 14, 1992 in Book 2016, Page 33 of Official Records
For: roadway and public utilities
20. Easement(s) for the purposes stated herein and incidental purposes as provided in the document:
Recorded: October 7, 1992 in Book 2030, Page 261 of Official Records
For: roadway and public utilities
21. Easement(s) for the purposes stated herein and incidental purposes as provided in the document:
Recorded: November 13, 1992 in Book 2039, Page 501 of Official Records
For: roadway and public utilities
22. Easement(s) for the purposes stated herein and incidental purposes as provided in the document:
Recorded: March 19, 1993 in Book 2069, Page 85 of Official Records
For: roadway and public utilities
23. Easement(s) for the purposes stated herein and incidental purposes as provided in the document:
Recorded: May 6, 1993 in Book 2080, Page 496 of Official Records
For: roadway and public utilities
24. Easement(s) for the purposes stated herein and incidental purposes as provided in the document:
Recorded: August 2, 1993 in Book 2102, Page 706 of Official Records
For: roadway
25. Terms and provisions as contained in an instrument,
Entitled : Quitclaim Deed
Recorded: February 22, 1994 in Book 2155, Page 431 of Official Records

26. Easement(s) for the purposes stated herein and incidental purposes as provided in the document:
Recorded: June 6, 1994 in Book 2180, Page 684 of Official Records
For: roadway and public utilities
27. Terms and provisions as contained in an instrument,
Entitled : Quitclaim Deed
Recorded: July 22, 1994 in Book 2190, Page 593 of Official Records
28. Terms and provisions as contained in an instrument,
Entitled : Easement Agreement
Recorded: May 21, 1996 in Book 2333, Page 612 of Official Records
29. Terms and provisions as contained in an instrument,
Entitled : Easement Agreement
Recorded: October 30, 1996 in Book 2371, Page 467 of Official Records
30. Easement(s) for the purposes stated herein and incidental purposes as provided in the document:
Recorded: January 26, 1998 in Book 2474, Page 378 of Official Records
For: road
In favor of: Pacific Bell
31. Easement(s) for the purposes stated herein and incidental purposes as provided in the document:
Recorded: April 7, 1998 in Book 2494, Page 684 of Official Records
For: roadway and public utilities
32. Easement(s) for the purposes stated herein and incidental purposes as provided in the document:
Recorded: April 15, 1998 in Book 2497, Page 261 of Official Records
For: ingress and egress
33. Easement(s) for the purposes stated herein and incidental purposes as provided in the document:
Recorded: February 25, 2005 as 2005-03984 of Official Records
For: ingress, egress and utilities

Terms and provisions contained therein.
34. Easement(s) for the purposes stated herein and incidental purposes as provided in the document:
Recorded: August 26, 2011 as 2011-12435 of Official Records
For: roadway and public utilities
35. Any claim or loss arising from any defect or invalidity in, or unenforceability of, the rights described as Tracts Four, Five C and Five G herein occasioned by the failure of the instrument which created said rights to contain a sufficient description for the location of such easement, anything contained in the policy or endorsements thereto to the contrary notwithstanding.
36. Terms and conditions contained in the Trust established under the will of Edward Miller as disclosed by Judgment of Distribution recorded April 29, 1976 in Book 1038, Page 156 of Official Records
NOTE: The requirement that both:
 - a. a Certification of Trust be furnished in accordance with California Probate Code Section 18100.5; and
 - b. a complete copy of the trust instrument(s), together with a statement that the trust has not been revoked or otherwise terminated, be furnished for this Company's review.The Company reserves the right to make additional exceptions and/or requirements upon review of either of the above.

37. Terms and provisions as contained in an instrument,
Entitled : Deed of Conservation Easement
Dated: July 17, 2015
Executed By : Florence Miller and Steven Miller as successor co-trustees of the trust established under the will of Edward Miller, deceased and Mendocino Land Trust, a California non-profit corporation
Recorded: September 28, 2015 as 2015-13162, Official Records

38. Matters as contained or referred to in an instrument,
Entitled : Notice of Unrecorded Grant Agreement (With Covenants Affecting Real Property)
Executed By : Mendocino Land Trust and the Wildlife Conservation Board
Recorded: September 28, 2015 as 2015-13163, Official Records

END OF SCHEDULE B

INFORMATIONAL NOTES:

1. NOTE: According to the public records, there have been no deeds conveying the property described in this report recorded within a period of 24 months prior to the date hereof except as follows:
NONE

EXHIBIT "A"

All that certain real property situated in the County of Mendocino, State of California, more particularly described as follows:

Tract One:

Parcel One:

The Northeast quarter of the Southwest quarter; the South half of the North half of the Southeast quarter; and the South half of the Southeast quarter of Section 22; the Northeast quarter of the Southwest quarter; the South half of the Southwest quarter; and the Southeast quarter of Section 23; the South half of Section 24; the North half; and the Southwest quarter of Section 25; the North half of the North half; the North half of the Southwest quarter; the Southeast quarter; and the South half of the North half of Section 26; the Northeast quarter of Section 27, Township 13 North, Range 16 West, Mount Diablo Base and Meridian, together with any portion of Sections 23 and 24, Township 13 North, Range 16 West, Mount Diablo Base and Meridian acquired by Miller in the quitclaim deed recorded November 3, 1986 in Book 1588, Page 544, Mendocino County Records, and excepting therefrom any portion of said Sections 23 and 24 conveyed to Piper in the quitclaim deed recorded November 3, 1986 in Book 1588, Page 547, Mendocino County Records, Also excepting those portions of said Sections 25, 26 and 27 described in the deeds recorded February 21, 1992 in Book 1968, Page 531; February 22, 1994 in Book 2155, Page 428; and July 22, 1994 in Book 2190, Page 591, Mendocino County Records and excepting Parcels 1 through 13, inclusive, as numbered and designated upon the Parcel Map of Parcel Division 1-88 filed for record on September 4, 1991 in Map Case 2, Drawer 54, Pages 10, 11, 12 and 13, Mendocino County Records,

APN: 133-160-08, 133-160-12, 133-170-11, 133-210-06, 133-210-10, 133-210-11, 133-220-01, 133-220-20 and 133-220-24

Parcel Two:

Lots 11 through 20, inclusive; and the South half of the Southeast quarter of Section 19, together with that portion of Section 19, Township 13 North, Range 15 West, Mount Diablo Base and Meridian acquired by Miller in the quitclaim deed recorded November 3, 1986 in Book 1588, Page 544, Mendocino County Records, and excepting therefrom any portion of said Section 19 conveyed to Piper in the quitclaim deed recorded November 3, 1986 in Book 1588, Page 547, Mendocino County Records,

APN: 026-470-07

Parcel Three:

Lots 1, 2, 3, 4, 5, 8, 9, 10, 11 and 12; the West half of the Northeast quarter; the North half of the Southeast quarter; and all that portion of the Southeast quarter of the Southeast quarter lying East of the South Fork of Brush Creek, all in Section 30, Township 13 North, Range 15 West, Mount Diablo Base and Meridian, excepting those portions described in the quitclaim deeds recorded January 26, 2005 as Instrument No. 2005-01783 and 2005-01784, Mendocino County Records.

APN: 026-490-82, 026-490-85 and 026-490-86

Parcel Four:

Parcel 5 as numbered and designated upon the Parcel Map of Parcel Division 1-88 filed for record on September 4, 1991 in Map Case 2, Drawer 54, Pages 10, 11, 12 and 13, Mendocino County Records.

APN: 133-220-11

All of the above described property being merged into and to become part of the Remainder Parcel of the Parcel Map recorded in Map Case 2, Drawer 54, Pages 10 through 13, Mendocino County Records pursuant to

Mendocino County Boundary Line Adjustment No. B18-94 by the deed recorded July 22, 1994 in Book 2190, Page 593, Mendocino County Records.

Tract Two:

All that certain real property situate in the County of Mendocino, State of California being a portion of Sections 30, 31 and 32, Township 13 North, Range 15 West, Mount Diablo Base and Meridian described as follows:

Commencing at the Southwest corner of said Section 30 as shown on that Record of Survey filed in Map Case 2, Drawer 44, Page 24, Mendocino County Records; thence along the Section line between said Sections 30 and 31 North 59°06'50" East, 1619.20 feet to a 1 inch iron pipe with aluminum cap stamped "P/C 1984 L.S. 4572" as shown on that Record of Survey filed in Map Case 2, Drawer 42, Page 48, Mendocino County Records; thence North 0°11'43" East, 2268.05 feet to the True Point of Beginning of this description; thence from the True Point of Beginning South 71°32'45" West, 548.73 feet to a 1/2 inch iron pipe plugged L.S. 3089 as shown on the aforementioned Record of Survey; thence North 0°06'34" West, 1427.79 feet to a 1/2 inch iron pipe plugged L.S. 3089 as shown on said Record of Survey; thence South 77°34'30" East, 2747.50 feet; thence North 74°16'04" East, 1155.40 feet; thence South 5°36'11" East, 2442.34 feet; thence South 88°31'27" East, 1274.06 feet; thence South 88°32'34" East, 1247.94 feet; thence South 9°40'00" East, 2895.00 feet; thence South 86°39'04" West, 50.00 feet; thence North 9°40'34" West, 1268.69 feet; thence South 83°54'38" West, 380.01 feet to a 3/4 inch rebar tagged L.S. 4455; thence South 25°25'38" West, 131.86 feet to a 3/4 inch rebar tagged L.S. 4455; thence South 83°35'04" West, 174.53 feet to a 3/4 inch rebar tagged L.S. 4455; thence South 73°02'44" West, 338.61 feet to a 3/4 inch rebar tagged L.S. 4455; thence South 72°31'04" West, 221.68 feet to a 3/4 inch rebar tagged L.S. 4455; thence South 9°43'55" East, 186.43 feet; thence South 8°18'56" East, 751.65 feet; thence South 86°39'04" West, 912.84 feet; thence North 13°36'49" West, 1276.50 feet to a 3/4 inch rebar tagged L.S. 4455; thence North 69°25'17" East, 242.52 feet to a 3/4 inch rebar tagged L.S. 4455; thence North 6°28'55" East, 211.80 feet to a 3/4 inch rebar tagged L.S. 4455; thence North 53°04'42" West, 514.90 feet to a 3/4 inch rebar tagged L.S. 4455; thence South 74°15'16" West 125.25 feet to a 3/4 inch rebar tagged L.S. 4455; thence South 12°31'36" East, 285.11 feet to a 3/4 inch rebar tagged L.S. 4455; thence South 80°39'16" West, 254.65 feet to a 3/4 inch rebar tagged L.S. 4455; thence North 9°18'43" East, 432.73 feet to a 3/4 inch rebar tagged L.S. 4455; thence North 31°55'49" West, 765.98 feet to a 3/4 inch rebar tagged L.S. 4455; thence South 4°38'54" East, 625.79 feet to a 3/4 inch rebar tagged L.S. 4455; thence South 6°40'54" East, 489.48 feet to a 3/4 inch rebar tagged L.S. 4455; thence South 81°08'57" West, 99.02 feet to a 3/4 inch rebar tagged L.S. 4455; thence North 12°29'34" West, 600.83 feet; thence North 9°51'05" West, 727.82 feet to a 3/4 inch rebar tagged L.S. 4455; thence North 35°44'23" West, 518.41 feet; thence North 35°37'05" West 475.09 feet to a 3/4 inch rebar tagged L.S. 4455; thence North 37°24'15" East, 100.00 feet to a 3/4 inch rebar tagged L.S. 4455; thence North 52°16'46" East, 1094.87 feet; thence North 5°49'08" West, 1064.68 feet; thence South 74°17'28" West, 1107.63 feet; thence South 53°49'31" West, 901.24 feet to a 3/4 inch rebar tagged L.S. 4455; thence South 78°13'52" East, 87.63 feet to a 3/4 inch rebar tagged L.S. 4455; thence South 24°42'55" East, 173.85 feet to a 3/4 inch rebar tagged L.S. 4455; thence South 22°03'10" West, 323.84 feet to a 3/4 inch rebar tagged L.S. 4455; thence South 67°43'55" East, 1029.21 feet to a 3/4 inch rebar tagged L.S. 4455; thence South 30°34'47" West, 100.00 feet to a 3/4 inch rebar tagged L.S. 4455; thence North 77°13'38" West, 778.82 feet to a 3/4 inch rebar tagged L.S. 4455; thence North 75°59'05" West, 1505.50 feet to a spike in the center of a 6.5 foot diameter double Redwood stump; thence North 24°38'03" West, 367.69 feet to the True Point of Beginning.

Excepting therefrom those portions described in the deed to Toni A. Saulls recorded August 26, 2011 as 2011-12435, Official Records.

APN: 026-490-88

The above described parcel is pursuant to Mendocino County Boundary Line Adjustment No. B4-11 by the deed recorded August 26, 2011 as 2011-12436, Mendocino County Records.

Tract Three:

Those certain easements for ingress, egress and utilities reserved in the deed executed by Florence Miller and Steven Miller as co-trustees, to Carsten Hunter, recorded February 25, 2005 as 2005-03984, Mendocino County Records.

Tract Four:

Those certain easements created in the Agreements executed by and between Longview Fibre Company and Florence Miller, et al, recorded September 8, 1983 in Book 1419, Pages 103 and 127, Mendocino County Records.

Tract Five:

Those certain easements for roadway and public utility purposes reserved as a benefit to the lands described in Tracts One and Two above in the following deeds:

- A) Deed to Charles S. Defay recorded January 30, 1992 in Book 1963, Page 267, Official Records.
- B) Deed to Susan D. Lynch recorded February 21, 1992 in Book 1968, Page 531, Official Records.
- C) Deed to Melvin and Kristine A. Kunihiro, Trustees recorded October 7, 1992 in Book 2030, Page 261, Official Records.
- D) Deed to William and Marilyn Spickler recorded November 13, 1992 in Book 2039, Page 501, Official Records.
- E) Deed to Leonard H. and Rachel L. Delffs recorded March 19, 1993 in Book 2069, Page 85, Official Records.
- F) Deed to Heather E. Burkhardt and Joaquin Sherman recorded May 6, 1993 in Book 2080, Page 496, Official Records.
- G) Deed to William B. Anderson and Jo Ann L. Alakszay recorded June 6, 1994 in Book 2180, Page 684, Official Records.

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Sec. 16, 17, 18, 19, 20, 21, T. 13 N., R. 15 W., M.D.B. & M.

(45)

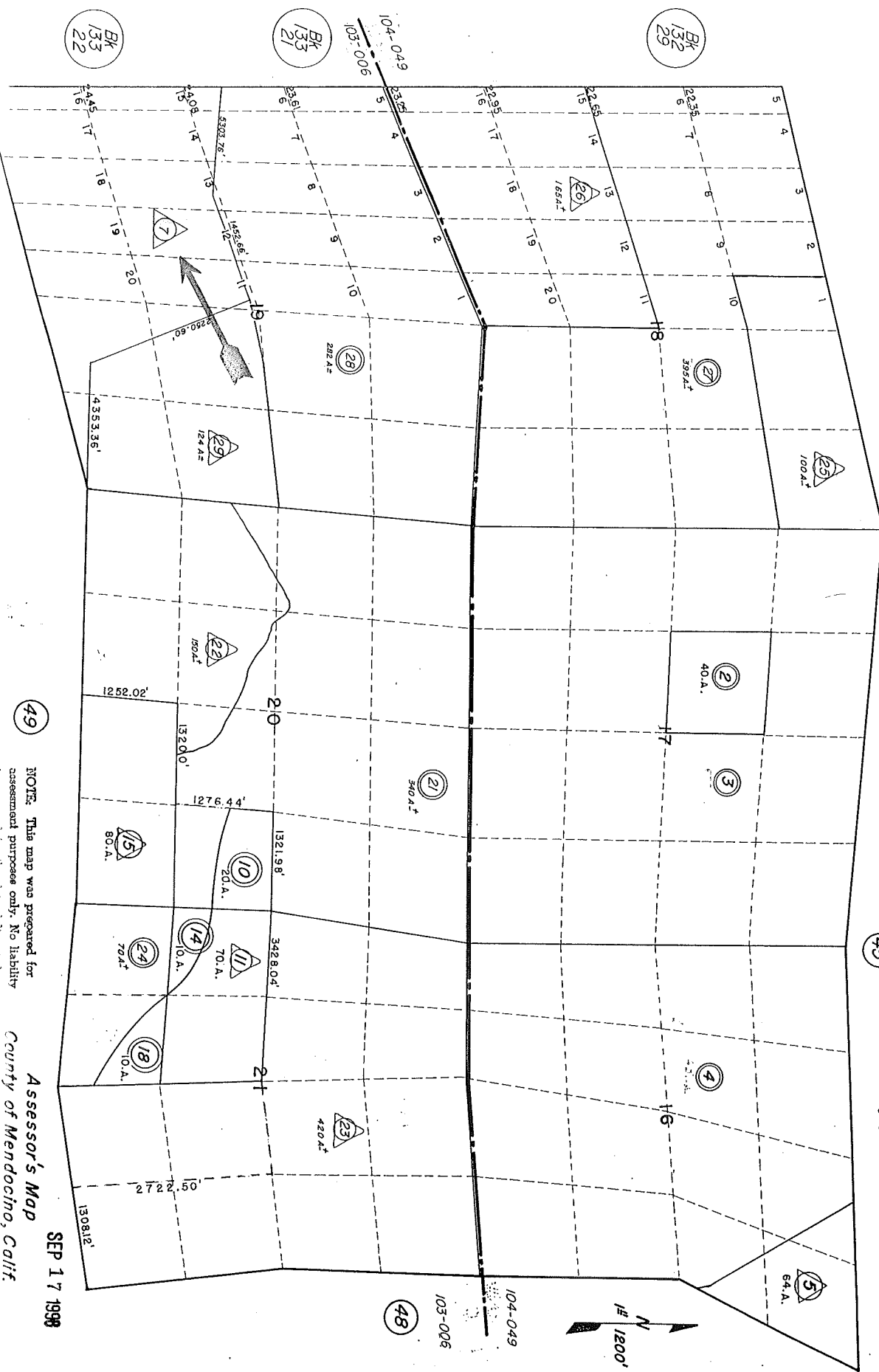
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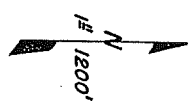
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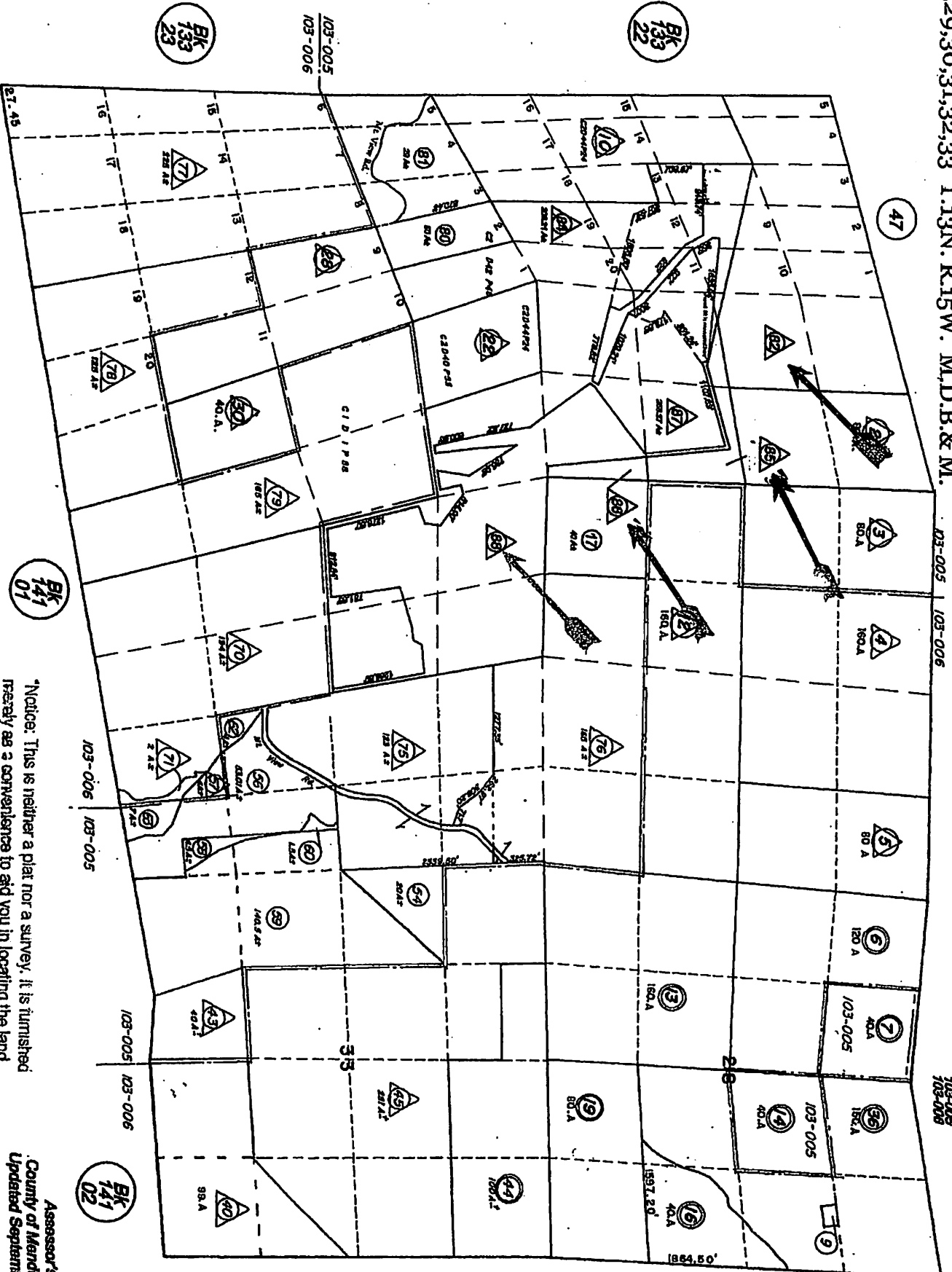


(49)

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Assessor's Map
County of Mendocino, Calif.

SEP 17 1998



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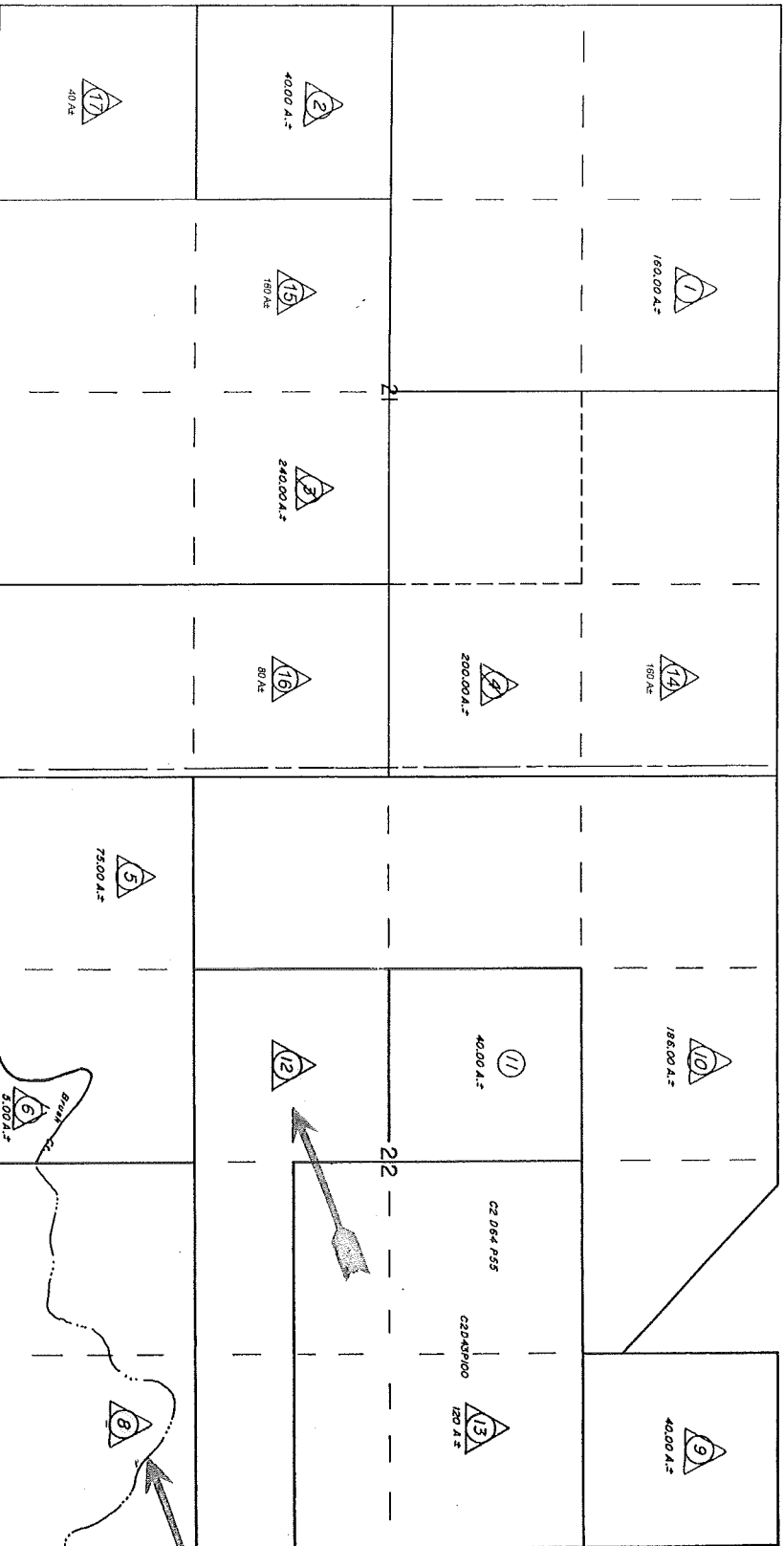
Sec. 21 & 22 T.13N. R.16W. M.D.B.& M.

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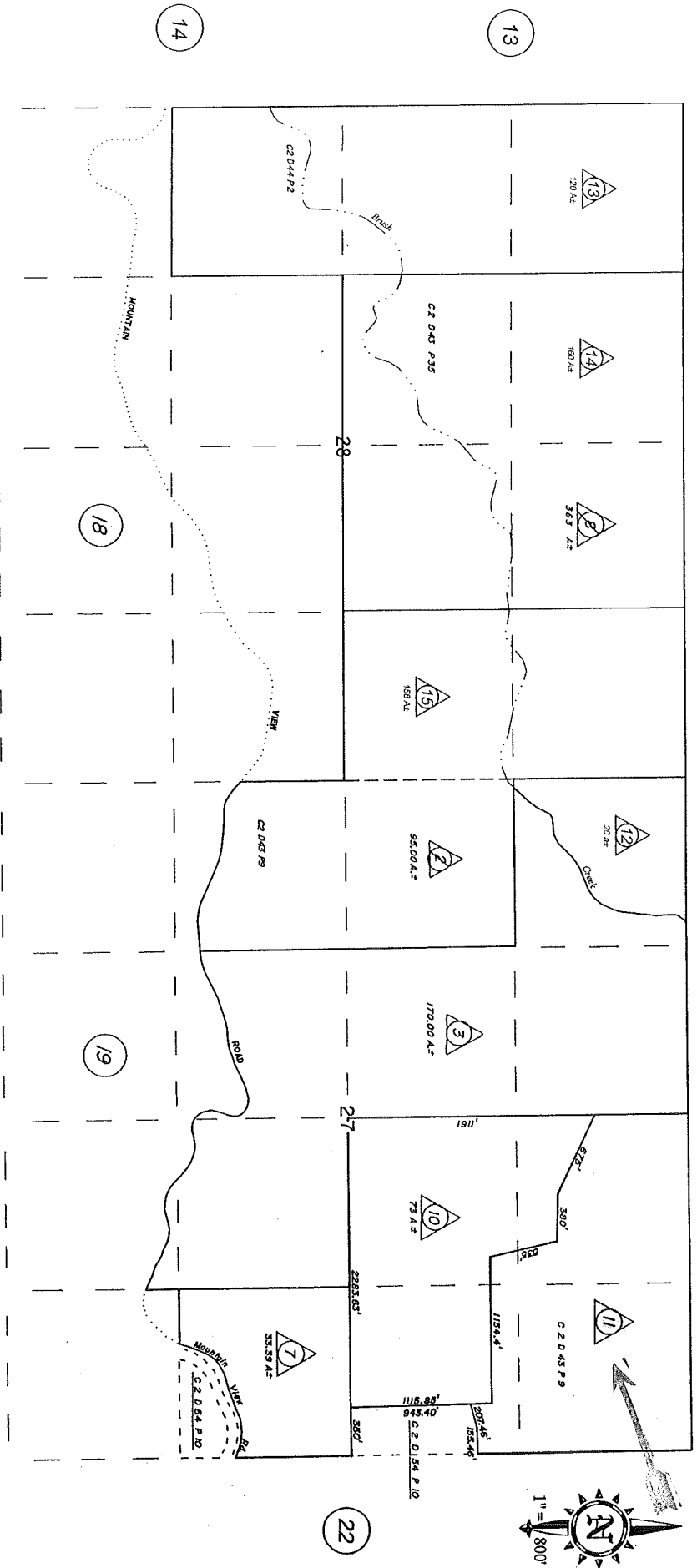
Assessor's Map
County of Mendocino, Calif.
Indated May 9, 2007

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Por. of Sec. 27 & 28 T.13N. R.16W. M.D.B.&M.

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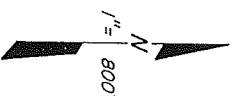


NOTE: This map was prepared for assessment purposes only. No liability is assumed for the data delineated

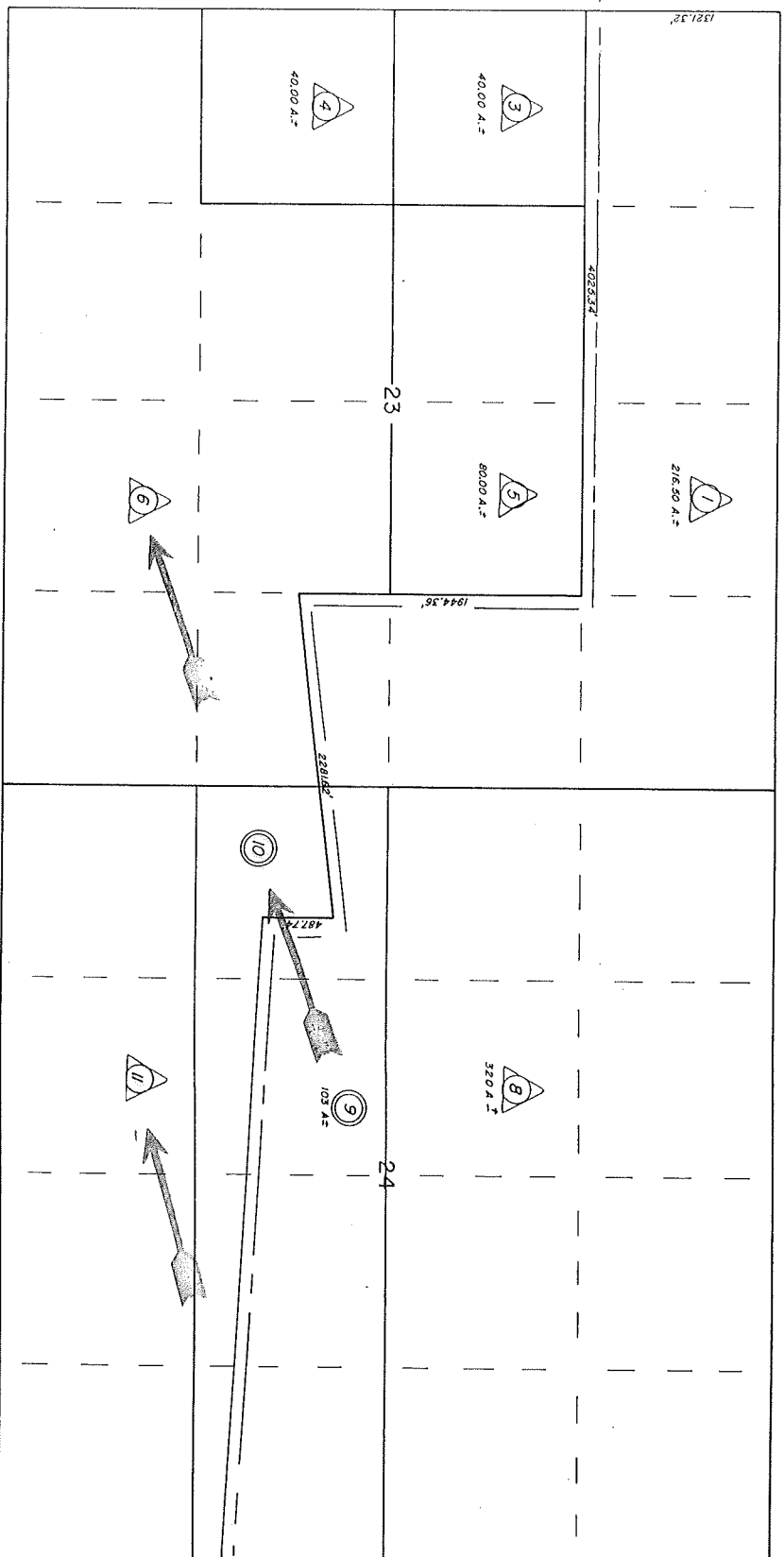
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16



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Assessor's Map

County of Mendocino, Calif.

NOTE: This map was prepared for assessment purposes only. No liability is assumed for the data delineated hereon.

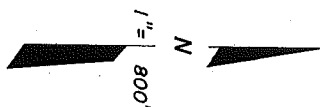
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Sec. 25 & 26 T.13 N. R. 16 W. M.D. B. & M.

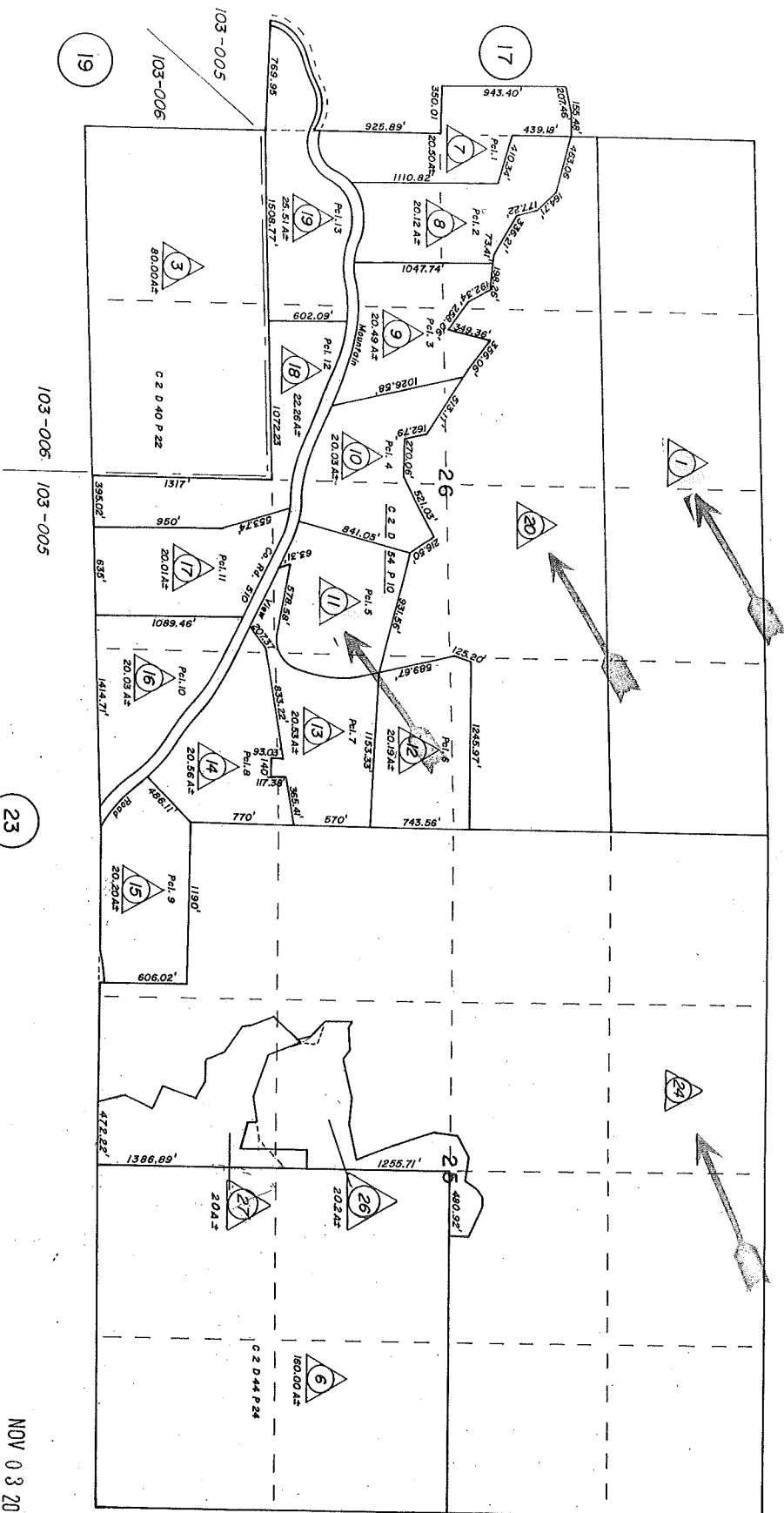
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NOV 03 2004

Assessor's Map

County of Mendocino, Calif.

CLTA PRELIMINARY REPORT FORM (EXHIBIT A) (01-01-08)

**CALIFORNIA LAND TITLE ASSOCIATION
STANDARD COVERAGE POLICY - 1990**

EXCLUSIONS FROM COVERAGE

The following matters are expressly excluded from the coverage of this policy and the Company will not pay loss or damage, costs, attorneys' fees or expenses which arise by reason of:

1. (a) Any law, ordinance or governmental regulation (including but not limited to building or zoning laws, ordinances, or regulations) restricting, regulating, prohibiting or relating (i) the occupancy, use, or enjoyment of the land; (ii) the character, dimensions or location of any improvement now or hereafter erected on the land; (iii) a separation in ownership or a change in the dimensions or area of the land or any parcel of which the land is or was a part; or (iv) environmental protection, or the effect of any violation of these laws, ordinances or governmental regulations, except to the extent that a notice of the enforcement thereof or a notice of a defect, lien, or encumbrance resulting from a violation or alleged violation affecting the land has been recorded in the public records at Date of Policy.
(b) Any governmental police power not excluded by (a) above, except to the extent that a notice of the exercise thereof or notice of a defect, lien or encumbrance resulting from a violation or alleged violation affecting the land has been recorded in the public records at Date of Policy.
2. Rights of eminent domain unless notice of the exercise thereof has been recorded in the public records at Date of Policy, but not excluding from coverage any taking which has occurred prior to Date of Policy which would be binding on the rights of a purchaser for value without knowledge.
3. Defects, liens, encumbrances, adverse claims or other matters:
 - (a) whether or not recorded in the public records at Date of Policy, but created, suffered, assumed or agreed to by the insured claimant;
 - (b) not known to the Company, not recorded in the public records at Date of Policy, but known to the insured claimant and not disclosed in writing to the Company by the insured claimant prior to the date the insured claimant became an insured under this policy;
 - (c) resulting in no loss or damage to the insured claimant;
 - (d) attaching or created subsequent to Date of Policy; or
 - (e) resulting in loss or damage which would not have been sustained if the insured claimant had paid value for the insured mortgage or for the estate or interest insured by this policy.
4. Unenforceability of the lien of the insured mortgage because of the inability or failure of the insured at Date of Policy, or the inability or failure of any subsequent owner of the indebtedness, to comply with the applicable doing business laws of the state in which the land is situated.
5. Invalidity or unenforceability of the lien of the insured mortgage, or claim thereof, which arises out of the transaction evidenced by the insured mortgage and is based upon usury or any consumer credit protection or truth in lending law.
6. Any claim, which arises out of the transaction vesting in the insured the estate of interest insured by this policy or the transaction creating the interest of the insured lender, by reason of the operation of federal bankruptcy, state insolvency or similar creditors' rights laws.

EXCEPTIONS FROM COVERAGE - SCHEDULE B, PART I

This policy does not insure against loss or damage (and the Company will not pay costs, attorneys' fees or expenses) which arise by reason of:

1. Taxes or assessments which are not shown as existing liens by the records of any taxing authority that levies taxes or assessments on real property or by the public records.
Proceedings by a public agency which may result in taxes or assessments, or notices of such proceedings, whether or not shown by the records of such agency or by the public records.
2. Any facts, rights, interests, or claims which are not shown by the public records but which could be ascertained by an inspection of the land or which may be asserted by persons in possession thereof.
3. Easements, liens or encumbrances, or claims thereof, not shown by the public records.
4. Discrepancies, conflicts in boundary lines, shortage in area, encroachments, or any other facts which a correct survey would disclose, and which are not shown by the public records.
5. (a) Unpatented mining claims; (b) reservations or exceptions in patents or in Acts authorizing the issuance thereof; (c) water rights, claims or title to water, whether or not the matters excepted under (a), (b) or (c) are shown by the public records.
6. Any lien or right to a lien for services, labor or material not shown by the public records.

2006 ALTA LOAN POLICY (06-17-06)

EXCLUSIONS FROM COVERAGE

The following matters are expressly excluded from the coverage of this policy, and the Company will not pay loss or damage, costs, attorneys' fees, or expenses that arise by reason of:

1. (a) Any law, ordinance, permit, or governmental regulation (including those relating to building and zoning) restricting, regulating, prohibiting, or relating to
 - (i) the occupancy, use, or enjoyment of the Land;
 - (ii) the character, dimensions, or location of any improvement erected on the Land;
 - (iii) the subdivision of land; or
 - (iv) environmental protection;or the effect of any violation of these laws, ordinances, or governmental regulations. This Exclusion 1(a) does not modify or limit the coverage provided under Covered Risk 5.
(b) Any governmental police power. This Exclusion 1(b) does not modify or limit the coverage provided under Covered Risk 6.
2. Rights of eminent domain. This Exclusion does not modify or limit the coverage provided under Covered Risk 7 or 8.

3. Defects, liens, encumbrances, adverse claims, or other matters:
 - (a) created, suffered, assumed, or agreed to by the Insured Claimant;
 - (b) not Known to the Company, not recorded in the Public Records at Date of Policy, but Known to the Insured Claimant and not disclosed in writing to the Company by the Insured Claimant prior to the date the Insured Claimant became an Insured under this policy;
 - (c) resulting in no loss or damage to the Insured Claimant;
 - (d) attaching or created subsequent to Date of Policy (however, this does not modify or limit the coverage provided under Covered Risk 11, 13, or 14); or
 - (e) resulting in loss or damage that would not have been sustained if the Insured Claimant had paid value for the Insured Mortgage.
 4. Unenforceability of the lien of the Insured Mortgage because of the inability or failure of an Insured to comply with applicable doing-business laws of the state where the Land is situated.
 5. Invalidity or unenforceability in whole or in part of the lien of the Insured Mortgage that arises out of the transaction evidenced by the Insured Mortgage and is based upon usury or any consumer credit protection or truth-in-lending law.
 6. Any claim, by reason of the operation of federal bankruptcy, state insolvency, or similar creditors' rights laws, that the transaction creating the lien of the Insured Mortgage, is
 - (a) a fraudulent conveyance or fraudulent transfer, or
 - (b) a preferential transfer for any reason not stated in Covered Risk 13(b) of this policy.
 7. Any lien on the Title for real estate taxes or assessments imposed by governmental authority and created or attaching between Date of Policy and the date of recording of the Insured Mortgage in the Public Records. This Exclusion does not modify or limit the coverage provided under Covered Risk 11(b).
- The above policy form may be issued to afford either Standard Coverage or Extended Coverage. In addition to the above Exclusions from Coverage, the Exceptions from Coverage in a Standard Coverage policy will also include the following Exceptions from Coverage:

EXCEPTIONS FROM COVERAGE

This policy does not insure against loss or damage (and the Company will not pay costs, attorneys' fees or expenses) that arise by reason of:

1. (a) Taxes or assessments that are not shown as existing liens by the records of any taxing authority that levies taxes or assessments on real property or by the Public Records; (b) proceedings by a public agency that may result in taxes or assessments, or notices of such proceedings, whether or not shown by the records of such agency or by the Public Records.
2. Any facts, rights, interests, or claims that are not shown by the Public Records but that could be ascertained by an inspection of the Land or that may be asserted by persons in possession of the Land.
3. Easements, liens or encumbrances, or claims thereof, not shown by the Public Records.
4. Any encroachment, encumbrance, violation, variation, or adverse circumstance affecting the Title that would be disclosed by an accurate and complete land survey of the Land and not shown by the Public Records.
5. (a) Unpatented mining claims; (b) reservations or exceptions in patents or in Acts authorizing the issuance thereof; (c) water rights, claims or title to water, whether or not the matters excepted under (a), (b), or (c) are shown by the Public Records.

2006 ALTA OWNER'S POLICY (06-17-06)

EXCLUSIONS FROM COVERAGE

The following matters are expressly excluded from the coverage of this policy, and the Company will not pay loss or damage, costs, attorneys' fees, or expenses that arise by reason of:

1. (a) Any law, ordinance, permit, or governmental regulation (including those relating to building and zoning) restricting, regulating, prohibiting, or relating to
 - (i) the occupancy, use, or enjoyment of the Land;
 - (ii) the character, dimensions, or location of any improvement erected on the Land;
 - (iii) the subdivision of land; or
 - (iv) environmental protection;
 or the effect of any violation of these laws, ordinances, or governmental regulations. This Exclusion 1(a) does not modify or limit the coverage provided under Covered Risk 5.
 - (b) Any governmental police power. This Exclusion 1(b) does not modify or limit the coverage provided under Covered Risk 6.
2. Rights of eminent domain. This Exclusion does not modify or limit the coverage provided under Covered Risk 7 or 8.
3. Defects, liens, encumbrances, adverse claims, or other matters:
 - (a) created, suffered, assumed, or agreed to by the Insured Claimant;
 - (b) not Known to the Company, not recorded in the Public Records at Date of Policy, but Known to the Insured Claimant and not disclosed in writing to the Company by the Insured Claimant prior to the date the Insured Claimant became an Insured under this policy;
 - (c) resulting in no loss or damage to the Insured Claimant;
 - (d) attaching or created subsequent to Date of Policy (however, this does not modify or limit the coverage provided under Covered Risk 9 and 10); or
 - (e) resulting in loss or damage that would not have been sustained if the Insured Claimant had paid value for the Title.
4. Any claim, by reason of the operation of federal bankruptcy, state insolvency, or similar creditors' rights laws, that the transaction vesting the Title as shown in Schedule A, is
 - (a) a fraudulent conveyance or fraudulent transfer; or
 - (b) a preferential transfer for any reason not stated in Covered Risk 9 of this policy.
5. Any lien on the Title for real estate taxes or assessments imposed by governmental authority and created or attaching between Date of Policy and the date of recording of the deed or other instrument of transfer in the Public Records that vests Title as shown in Schedule A.

The above policy form may be issued to afford either Standard Coverage or Extended Coverage. In addition to the above Exclusions from Coverage, the Exceptions from Coverage in a Standard Coverage policy will also include the following Exceptions from Coverage:

EXCEPTIONS FROM COVERAGE

This policy does not insure against loss or damage (and the Company will not pay costs, attorneys' fees or expenses) that arise by reason of:

1. (a) Taxes or assessments that are not shown as existing liens by the records of any taxing authority that levies taxes or assessments on real property or by the Public Records; (b) proceedings by a public agency that may result in taxes or assessments, or notices of such proceedings, whether or not shown by the records of such agency or by the Public Records.
2. Any facts, rights, interests, or claims that are not shown in the Public Records but that could be ascertained by an inspection of the Land or that may be asserted by persons in possession of the Land.
3. Easements, liens or encumbrances, or claims thereof, not shown by the Public Records.
4. Any encroachment, encumbrance, violation, variation, or adverse circumstance affecting the Title that would be disclosed by an accurate and complete land survey of the Land and that are not shown by the Public Records.
5. (a) Unpatented mining claims; (b) reservations or exceptions in patents or in Acts authorizing the issuance thereof; (c) water rights, claims or title to water, whether or not the matters excepted under (a), (b), or (c) are shown by the Public Records.

Privacy Statement

July 1, 2001

We recognize and respect the privacy expectations of today's consumers and the requirements of applicable federal and state privacy laws. We believe that making you aware of how we use your non-public personal information ("Personal Information"), and to whom it is disclosed, will form the basis for a relationship of trust between us and the public we serve. This Privacy Statement provides that explanation. We reserve the right to change this Privacy Statement from time to time consistent with applicable privacy laws.

In the course of our business, we may collect Personal Information about you from the following sources:

- From applications or other forms we receive from you or your authorized representative;
- From your transactions with, or from the services being performed by us, our affiliates, or others;
- From our Internet web sites;
- From the public records maintained by governmental entities that we either obtain directly from those entities, or from our affiliates or others; and
- From consumer or other reporting agencies.

Our Policies Regarding the Protection of the Confidentiality and Security of Your Personal Information

We maintain physical, electronic and procedural safeguards to protect your Personal Information from unauthorized access or intrusion. We limit access to the Personal Information only to those employees who need such access in connection with providing products or services to you or for other legitimate business purposes.

Our Policies and Practices Regarding the Sharing of Your Personal Information

We may share your Personal Information with our affiliates, such as insurance companies, agents, and other real estate settlement providers. We may also disclose your Personal Information:

- to agents, brokers or representatives to provide you with services you have requested.
- to third-party contractors or service providers who provide services or perform marketing or other functions on our behalf; and
- to others with whom we enter into joint marketing agreements for products or services that we believe you may find of interest.

In addition, we will disclose your Personal Information when you direct or give us permission, when we are required by law to do so, or when we suspect fraudulent or criminal activities. We may also disclose your Personal Information when otherwise permitted by applicable privacy laws such as, for example, when disclosure is needed to enforce our rights arising out of any agreement, transaction or relationship with you.

One of the important responsibilities of some of our affiliated companies is to record documents in the public domain. Such documents may contain your Personal Information.

Right to Access Your Personal Information and Ability to Correct Errors or Request Changes or Deletion

Certain states afford you the right to access your Personal Information and, under certain circumstances, to find out to whom your Personal Information has been disclosed. Also, certain states afford you the right to request correction, amendment or deletion of your Personal Information. We reserve the right, where permitted by law, to charge a reasonable fee to cover the costs incurred in responding to such requests.

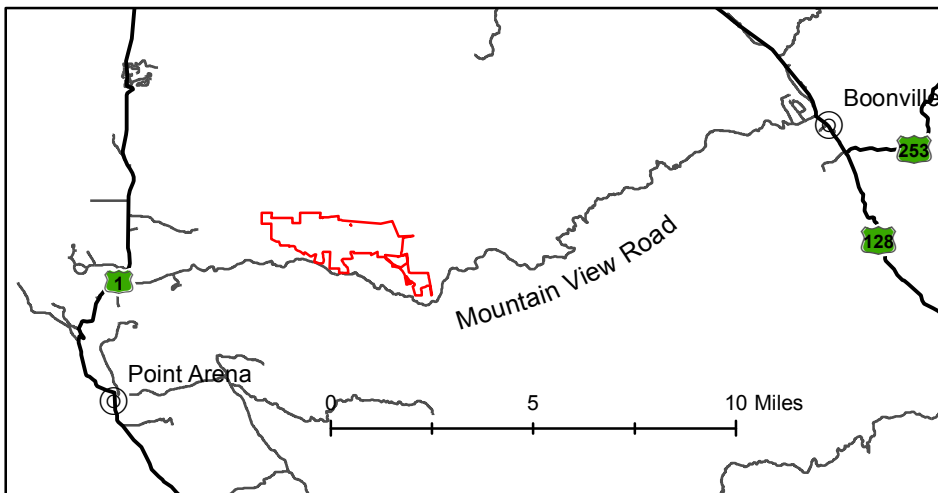
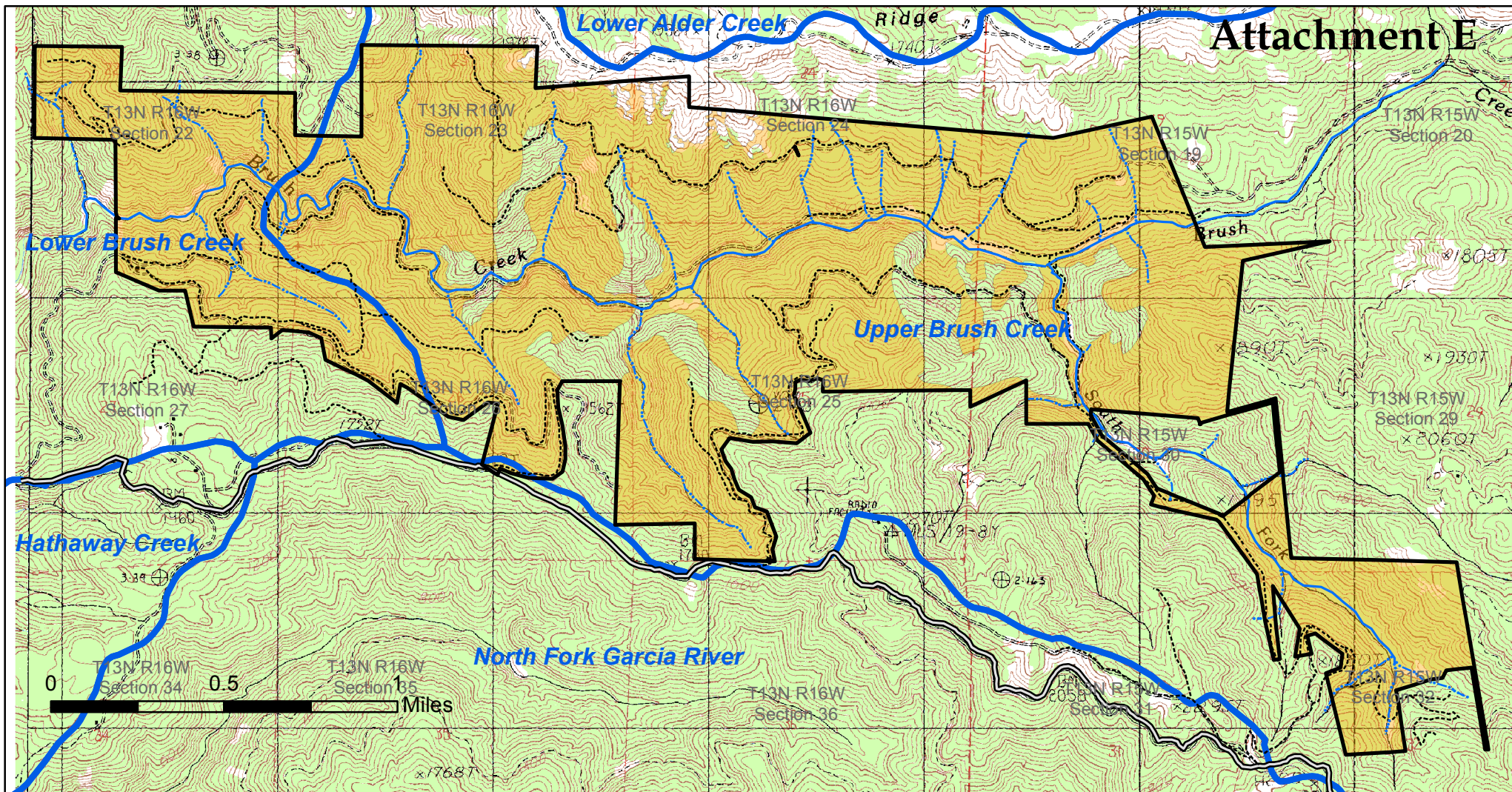
All requests must be made in writing to the following address:

Privacy Compliance Officer
Redwood Empire Title Company
P.O. Box 238
Ukiah, CA 95482

Multiple Products or Services

If we provide you with more than one financial product or service, you may receive more than one privacy notice from us. We apologize for any inconvenience this may cause you.

ATTACHMENT E



Brush Creek Project

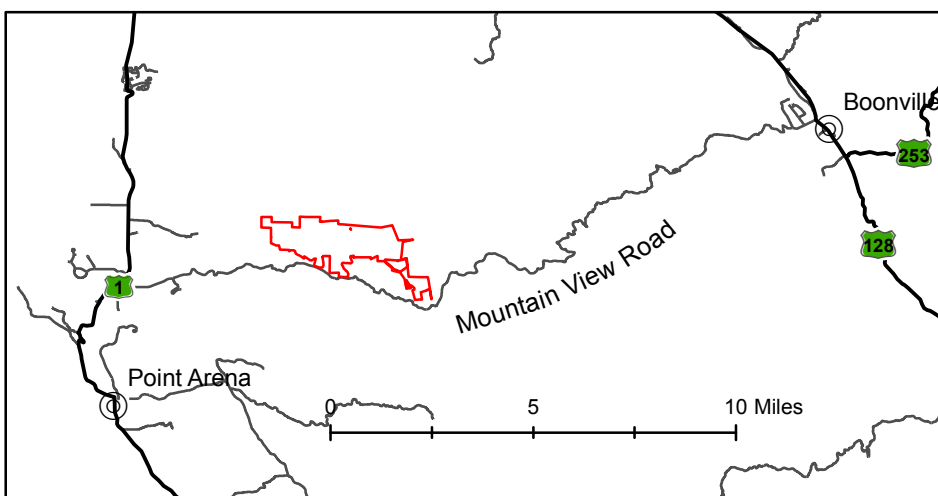
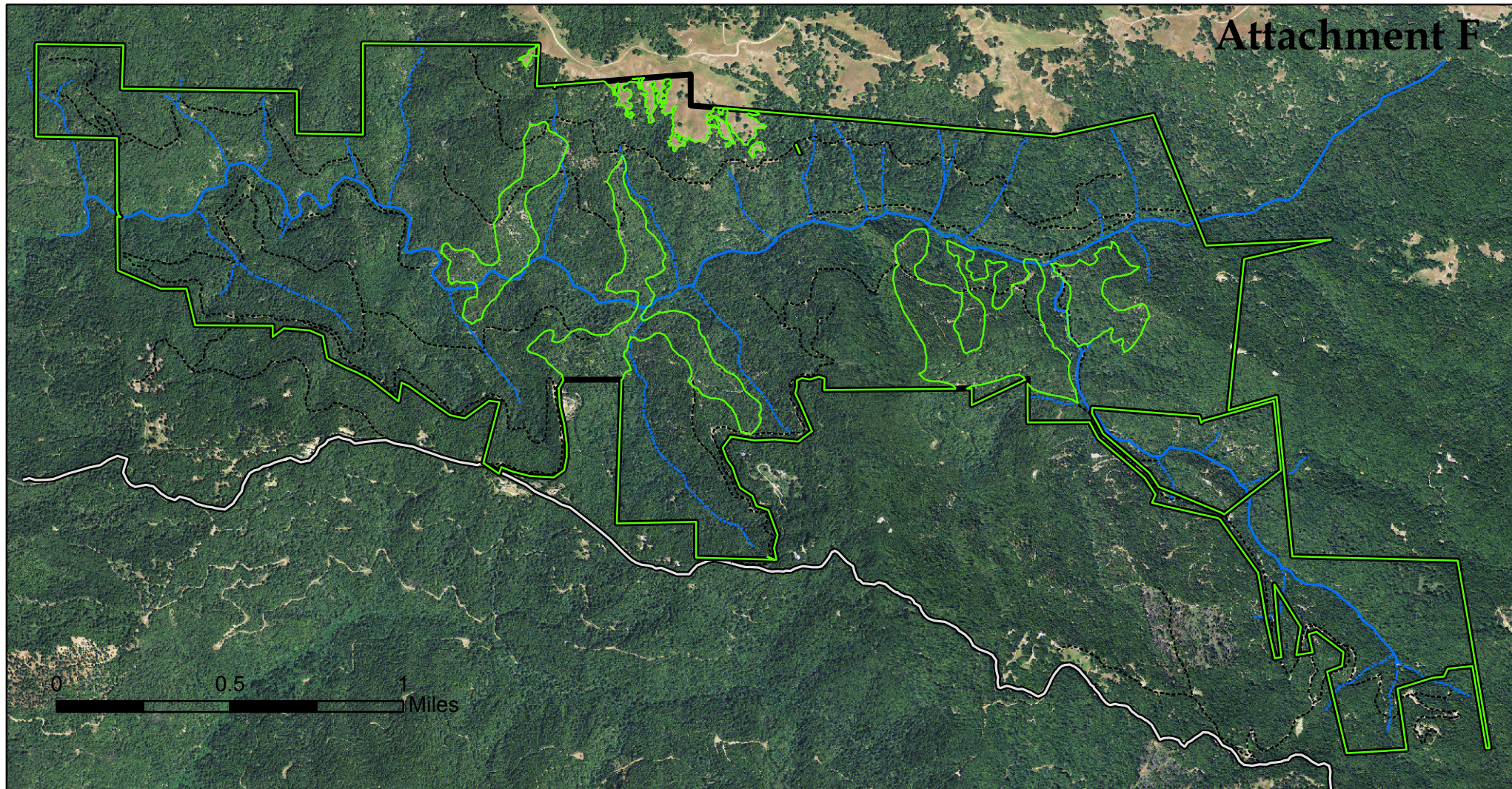
Portions of sections 22, 23, 24, 25, 26, and 27 Township 13N Range 16W and sections 19, 30, 31, and 32 Township 13N Range 15W all Mount Diablo Baseline and Meridian

Legend

- | | | | |
|--|--------------------|--|----------------------|
| | Property Boundary | | Class I Watercourse |
| | Project Boundary | | Class II Watercourse |
| | Watershed Boundary | | Public Road |
| | | | Private Road |









ATTACHMENT F



Brush Creek Project

Portions of sections 22, 23, 24, 25, 26, and 27 Township 13N
Range 16W and sections 19, 30, 31, and 32 Township 13N
Range 15W all Mount Diablo Baseline and Meridian

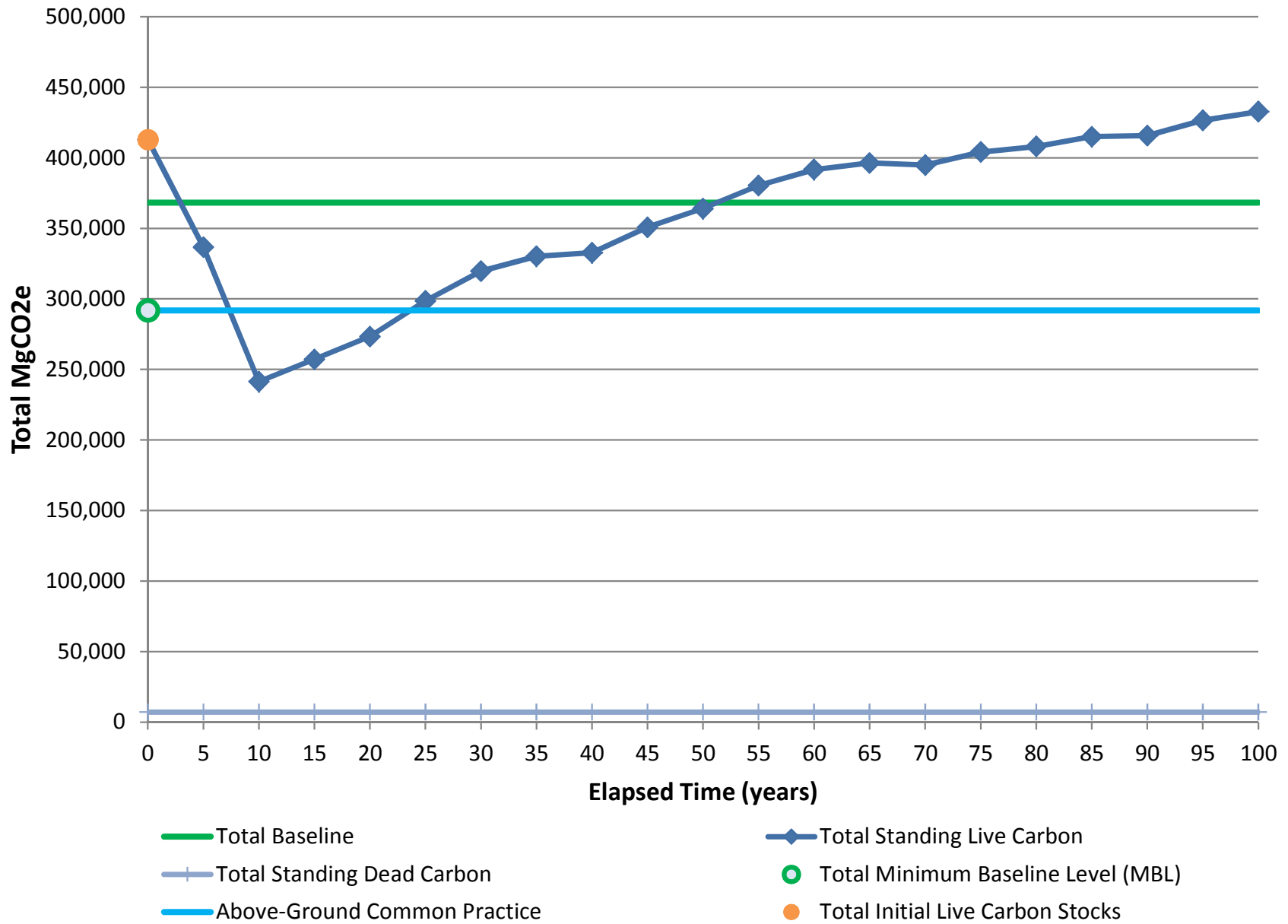
Legend

- | | | | |
|--------------------------------------------------------------------------------------|-------------------|---------------------------------------------------------------------------------------|----------------------|
|  | Project Area |  | Class I Watercourse |
|  | Property Boundary |  | Class II Watercourse |
| | |  | Public Road |
| | |  | Private Road |



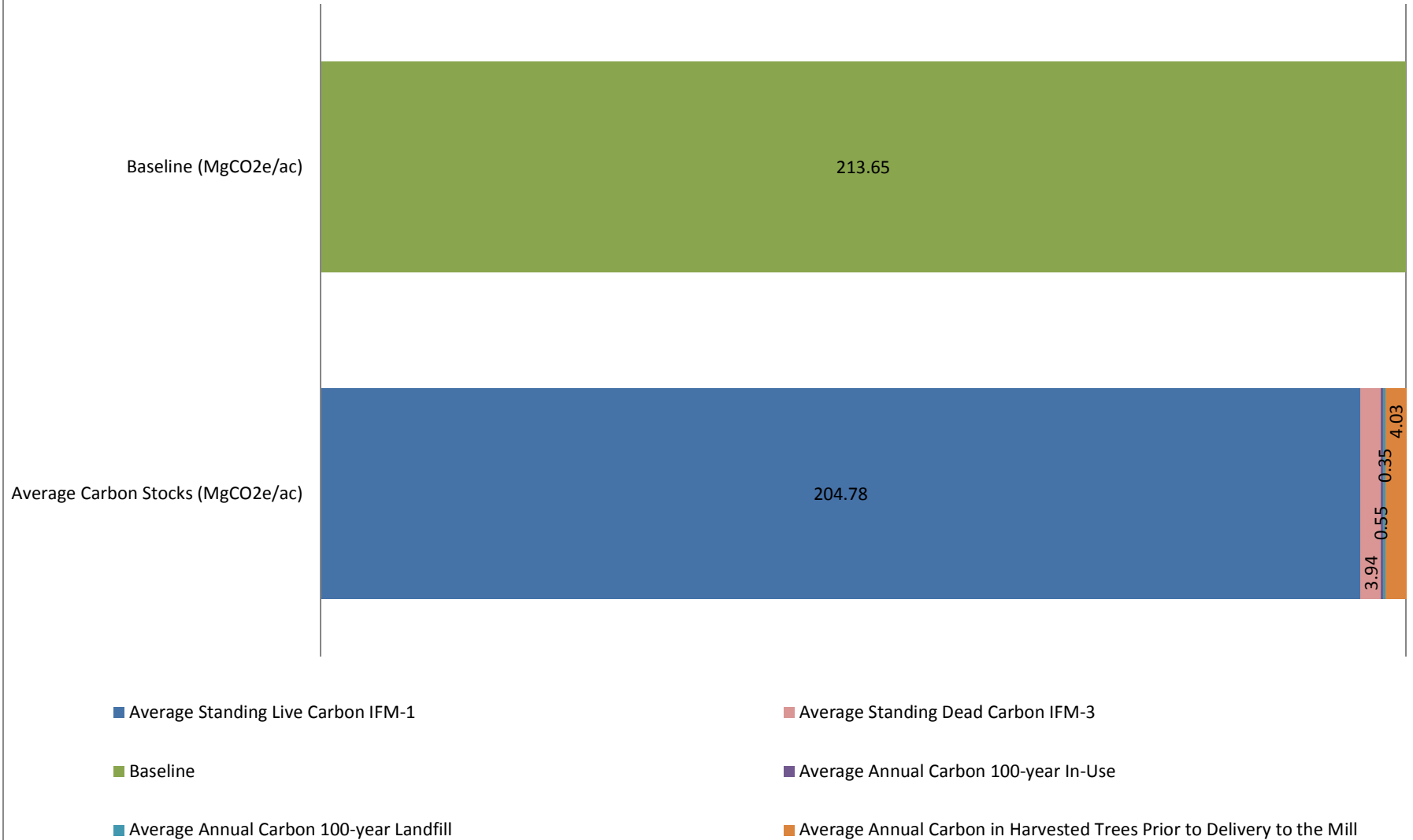
ATTACHMENT G

Attachment G Baseline Graph



ATTACHMENT H

Attachment H - Carbon Stocks and Baseline



Attachment H

Baseline Carbon Stocks (MgCO₂e per Acre)

Elapsed Time	Standing Live Carbon Pool IFM-1	Standing Dead Carbon Pool IFM-3	Baseline
0	234.18	3.94	208.72
5	190.94	3.94	208.72
10	136.90	3.94	208.72
15	145.84	3.94	208.72
20	155.02	3.94	208.72
25	169.33	3.94	208.72
30	181.30	3.94	208.72
35	187.28	3.94	208.72
40	188.73	3.94	208.72
45	198.94	3.94	208.72
50	206.46	3.94	208.72
55	215.68	3.94	208.72
60	222.09	3.94	208.72
65	224.77	3.94	208.72
70	223.91	3.94	208.72
75	229.14	3.94	208.72
80	231.39	3.94	208.72
85	235.34	3.94	208.72
90	235.78	3.94	208.72
95	241.91	3.94	208.72
100	245.35	3.94	208.72
Average	204.78	3.94	208.72

Carbon Pool	Mg C/acre	Mg CO ₂ e/acre	Total Mg CO ₂ e
Average Standing Live and Standing Dead Pools	56.97	208.72	368,059
Average Annual Carbon 100-year In-Use	0.15	0.55	964.69
Average Annual Carbon 100-year Landfill	0.10	0.35	623.25
Average Annual Carbon in Harvested Trees Prior to Delivery to the Mill	1.10	4.03	7122.63

ATTACHMENT J

Attachment J

Legal Constraints Affecting Forest Management Activities on the Project Area

- Z'Berg-Nejedly Forest Practice Act of 1973 (California Public Resources Code – Division 4, Chapter 8): Designed to protect, enhance & restore California's timberland.
- California Forest Practice Rules (Title 14, California Code of Regulations, Chapter 4): Regulations used to implement the Forest Practice Act that govern timber operations.
- California Timberland Productivity Act of 1982 (Gov.C. 51100 et seq.): The intent of this Act is to *"encourage investment in timberlands based on reasonable expectation of harvest"*, and to *"discourage premature or unnecessary conversion of timberland to urban and other uses"*.
- California Environmental Quality Act (CEQA) (Pub.Res.C. 21000 et seq.): statute that requires state and local agencies to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible.
- Porter-Cologne Water Quality Control Act (California Water Code, Division 7. Water Quality): This is the primary vehicle for implementation of California's responsibilities under the federal 1972 Clean Water Act.
- Clean Water Act of 1972 (33 U.S.C. §1251 et seq.): The Act (CWA) establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters.
- California Endangered Species Act (Fish & G.C. 2050 et seq.): Protects and Preserves all native species of fishes, amphibians, reptiles, birds, mammals, invertebrates, and plants, and their habitats, that are threatened with extinction.
- Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884): The Act provides for the conservation of ecosystems upon which threatened and endangered species of fish, wildlife, and plants depend.

ATTACHMENT K

Brush Creek Modeling Plan

By Jim Clark, RPF #2528

April 27, 2016

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Growth and Yield Modeling:

The growth and yield modeling described in this modeling plan is performed using the FORSEE model and the AllCA_ResLib resource library, and is based on the following:

Plot Data:

The modeling presented in this document is based on 249 cruise plots installed in 2014 across the Brush Creek Project Area. The inventory plots were installed systematically across the Brush Creek Project Area as described in the OPDR.

Volume Calculations:

Conifer board foot volume calculations presented in Table 5a below utilize the standard FORSEE volume equations taken from Wensel and Olson's *Hilgardia* 5 for interior conifers. Reported volumes are in board feet Scribner Scale for all conifers 8.5 inches DBH and larger. The FIA volume and biomass equations described in the OPDR are used for the calculation of all carbon stock values presented below.

Biomass Calculations:

Biomass calculations utilized in the modeling are described in detail in the OPDR. The OPDR lists all of the species specific volume and biomass equations utilized which are in compliance with the Compliance Offset Protocol U.S. Forest Projects.

Adjusting the 2014 Inventory Data to 12/10/2013:

As the plots were measured in either February or after August 6th of 2014, the cruise data was adjusted backward to the Offset Project Commencement date of 12/10/2013 by adjusting the height and diameter of each tree in the inventory database based on the number of days from 12/10/2013 to the date the plot on which the tree is located was cruised and applying a calculated height and diameter increment developed from data produced by growing the plot data five years forward in FORSEE.

Projecting the 2014 Inventory Data to 6/30/2015:

The inventory data used to estimate carbon stocking as of 6/30/2015 or the end of the first reporting period was constructed in a manner similar to the adjustment to the start date described above; however, the height and diameter of each tree will be increased based on the number of days since the plot was cruised and the end of the reporting period.

Updating the Inventory:

The inventory methodology included as Attachment L to the OPDR provides a detailed description of the methods that will be used to maintain and update the Brush Creek inventory. FORSEE will be used to project inventory data either forward or backward as needed so that inventory plot data can be adjusted to the appropriate date for reporting of carbon stocks in future OPDRs. The following procedures will apply to inventory updates using average diameter and height increment data derived from 5-year FORSEE projections:

1. Inventory data gathered less than 3 months from the end of the reporting period will not be adjusted to the reporting period date.
2. Inventory data gathered between 3 months and 6 months from the end of the reporting period will be adjusted for one-half year's growth to represent the reporting period date.

3. Inventory data gathered between 6 months and 12 months from the end of the reporting period will be adjusted for one year's growth to represent the reporting period date.

Alternatively, if the inventory data needs to be adjusted in whole year increments, the inventory update feature of FORSEE may be utilized.

Calibration:

The FORSEE model allows the assignment of 'calibration' factors to each species for height, DBH, and crown growth and mortality. Calibration factors are applied to certain harvest regimes in order to adjust the model output to local conditions. The harvest regimes described in Table 3b below do not use calibration with the exception of the "No-Harvest" regime (R9). As FORSEE was never designed to perform 100-year no-harvest analyses, a basal area calibration of 0.70 was applied to all species. If the "No-Harvest" regime were allowed to run uncalibrated, the resulting carbon stocking levels at the end of the 100-year baseline analysis period would be unrealistically high.

In order to assess the reasonableness of the no-harvest regime output, the basal area per acre values for the regime were compared to values predicted by normal yield tables for Douglas-fir. The basal area per acre value for a fully stocked stand of Douglas-fir for site index 130 and stand age 160 taken from McArdle and Meyer, Technical Bulletin No. 201, (Table 4) is 313 square feet per acre (trees 12" DBH and larger). The Brush Creek timber stands are on average approximately 60 years old, thus at the end of the 100-year baseline analysis period, they would be approximately 160 years old. The site index of 130 (100-year base age) is approximately equivalent to the Brush Creek Project's average 50-year base age site index of approximately 99.

At the end of the 100-year baseline analysis period, the Brush Creek stands treated under the R9 prescription contain approximately 260 square feet of conifer basal area per acre in trees 12" DBH and larger. These conifers 12" DBH and larger represent approximately 82% of the total stands basal area per acre 12" DBH or larger at that time. If the modeled conifer stocking output is compared to 82% of the yield table estimate of 313 square feet per acre, the modeled output is just over 101.9% of the value predicted by the normal yield table.

Missing Volume:

The inventory data upon which the baseline growth and yield analysis is based gathered data on missing volume from trees with broken tops, or from trees that included defects that reduced the tree's net carbon value. FORSEE outputs all growth and yield results in terms of gross volume or biomass. The carbon stock values presented in the OPDR as of the project commencement date, and the end of the initial reporting period are net of the missing volume recorded in the inventory data. In order to represent this missing volume in the baseline analysis, the average percentage of missing standing live carbon stocks as of the Project start date are used to reduce the baseline growth and yield output from FORSEE.

Ingrowth:

Ingrowth in FORSEE is handled through the sprouting of tanoak and redwood and the addition of regeneration to bring the stand up to a minimum Forest Practice point count. The sprouting function in FORSEE (FSE.fsprout) was set to sprout 20% of sprouting species, as well as bringing the point count up to the minimum point count defined by the Forest Practice Rules (150 points per acre for sites IV and V and 300 points per acre for site II and III). This is done by calculating the minimum TPA needed to reach the minimum point count and applying the FORSEE TPA regeneration function (FSE.fRegen_PtCount).

Tables 1 and 2 below represent the regeneration tree list, and sprout tree list used by FORSEE as a part of the regeneration functions.

Table 1: Regeneration Tree List

SpeciesID	SpNum	DBH	TotalHT	CRatio	RegenYears	Relative Weight
RW	22	1	5	77	5	20
DF	3	1	7	80	5	80

Table 2: Sprout Tree List

SpeciesID	SpNum	DBH	TotalHT	CRatio	RegenYears	Relative Weight
RW	22	1	7	80	5	70
hTO	69	1	7	80	5	1
hTO	69	1	7	80	10	1
RW	22	1	7	80	0	30

Site Index:

In order to conduct growth modeling for the property, it was necessary to develop an estimate of average 50-year base age site index by species for the Project Area. FORSEE calculates 50-year base age site index for all species on the project area based on estimated 50-year site index for Douglas-fir.

Average site index values by soil type were used to calculate an average site index for each stand type found on the Brush Creek Project by calculating the weighted average site index based on the acres of each soil type in a given stand type. Average site index by soil type was used as a method of capturing the variability of site potential across each stand type. Douglas-fir 50-year site index for the project area is calculated from site index data provided by the Soil Survey of Mendocino County (United States Department of Agriculture, Soil Conservation Service, January 1991) as described below:

Site index was estimated at the stand level using soil survey data and site index data for associated soil components. Soils were categorized by map unit symbol. For those with Douglas-fir site index data (DFSI) for major components, average DFSI was calculated by weighting major component site index data by their relative percentages within the map unit symbol. For soil map unit symbols with only DFSI data for minor components, relative percentages for weighting were not available. The average DFSI of each minor component within the map unit symbol was calculated. This minor component DFSI data was then averaged again to estimate average DFSI for each soil map unit symbol without major component DFSI data. Some soil map unit symbols on the property lacked both major component and minor component DFSI data. These soil map unit symbols were reassigned to others that had DFSI data based on similarities assessed using orthographic photos. Site indices for each map unit symbol in a stand were weighted by the relative acreage of that symbol's area within the stand to calculate average stand site index.

Individual site class assignments by plot were calculated using a method similar to the one described above. Plots were assigned a soil map unit symbol and its associated site class if they were within its bounds. These site class assignments were used in assigning silvicultural prescriptions only. Site indices used to grow plots forward or to apply regimes were consistent with the site indices at the stand level.

Site index estimates from soil data are reported as 100-year base age from McArdle and Meyer, Bulletin 201. These site indices were converted to the King 50-year base age values using table 1 from Research Note No 10 (Krumland and Wensel, 1979). The proportional difference between a stand's 100-year site index and the upper and lower bounds of its class according to

Bulletin 201 was applied to the site index ranges of that class according to King to yield an estimate of each stand's 50-year base site index. The average Douglas-fir 50-year base age site index for each stand type are shown in Table 3a below.

Table 3a: Average Douglas-fir 50-year base age Site Index by Stand

Stand Type	Site Index
103	100
1032	100
202	98

Project Acreage:

The Brush Creek Forest Improved Forest Management Project is comprised of 1763.41 acres of timberland. The topographic map included in Attachment E of the Project Application shows the Project Area boundary. Attachment E also includes GIS data in the form of a geodatabase that includes the Project Area boundary.

Baseline Modeling:

The baseline modeling utilizes the above-described 2013plot dataset, and an unevenaged management harvesting strategy employing selection, transition and rehabilitation of understocked stands combined with small group openings not exceeding 2.5 acres in size. Portions of Brush Creek timber stands are dominated by hardwoods species, or are in an understocked condition. The baseline modeling assumes an aggressive treatment of hardwood species in order to release existing conifer regeneration, and convert areas dominated by hardwoods to conifer occupation. This reduction is accomplished through rehabilitation and hardwood release treatments.

At the Project's initiation on 12/10/2013 there we no approved Timber Harvest Plans (THPs) on the Project Area.

Baseline Harvest Strategy:

The baseline harvest strategy relies on the application of a series of harvest regimes across the Project Area timber stands. The regimes are modeled at the plot level and the growth and yield data is converted to stand level data. This group-selection harvest strategy results in the eventual harvest in small groups of those areas of the property located outside of WLPZs and no-harvest reserve areas within an 80-year period. Table 3b below describes the harvest regimes applied across the Brush Creek timber stands. The final baseline growth and yield analysis is determined by applying a percentage of each regime to each timber stand type.

The silvicultural prescriptions incorporated into the regimes are designed to best accommodate local timber stand conditions, while complying with the Forest Practice Rules as well as all other legal requirements. To accomplish this, a harvest strategy has been developed that evaluates each plot's stocking status in square feet of basal area per acre and point count stocking. Tables 4a-4c below illustrate the silviculture decision matrix upon which the growth and yield modeling is based. Harvesting under selection-transition, utilizes a BDq harvest strategy.

The "Bdq" formula is commonly used to describe the stand structure of uneven-aged forest stands and has been described extensively in the scientific literature. BDq refers to the stand structure with, in order of relative importance: B, the residual basal area; D, the maximum retained diameter class; and q, the ratio of the number of trees in adjacent (one inch) diameter classes.

Table 3b: Harvest Regime Descriptions

Regime	Harvest Scenario Description
R1	This regime applies the silvicultural parameters outlined in tables 4a through 4c below. Simulates group selection by assigning plots to be group-selected in a given decade.
R9	No-harvest prescription applied to watercourse core zones and NSO activity centers. Assumes a basal area calibration of 0.70 for all species.
R10	WLPZ harvest / NSO Nesting/Roosting prescription. Performs selection harvest every decade while retaining a minimum of 150 square feet of conifer and hardwood basal area per acre, and 60% canopy.
R2	NSO Foraging Habitat prescription. Performs selection harvest every decade while retaining a minimum of 82 square feet of conifer and hardwood basal area per acre and 40%-100% canopy.

General Harvest Constraints:

Harvest on the Brush Creek Project is constrained by several factors. Firstly, the California Forest Practice Rules (FPR) create a minimum set of silvicultural standards below which harvest cannot occur.

Legal requirements include all laws, regulations, and legally-binding commitments applicable to the Project Area at the time of the project's initiation that could affect standing live carbon stocks. Brush Creek is subject to the Z'berg- Nejedly Forest Practice Act of 1973 (FPA) and the corresponding Forest Practice Rules (FPR).

The rules that specifically effect the determination of baseline are those that include limits to silviculture activities. This includes the requirements for minimum basal area retention, rotation ages, harvest adjacency restrictions, watercourse buffer widths and sustained yield requirements.

The pertinent rules include the following:

- 14 CCR 913.11(c): Maximum Sustained Production of High Quality Timber Products;
- 14 CCR 913.2: Minimum basal area retention standards for Unevenaged Regeneration Methods;
- 14 CCR 913.2 (a)(2)(B): Group selection harvest limitations;
- 14 CCR 913.2 (b)(6): Minimum post-harvest residual basal area retention standards for the Transition method;
- 14 CCR 913.4 (b): Standards for rehabilitation of Understocked Areas;
- 14 CCR 913.1 (c): Standards for Seed Tree Seed Step;
- 14 CCR 916.5: Procedure for Determining Watercourse and Lake Protection Zone (WLPZ) Widths and Protective Measures;
- 14 CCR 916.9: Details harvest limitations for Watercourse and Lake Protection Zones around Class 1, 2 and 3 streams;
- 14 CCR 919.9: Northern Spotted Owl
- 14 CCR 912.7(b): Resource Conservation Standards for Minimum Stocking

The methods by which the Forest Practice Rule constraints listed above as well as other legally binding constraints are incorporated into the baseline harvest scenario are described in the following sections.

Constraints Analysis:

Characterization:

Timber harvesting was modeled over 100 years for the baseline scenario, taking legal constraints, financial feasibility, and physical limitations into consideration while maintaining average live above-ground carbon stocks above the minimum baseline level. Forest stand development was projected using a combination of uneven-aged systems to create multi-aged conditions depending on the arrangement of treatment types over space and time. Forest stands were subject to treatment types based primarily on their forest structure and site attributes as it relates to the California Forest Practice Rules, e.g. Timber Site III vs. Timber Site IV or designated northern spotted owl (NSO) habitat vs. non-designated NSO habitat.

Baseline Legal Constraints:

Constraints that affect land-use specific to forest management activities have been incorporated into the carbon modeling. For this project, legal constraints have the greatest effect on timber harvesting levels, as opposed to what is financially feasible or physically possible. These legal constraints dictate what types of silvicultural activities (treatment types) are allowed, and where (spatial) and when (temporal) they are allowed, that is, there are different legal constraints for different locations of the project area.). There are four general constraint types that determine what treatments are operable for any given area: 1) Timber Site; 2) NSO designated habitat; and 3) Water and Lake Protection Zones; and 4) Watercourse core zones. Each constraint, and how it is applied in the modeling, is described below by constraint class.

Northern Spotted Owl:

Two NSO activity centers are associated with the Brush Creek Forest Project Area.

Harvest activity is restricted using the following parameters taken from guidance from the US Fish and Wildlife Service “Northern Spotted Owl Take Avoidance Analysis and Guidance For California Coast Forest District” (“Attachment A”), March 15, 2011.

These restrictions are summarized as follows:

Within the 0.7 mile radius (985 acres) of each Activity Center:

- 1) Retain habitat to maximize attributes desirable for NSO.
- 2) Retain at least 500 acres of suitable (Nesting /Roosting/Foraging) NSO habitat, post-harvest, as follows:
 - a) Retain 200 acres of Nesting/Roosting habitat within a 0.7 mile radius of the Activity Center consisting of:
 - i) 100 acres of the 200 acres of Nesting /Roosting habitat retained should be contiguous, or contiguous as possible with the Activity Center.
 - ii) An Additional 100 acres of Nesting/Roosting habitat within the 0.7 mile radius:
 - 1) If the second 100 acres of Nesting/Roosting habitat is also contiguous with the Activity Center, or within the same drainage, operations should retain a minimum of 66% of the pre-harvest basal area per acre of trees at least 11" DBH.
 - 2) If the remaining 100 acres of Nesting/Roosting habitat is not contiguous with the Activity Center, retain at least Nesting/Roosting habitat.
 - b) Retain at least 300 acres of Suitable NSO habitat, post-harvest, of at least Foraging quality.
- 3) Remove no more than 1/3 of the remaining suitable habitat in excess of 500 acres within 0.7 miles of an Activity Center during the life of timber operations.

NSO Habitat Definitions:

Activity Center (AC): Area of concentrated activity of either a pair of NSO or a single territorial NSO, represented by a mapped location (e.g., usually a nest tree) that occurs within, but not necessarily in the exact center of, the "Core Area," defined below.

Core Area: 100 acres of the 200 acres of Nesting/Roosting habitat retained within a 0.7 mile radius contiguous with the Activity Center. If 100 acres of contiguous Nesting/Roosting is not available, then the highest quality habitat available shall be included.

Foraging Habitat: Habitat that contains $\geq 40\%$ canopy cover of trees that are $\geq 11"$ DBH (diameter at breast height), and have a basal area ≥ 75 square feet per acre of trees $\geq 11"$ DBH. Trees may be conifer or hardwood.

Nesting/Roosting Habitat: Forested habitat that supports successful nesting and associated roosting behavior by NSO. Habitat with $\geq 60\%$ canopy cover of trees that are $\geq 11"$ DBH, and have a basal area ≥ 100 square feet per acre of trees $\geq 11"$ DBH. Trees may be conifer or hardwood.

Regimes R2, R9, and R10 have been designed to retain the required basal area and tree sizes as described in tables 4a-4c below for each respective NSO habitat type description. A buffer analysis around the NSO activity centers was conducted to ensure that the required acreage of each type of NSO habitat was retained in the required quantity.

Within 1000 feet of each AC, no harvest was modeled and stratum acreage within this 1000' buffer distance are assigned to the R9 regime. Within a 0.7 mile radius of the AC, acreage was assigned to either the R2 or R10 regime while considering proximity to the NSO activity center. Areas classified as the R10 regime were selected from stands in proximity to the 1000' AC buffer in order to create a contiguous core zone for each NSO. Stands classified as WLPZ buffer within the 0.7 mile buffer were not included in the assignment of R2/R10 regimes, but were spatially considered in the selection of stands to be retained as either R2 or R10. In general, areas designated as WLPZ were adjacent to stands selected as R2 or R10.

As a means of performing a conservative analysis of NSO habitat retention, 100% of stand acres assigned to the R10 regime within the 0.7 mile AC buffer are modeled as no harvest as a part of the final NSO harvest constraint analysis. This is felt to be conservative given the fact that some level of harvest is allowed within stands designated as NSO Nest/Roost habitat as long as sufficient acreage is retained.

Harvesting WLPZ Areas:

Utilizing the Brush Creek GIS the acreage associated with class I and II WLPZs was determined. These WLPZ acres are harvested using a selection silvicultural prescription R10. Harvest levels within the WLPZ are designed to meet FPR standards for shade canopy retention. FPR requirements for the retention of the largest trees, and restrictions on harvests within the channel zone are addressed by adhering to harvest methods allowed by zone and slope

pursuant to 14 CCR 916.9 as indicated in tables 3d through 3g from the Forest Practice Rules, shown below.

Based on average slope adjacent to Class I and II watercourses, a horizontal buffer distance of 100 feet was applied to either side of Class I watercourses and Class II Large watercourses, and a horizontal buffer distance of 85 feet was applied to either side of Class II Standard watercourses. Across the Brush Creek Project Area, this buffer analysis resulted in 214.27 acres located within class I or II WLPZs not including the class I and II core zones. This represents approximately 12.2% of the unconstrained timbered acreage. Overall, WLPZ areas represent approximately 16.8% of the total timbered acreage

As with Class I and II core zones, in some instances, NSO no-harvest areas are coincident with WLPZ zones.

Additional Assignments to the R10 Regime:

After treating 100% of stand acres assigned to the R10 regime within the 0.7 mile AC buffer as no harvest, average standing live above ground stocks for the next 100 years were still slightly below the minimum baseline level. To compensate, 1.219% of the acreage in each strata was reassigned from the R1 regime to the R10 regime.

Table 3c: Acres by Regime following NSO, Core Zone, WLPZ Buffer Analysis, and MBL Adjustment

Stand	Acres	R9	R10	R2	Constrained Acres
103	755.01	69.48	69.70	9.20	148.39
202	280.23	45.94	19.03	3.42	68.39
1032	728.17	177.25	26.55	275.32	479.12
Total	1,763.41	292.67	115.28	287.94	695.89

Table 3d: Procedure for Determining WLPZ Widths and Protective Measures Class I WLPZs - Confined Channels - Coastal Anadromy Zone

Pursuant to 14 CCR 916.9 (f)(2)						
Zone Designation	Zone width (ft.)	Overstory Canopy Cover		Large Tree Retention	Silviculture Requirements	Operational Requirements
Channel Zone	Variable	Retain all trees except per 916.9 [936.9, 956.9](e)(1) A-F or 916.9 [936.9 956.9] (v)		Retain all trees except per 916.9 [936.9, 956.9](e) (1) A-F or 916.9 [936.9 956.9] (v)	Retain all trees except per 916.9 [936.9, 956.9] (e) (1) A-F or 916.9 [936.9, 956.9](v)	No timber operations except per 916.9 [936.9, 956.9] (e) (1)A-F or 916.9 [936.9, 956.9](v);
Core Zone per 916.9 [936.9 956.9] (f)(2)(A)	30 ft.	Retain all trees except per 916.9 [936.9, 956.9](e) (1)A-F or 916.9 [936.9 956.9] (v)		Retain all trees except per 916.9 [936.9, 956.9](e)(1) A-F or 916.9 [936.9 956.9] (v)	Retain all trees except per 916.9 [936.9, 956.9] (e) (1) A-F or 916.9 [936.9, 956.9](v); no sanitation salvage except 916.9 (s)(t)and (u).	No timber operations except per 916.9 [936.9, 956.9] (e) (1) A-For 916.9 [936.9, 956.9](v);
Inner Zone per 916.9 [936.9 956.9] (f)(2)(B)	70 ft.	80% Coast and Southern Forest District of Coastal Anadromy Zone per 916.9 [936.9 956.9] (f)(2)(B)3.	70% in Northern Forest District of Coastal Anadromy Zone per 916.9 [936.9 956.9] (f)(2)(B)3.	13 largest trees /ac. per 916.9 [936.9 956.9] (f)(2)(B)4.	Increase QMD; No sanitation salvage except 916.9 (s)(t)and (u); commercial thinning or single tree selection only.	Preferred Management Practices in 916.9[936.9, 956.9] (f)(2)(D)
Outer Zone per 916.9 [936.9 956.9] (f)(2)(C) Outer Zone applicable only where even-aged regeneration used adjacent to the WLPZ	50 ft.	50% per 916.9 [936.9 956.9] (f)(2)(C).1.		NA	Commercial thinning or single tree selection only; Retain wind firm trees.	Preferred Management Practices in 916.9[936.9, 956.9] (f)(2)(D)
Special Operating Zone per 916.9 [936.9 956.9] (f)(2)(E)	50 ft.	NA		NA	SOZ applicable only where even-aged regeneration used adjacent to the WLPZ . Retain understory and midstory trees per 916.9 [936.9, 956.9] (f)(2)(E)	All other Forest Practice Rules

Table 3e: Procedure for Determining WLPZ Widths and Protective Measures Class I WLPZs – with flood prone areas or channel migration zones

Pursuant to 14 CCR 916.9 (f)(3)						
Zone Designation	Zone width (ft.)	Overstory Canopy Cover		Large Tree Retention	Silviculture Requirements	Operational Requirements
Channel Zone or Channel Migration Zone per 916.9 [936.9 956.9] (f)(3)(A)	Variable	Retain all trees except per 916.9 [936.9, 956.9](e) (1)A-F or 916.9 [936.9 956.9] (v)		Retain all trees except per 916.9 [936.9, 956.9](e) (1)A-F or 916.9 [936.9 956.9] (v)	Retain all trees except per 916.9 [936.9, 956.9] (e) (1) A-F or 916.9 [936.9, 956.9](v)	No timber operations except per 916.9 [936.9, 956.9] (e)(1) A-For 916.9 [936.9, 956.9](v);
Core Zone per 916.9 [936.9 956.9] (f)(3)(B)	30 ft.	Retain all trees except per 916.9 [936.9, 956.9](e) (1)A-F or 916.9 [936.9 956.9] (v)		Retain all trees except per 916.9 [936.9, 956.9](e) (1)A-F or 916.9 [936.9 956.9] (v)	Retain all trees except per 916.9 [936.9, 956.9] (e) (1) A-F or 916.9 [936.9, 956.9](v); no sanitation salvage except 916.9 (s)(t)and (u).	No timber operations except per 916.9 [936.9, 956.9] (e) (1)A-For 916.9 [936.9, 956.9](v);
Inner Zone A per 916.9 [936.9 956.9] (f)(3)(C)	Minimum 70 ft. Maximum 120 ft.	80% Coast and Southern Forest District of Coastal Anadromy Zone per 916.9 [936.9 956.9] (f)(3)(C)3.	70% in all other watersheds per 916.9 [936.9 956.9] (f)(3)(C)3.	13 largest trees /ac. per 916.9 [936.9 956.9] (f)(3)(C)4.	Increase QMD; No sanitation salvage except 916.9 (s)(t)and (u); commercial thinning or single tree selection only.	Preferred Management Practices in 916.9 [936.9, 956.9] (f)(3)(E)
Inner Zone B per 916.9 [936.9 956.9] (f)(3)(D)	Variable: distance from Inner Zone A to end of FPA.	50%		13 largest trees /ac. per 916.9 [936.9 956.9] (f)(3)(D)1.	Increase QMD; No sanitation salvage except 916.9 (s)(t)and (u); commercial thinning or single tree selection only.	Preferred Management Practices in 916.9[936.9, 956.9] (f)(3)(E)
Outer Zone per 916.9 [936.9 956.9] (f)(3)(F) Applicable only where even-aged regeneration used adjacent to the WLPZ	50 ft.	50%		NA	Commercial thinning or single tree selection only; Retain wind firm trees.	Preferred Management Practices in 916.9[936.9, 956.9] (f)(3)(E)

Table 3f. Core and Inner Zone widths.				
Water Class	Class II-S (feet)		Class II-L (feet)	
Geographic location	Watersheds in the coastal anadromy zone		Watersheds in the coastal anadromy zone	
Slope class	Core Zone (feet)	Inner Zone (feet)	Core Zone (feet)	Inner Zone (feet)
≤30%	15	35	30	70
30-50%	15	60	30	70
>50%	15	85	30	70

Table 3g: Procedures for Determining Watercourse and Lake Protection Zone Widths and Protective Measures ¹								
Pursuant to 14 CCR 916.5								
Water Class Characteristics or Key Indicator Beneficial Use	1) Domestic supplies, including springs, on site and/or within 100 feet downstream of the operations area and/or 2) Fish always or seasonally present onsite, includes habitat to sustain fish migration and spawning.		1) Fish always or seasonally present offsite within 1000 feet downstream and/or 2) Aquatic habitat for nonfish aquatic species. 3) Excludes Class III waters that are tributary to Class I waters.		No aquatic life present, watercourse showing evidence of being capable of sediment transport to Class I and II waters under normal high water flow conditions after completion of timber operations.		Man-made watercourses, usually downstream, established domestic, agricultural, hydroelectric supply or other beneficial use.	
Water Class	Class I		Class II		Class III		Class IV	
Slope Class (%)	Width Feet	Protection Measure	Width Feet	Protection Measure	Width Feet	Protection Measure	Width Feet	Protection Measure
					[see 916.4(c)] [see 936.4(c)] [see 956.4(c)]		[see 916.4(c)] [see 936.4(c)] [see 956.4(c)]	
<30	75	BDG	50	BEI	See CFH		See CFI	
30-50	100	BDG	75	BEI	See CFH		See CFI	
>50	150 ²	ADG	100 ³	BEI	See CFH		See CFI	
1 - See Section 916.5(e) for letter designations application to this table.								
2 – Subtract 50 feet width for cable yarding operations.								
3 – Subtract 25 feet width for cable yarding operations.								

Unevenaged Silviculture:

All forest stands in the project area are subject to retention standards for uneven-aged silviculture based on their “Timber Site” or site class. Forest stands in the project area of this constraint class must follow these terms at a minimum:

All forest stands where uneven-aged silviculture is applied shall maintain the minimum basal area retention thresholds of 125 square feet per acre for Site I stands and 75 square feet per acre for Site II and III stands and 50 square feet per acre for Site IV and V stands for selection silviculture, and 50 square feet per acre for transition silviculture for Site II and III stands.

Selection:

14 CCR 913.2: Minimum basal area retention standards for Unevenaged Regeneration Methods:

Unevenaged management is utilized to establish and maintain an unevenaged stand structure. Unevenaged management attributes include the establishment and/or maintenance of a multi-aged, balanced stand structure, promotion of growth on leave trees throughout a broad range of diameter classes, and encouragement of natural reproduction.

- a) Selection** Under the selection regeneration method, the trees are removed individually or in small groups sized from .25 acres to 2.5 acres.
- 1) Trees to be harvested or trees to be retained shall be marked by or under the supervision of the RPF prior to felling operations. When openings greater than .25 acres will be created, the boundaries of the small group(s) may be designated in lieu of marking individual trees within the small group areas. A sample area must be marked prior to a preharvest inspection for evaluation. The sample area shall include at least 10% of the harvest area up to a maximum of 20 acres per stand type which is representative of the range of conditions present in the area.
 - 2) Post harvest stand stocking levels shall be stated in the THP. The level of residual stocking shall be consistent with maximum sustained production of high

quality timber products. In no case shall stocking be reduced below the following standards:

A. Selection System.

1. On Site I lands at least 125 square feet per acre of basal area shall be retained.
2. On Site II and III lands at least 75 square feet per acre of basal area shall be retained.
3. On Site IV and V lands at least 50 square feet per acre of basal area shall be retained.
4. Unless the plan submitter demonstrates how the proposed harvest will achieve MSP pursuant to 14 CCR § 913.11 (a) or (b), the residual stand shall contain sufficient trees to meet at least the basal area, size, and phenotypic quality of tree requirement specified under the seed tree method.

B. Group Selection.

1. At least 80% of the stocked plots must meet the Basal Area stocking standards of 14 CCR 913.2(a)(2)(A).
 2. Not more than 20% of the stocked plots may meet stocking standards utilizing the 300 point count standard with trees that are at least 10 (ten) years old.
 3. An RPF or supervised designee may offset up to 8 plots per 40 plots where those plot centers are initially placed within small group clearings created during the current harvest. Unless substantially damaged by fire, the RPF or supervised designee shall not exclude small group clearings created by previous timber harvesting from the stocking survey.
 4. Unless the plan submitter demonstrates how the proposed harvest will achieve MSP pursuant to 14 CCR 913.11 (a) or (b), the residual stand shall contain sufficient trees to meet at least the basal area, size, and phenotypic quality of tree requirements specified under the seed tree method.
- 3) Within any THP, small group clearings under the selection method shall be separated by a logical logging area.

- 4) Following completion of timber operations (including site preparation) not more than 20 percent of the THP area harvested by this method shall be covered by small group clearings.

Transition:

14 CCR 913.2: Minimum basal area retention standards for Unevenaged Regeneration Methods:

- b) Transition.** The transition method may be used to develop an unevenaged stand from a stand that currently has an unbalanced irregular or evenaged structure. The transition method involves the removal of trees individually or in small groups from irregular or evenaged stands to create a balanced stand structure and to obtain natural reproduction.
- 1) Area for determination of preharvest seed tree retention levels shall be no greater than 20 acres in size.
 - 2) This method is to be used to increase stocking and improve the balance of age classes so as to allow the residual stand to be managed by the selection regeneration method. This method shall not be used more than two times for a stand. The RPF shall delineate areas previously treated by the transition method on the plan map.
 - 3) Stands suitable for the transition method contain adequate quantity and quality of seed producing trees to provide adequate regeneration for new age classes. Stands suitable for this method shall have no more than 50 sq. ft. of basal area greater than the selection basal area standards.
 - 4) Trees to be harvested or trees to be retained shall be marked by or under the supervision of a RPF before felling operations. A sample area must be marked before the preharvest inspection for evaluation. The sample area shall include at least 10% of the harvest area up to a maximum of 20 acres per stand type which is representative of the range of conditions present.
 - 5) Immediately following the completion of timber operations, the minimum basal area standards in 14 CCR 912.7(b)(2) shall be met.
 - 6) The post harvested residual stand shall contain at least 15 square feet of basal area per acre of seed

trees at least 12 inches dbh or greater for timber sites I, II or III; or 12 square feet of basal area per acre of seed trees 12 inches dbh or greater for timber sites IV or V. Unless obviously stocked, these basal area requirements will be determined from sampling averaged across each harvested area required in 14 CCR § 913.2(b)(1). Unless the plan submitter demonstrates how the proposed harvest will achieve MSP pursuant to 14 CCR § 913.11(a) or (b) [953.11(a) or (b)], where present in the preharvest stand, disease free, undamaged seed trees 18 inches dbh or greater shall be retained post harvest until the stand exceeds the minimum seed tree requirements of 14 CCR § 913.1(c)(1)(A). The seed trees shall be full crown, capable of seed production and representative of the best phenotypes available in the present stand.

- 7) Following completion of timber operations (including site preparation) not more than 20 percent of the Plan area harvested by this method shall be occupied by small group clearings.

14 CCR 912.7: Resource Conservation Standards for Minimum Stocking:

The following resource conservation standards constitute minimum acceptable stocking in the Coast Forest District after timber operations have been completed.

- b) An area on which timber operations have taken place shall be classified as acceptably stocked if either of the standards set forth in (1) or (2) below are met within five (5) years after completion of timber operations unless otherwise specified in the rules.
 - 2) The average residual basal area measured in stems 1 inch or larger in diameter, is at least 85 square ft. per acre on Site I lands, and 50 square ft. per acre on lands of Site II classification or lower. Site classification shall be determined by the RPF who prepared the plan.

Commercial Thinning:

14 CCR 913.3: Intermediate Treatments:

- a) **Commercial thinning.** Commercial thinning is the removal of trees in a young-growth stand to maintain or increase average stand diameter of the residual crop trees, promote timber growth, and/or improve forest health. The residual stand shall consist primarily of healthy and vigorous dominant and codominant trees from the preharvest stand.
- 1) Post harvest stand stocking levels shall be stated in the THP. The level of residual stocking shall be consistent with maximum sustained production of high quality timber products. Generally stands will develop stand structures with considerably higher levels of basal area than provided in these minimum standards as stand age increases. In no case shall stocking be reduced below the following standards:
 - A. Where the preharvest dominant and codominant crown canopy is occupied primarily by trees greater than 14 in. DBH:
 1. On Site I lands, at least 125 sq. ft. per acre of basal area shall be left.
 2. On Site II and III lands, at least 100 sq. ft. per acre of basal area shall be left.
 3. On Site IV lands, at least 75 sq. ft. per acre of basal area shall be left.
 4. On Site V lands, at least 50 sq. ft. per acre of basal area shall be left.
 - B. Where the preharvest dominant and codominant crown canopy is occupied primarily by trees less than 14 in. DBH, a minimum of 100 trees per acre over 4 in. DBH shall be retained for site I, II and III. For site IV and V - 75 trees per acre over 4 in. dbh shall be retained.

Rehabilitation of Understocked Areas:

14 CCR 913.3: Special Prescriptions:

The following special harvesting methods are appropriate under certain conditions:.

- b) **Rehabilitation of Understocked Area Prescription.** For the purposes of restoring and enhancing the productivity of commercial timberlands which do not meet the stocking standards defined in 14 CCR 912.7 prior to any timber operations on such lands, an area may be harvested provided it

is restocked in accordance with Subsections (1) or (2). To facilitate restocking, a regeneration plan must be included in the THP. The regeneration plan shall include site preparation, method of regeneration, and other information appropriate to evaluate the plan.

- 1) If the area meets the standards of 14 CCR 912.7 within five years of completion of timber operations, the area shall be considered acceptably stocked, or shall be considered acceptably stocked if it contains at least 10 planted countable trees for each tree harvested on sites I, II, and III, and 5 planted countable trees for each tree harvested on site IV and V.
- 2) On understocked timberlands where no countable conifer trees are to be harvested and the broadleaf species are not designated for management, the area shall be planted to equal or exceed the stocking standards of 14 CCR 912.7(b)(1) [932.7(b)(1), 952.7(b)(1)] and shall be considered acceptably stocked if within five years of completion of timber operations it contains at least an average point count of 150 of Group A species on all site classifications.

This overall constraint is emulated in the baseline by setting a minimum basal area target for uneven-aged stands when they are treated. Approximately 12% of the Project Area is harvested as small groups each decade of the 100-year baseline analysis period.

MSP:

All forest stands and baseline activities in the project area are subject to the Maximum Sustained Production (MSP) of High Quality Timber Products section of the California Forest Practice Rules. It is assumed in the baseline model that MSP is achieved pursuant to 14 CCR 913.11(c)(2) and (3), paraphrased below:

- 2) For uneven-aged management, complying with the seed tree retention standards, meeting minimum stocking and basal area standards for the selected silvicultural methods as contained in the Forest Practice Rules only with group A species, and protecting the soil, air, fish and wildlife, water resources and other public trust resources through the application of these rules.

- 3) For intermediate treatments and special prescriptions, complying with the stocking requirements of the individual treatment or prescription.

This overall constraint is emulated in the baseline by requiring that selection and transition harvest retain at least 15 square feet of conifer basal area in trees 18" DBH or larger for site class III areas, and 12 square feet of conifer basal area in trees 18" DBH or larger and that rehabilitation and commercial thinning harvests meet the minimum stocking standards of the Forest Practice Rules. On average, all strata contain at least 15 square feet of conifer basal area in trees 18" DBH or larger post harvest, including portions harvest with small groups under group selection.

Hardwood Harvest:

The Brush Creek's hardwood reduction program calls for the manipulation of hardwood stocking levels through, manual or mechanical treatments or commercial harvest, or basal herbicide treatments as appropriate. Understocked portions of the Project Area were modeled as a rehabilitation harvest per 14 CCR 913.4(b).

Baseline Harvest Summary:

Treatment types, or silviculture systems, were applied to forest stands in the baseline model such that they followed the silvicultural method objectives in Article 3 of the Forest Practice Rules and as additionally described in this section. Specifically, these treatments included selection, transition, commercial thinning, and rehabilitation of understocked stands. Treatments were selected and scheduled in the baseline based on legal constraint(s) and stocking.

Non-Commercial Treatments:

Portions of the Brush Creek's timberlands exist in a condition that does not permit current commercial timber harvest. These stands are composed of advanced conifer regeneration with varying levels of hardwood competition. The stands with the heaviest hardwood component are targeted for a "Release" treatment during the first decade of the planning period. For stands with lesser amounts of hardwood competition, or those stands where the hardwood component is too small to treat economically, no treatment is

modeled in the baseline growth and yield analysis; however, Brush Creek may, at its discretion, undertake stand improvement treatments in these non-commercial stands. Non-commercial treatments may include hardwood reduction treatments and pre-commercial thinning of conifers.

The arrangement of these treatments over time and space create timber product value in both yields and appreciation and provide NSO habitat that is in line with the baseline scenario characterization and legal constraints. By the end of the baseline model, 292.67 acres remain un-treated as a result of being protected NSO habitat or restricted WLPZ areas. The application of the silvicultural regimes described below at the landscape level, yield an acceptable return on investment for the forest owner while maintaining compliance with the California Forest Practice Rules and NSO Take Avoidance protection measures. Overall, the baseline regime reflects maximum sustained productivity and a harvest and growth pattern that indefinitely serves multiple management objectives.

Standing Dead

The standing dead carbon pool represents approximately 1.6% of the total carbon found on the Project Area; however, standing dead levels are below the one metric ton test in the structural elements evaluation criteria under section 3.8.2 (Table 3.2) of the protocol. The standing dead carbon pool is treated as a static pool as a part of the baseline analysis. The level of the standing dead carbon pool on the Brush Creek meets the minimum standards for Standing Dead per the Natural Forest Management requirements of the protocol; furthermore, as the baseline analysis involves ongoing forest management and maintenance of young and vigorous stands, standing dead levels are expected to be maintained at the current levels. It could be argued that the baseline harvesting scenario would remove poorly formed and suppressed trees, thus capturing mortality that would have otherwise occurred under a harvest scenario that removed fewer trees and less volume over time.

Silvicultural Prescriptions

The following tables show the silvicultural constraints designed to demonstrate conformance with the requirements of the Forest Practice Rules. Table 4b contains the parameters used to assign first period (decade) silviculture. Harvests in following decades is guided by the minimum retention values shown in table 4c.

Table 4a: Silvicultural Prescriptions used by the Brush Creek Project

Regime	Prescription	Description
R1	Selection	The goal of this prescription is to create and maintain, multistoried, uneven-aged stands with varied diameter classes. Trees are harvested individually, or in small groups up to 2.5 acres in size.
	Transition	The goal of this prescription is to develop uneven-aged stands from stands that have an even-aged or irregular stand structure. Trees are harvested individually, or in small groups up to 2.5 acres in size.
	Rehabilitation	The goal of this prescription is to regenerate stands that are primarily experiencing excessive hardwood competition, and that also do not meet minimum stocking standards. Successive harvests will utilize uneven-aged silviculture.
	Hardwood Release	The goal of this prescription is to improve growth in stands that are primarily experiencing excessive hardwood competition, and that are also well stocked with conifer seedlings. Successive harvests will utilize uneven-aged silviculture.
	Commercial Thinning	To promote timber growth and improve forest health through the harvest of trees in a manner that results in a stand capable of being managed using single tree or group selection.
R9	No Harvest	This prescription is used to account for those portions of the Project Area where harvesting is prohibited.
R10	Single Tree Selection (WLPZ/NSO Nest Roost Habitat)	The goal of this prescription is to create and maintain dense, multistoried, uneven-aged stands with varied diameter classes while meeting the retention standards for NSO Nesting/Roosting Habitat.
R2	Single Tree Selection (NSO Foraging Habitat)	The goal of this prescription is to create and maintain dense, multistoried, uneven-aged stands with varied diameter classes while meeting the retention standards for NSO Foraging Habitat.

Table 4b: Pre-harvest Stand Conditions by Silvicultural Prescription

Regime	Prescription	Pre-Harvest Conifer Basal Area (Square Feet per Acre)		Other Pre-Harvest Considerations
		Lower Limit	Upper Limit	
R1	Selection Site Class II and III	125	None	Retain at least 15 square feet of basal area in trees 18” or larger.
	Selection Site Class IV	70	None	Retain at least 12 square feet of basal area in trees 18” or larger.
	Transition Site Class II and III	70	125	Retain at least 15 square feet of basal area in trees 18” or larger.
	Rehabilitation Site Class II and III	0	50	Less than 300 point count, at least 35 square feet of hardwood basal area.
	Rehabilitation Site Class IV	0	50	Less than 150 point count, at least 35 square feet of hardwood basal area.
	Hardwood Release	0	70	At least 300 point count, at least 100 square feet of hardwood basal area.
	Commercial Thinning Site Class II and III	100	None	At least 300 point count.
	Commercial Thinning Site Class IV	75	None	Less than 150 point count.
R9	No Harvest	None	None	
R10	Single Tree Selection (WLPZ/NSO Nest Roost Habitat)	None	None	At least 130 square feet of basal area in trees 11” or larger.
R2	Single Tree Selection (NSO Foraging Habitat)	None	None	At least 75 square feet of basal area in trees 11” or larger.

Table 4c: Post-harvest Stocking by Silvicultural Prescription

Regime	Prescription	Stocking Considerations	Conifer Basal Area Retention (sq. ft. per acre)	Hardwood Basal Area Retention (sq. ft. per acre)	Regeneration Assumptions	Time to Next Treatment
R1	Selection Site Class II and III	Less than 20% of stand in group openings, at least 15 sq. ft. >18" DBH	≥75	7	300 Point Count, Sprout 20%	At Least 10 Years
	Selection Site Class IV	Less than 20% of stand in group openings, at least 12 sq. ft. >18" DBH	≥50	7	150 Point Count, Sprout 20%	At Least 10 Years
	Transition Site Class II and III	Less than 20% of stand in group openings, at least 15 sq. ft. >18" DBH	≥50	7	300 Point Count, Sprout 20%	Selection within 10-20 Years
	Rehabilitation Site Class II and III		≥10 where conifer ≥10 pre-harvest	7	300 Point Count, Sprout 20%	Selection within 30-40 Years
	Rehabilitation Site Class IV		≥10 where conifer ≥10 pre-harvest	7	150 Point Count, Sprout 20%	Selection within 30-40 Years
	Hardwood Release	No Commercial Conifer Harvest	No Commercial Conifer Harvest	7	None	Selection within 20-40 Years
	Commercial Thinning Site Class II and III	≥ average stand diameter than pre-harvest stand	>100 if QMD >14" and 100 4"+ trees if QMD <14"	7	300 Point Count, Sprout 20%	Selection within 10-20 Years
	Commercial Thinning Site Class IV	≥ average stand diameter than pre-harvest stand	>75 if QMD >14" and 75 4"+ trees if QMD <14"	7	150 Point Count, Sprout 20%	Selection within 10-20 Years
R9	No Harvest	None	None		None	
R10	Single Tree Selection (WLPZ/NSO Nest Roost Habitat)	Retain at least 130 square feet of basal area in trees 11" or larger.	130	20	300 Point Count, Sprout 20% Hardwoods	At Least 10 Years
R2	Single Tree Selection (NSO Foraging Habitat)	Retain at least 75 square feet of basal area in trees 11" or larger.	75	7	300 Point Count, Sprout 20% Hardwoods	At Least 10 Years

Growth and Yield Analysis:

The baseline growth and yield analysis was modeled using the FORSEE model utilizing the above described harvest strategy. Table 5a shows the results of the growth and yield analysis in terms of conifer yields, while tables 5b and 5c show the results in terms of tonnes of live carbon for all species. Table 6 shows the results in terms of average basal area per acre over the 100-year planning horizon.

Table 5a: Average per Acre Conifer Growth and Yield through the Planning Horizon (Scribner Board Feet per Acre)

Elapsed Time (years)	Beginning Inventory (board feet)	Average Decadal Growth (board feet)	Average Decadal Harvest (board feet)	Ending Inventory (board feet)
10	11,897	459	786	8,624
20	8,624	480	293	10,493
30	10,493	572	303	13,180
40	13,180	607	392	15,329
50	15,329	608	364	17,777
60	17,777	621	419	19,797
70	19,797	610	557	20,330
80	20,330	583	462	21,535
90	21,535	568	460	22,614
100	22,614	559	456	23,643

Table 5b: Average per Acre Total Live Carbon Growth and Yield through the Planning Horizon (Mg C per Acre)

Elapsed Time (year)	Beginning Inventory (Mg)	Average Decadal Growth (Mg)	Average Decadal Harvest (Mg Carbon)	Ending Inventory (Mg Carbon)
10	52.39	2.90	4.35	37.90
20	37.90	1.68	1.18	42.92
30	42.92	1.70	0.98	50.19
40	50.19	1.66	1.45	52.25
50	52.25	1.66	1.16	57.16
60	57.16	1.67	1.23	61.49
70	61.49	1.63	1.58	61.99
80	61.99	1.62	1.42	64.06
90	64.06	1.62	1.50	65.28
100	65.28	1.70	1.44	67.93

Table 5c: Average Total Live Carbon Growth and Yield through the Planning Horizon (Total Mg C)

Elapsed Time (year)	Beginning Inventory (Mg)	Average Decadal Growth (Mg)	Average Decadal Harvest (Mg Carbon)	Ending Inventory (Mg Carbon)
10	92,390	5,119	7,675	66,836
20	66,836	2,965	2,080	75,683
30	75,683	3,002	1,719	88,512
40	88,512	2,925	2,562	92,140
50	92,140	2,919	2,053	100,798
60	100,798	2,941	2,178	108,427
70	108,427	2,881	2,792	109,317
80	109,317	2,864	2,499	112,967
90	112,967	2,857	2,643	115,110
100	115,110	2,999	2,532	119,782

Table 6: Average Basal Area per Acre through the Planning Horizon

Elapsed Time (years)	0	10	20	30	40	50	60	70	80	90	100
Conifer	116	85	94	108	110	118	124	122	124	124	129
Hardwood	86	25	27	29	27	27	27	27	27	27	27
Total	202	110	122	138	137	145	151	149	151	152	156

Table 7a below presents the percentage of each silvicultural regime applied to the various timber stands stratum for the entire baseline modeling analysis. Table 7b presents the number of plots treated as group selection for each of the first eight decades of the baseline analysis period. Plots with CCTrtPrd 1 are group selected in the first 10-year period, then again in the ninth 10-year period.

Table 7a: Application of Silvicultural Regimes through the 100-year Planning Horizon

Regime Name					
Stand	R1	R2	R9	R10	Grand Total
103	80.3%	1.2%	9.2%	9.2%	100.0%
202	75.6%	1.2%	16.4%	6.8%	100.0%
1032	34.2%	37.8%	24.3%	3.6%	100.0%

Table 7b: Distribution of Group Selection Silviculture through the 100-year Planning Horizon

Distribution of Group Selection by Decade

CCTrtPrd	Count	Percent
1	32	12.9%
2	32	12.9%
3	31	12.4%
4	31	12.4%
5	31	12.4%
6	31	12.4%
7	31	12.4%
8	30	12.0%
Grand Total	249	

Baseline Carbon Stocks

The baseline modeling scenario defined in this document follows the guidelines presented in section 6.2 of the Compliance Offset Protocol U.S. Forest Projects, October 20, 2011.

Key components of the calculated baseline are as follows:

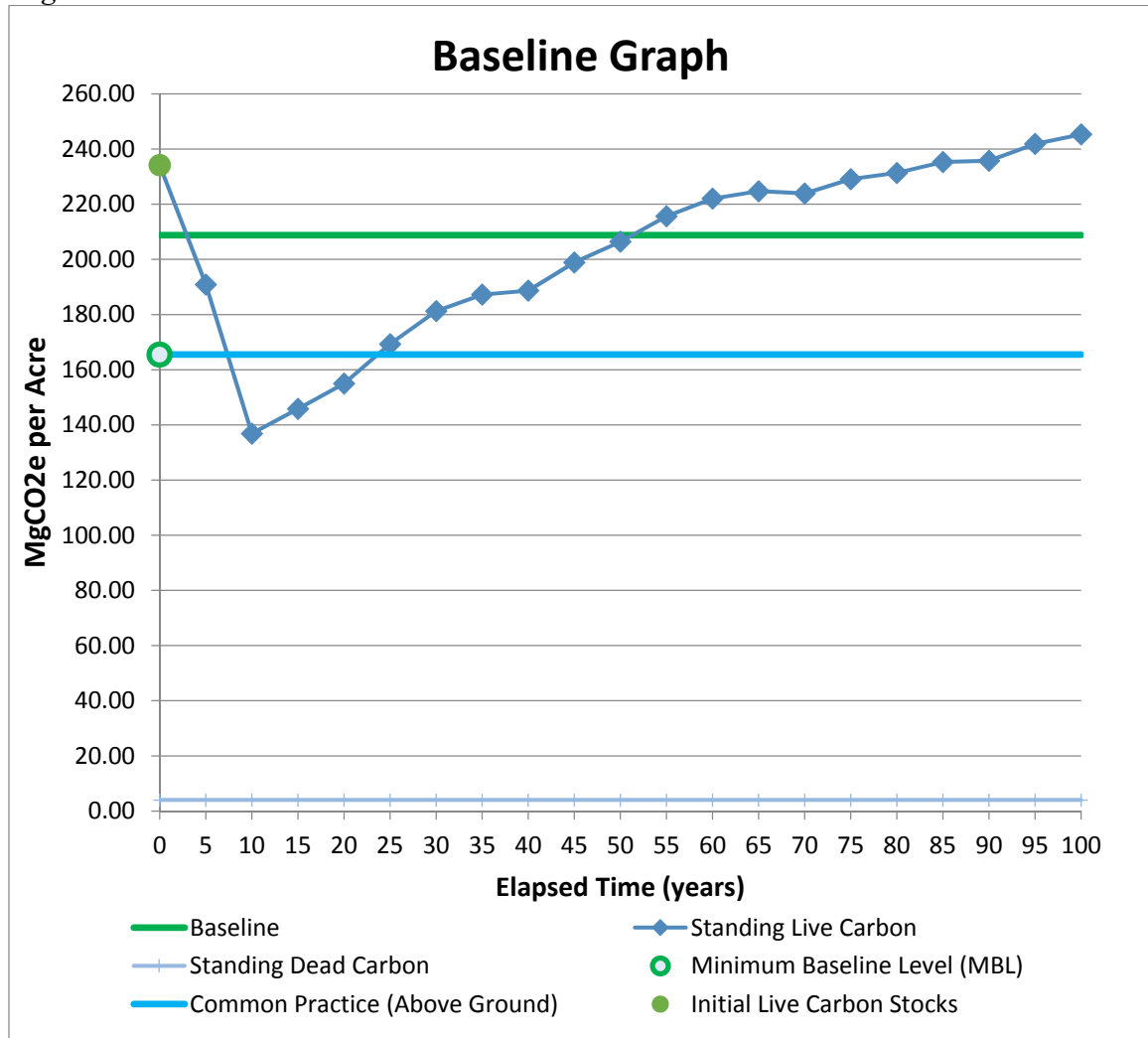
1. Initial Project live carbon stocks are above Common Practice.
2. The Project is not subject to the High Stocking Reference calculation.
3. Initial live carbon stocks have been modeled subject to all legal and financial constraints for a 100-year period.
4. The average carbon stocks of the 100-year baseline growth and yield modeling scenario have been calculated.
5. The average stocks of standing dead carbon over the 100-year period have been calculated.
6. The average production of In-Use carbon, landfill carbon, and harvested carbon prior to delivery to a mill have been calculated from the 100-year baseline growth and yield scenario.

Table 8 below shows the modeled standing live carbon stocks over the 100-year baseline analysis period, the projected standing dead carbon pool, and the resulting average baseline carbon stocks on a per acre basis. These figures are plotted in Figure 1 as well.

Table 8: Average Baseline Carbon Stocks per acre Generated by the Baseline Harvest Scenario (Mg CO₂e per Acre).

Elapsed Time	Standing Live Carbon Pool IFM-1	Standing Live Above Ground	Standing Live Below Ground	Standing Dead Carbon Pool IFM-3	Baseline
0	234.18	189.17	45.01	3.94	208.72
5	190.94	153.94	37.00	3.94	208.72
10	136.90	109.49	27.41	3.94	208.72
15	145.84	116.90	28.94	3.94	208.72
20	155.02	124.36	30.66	3.94	208.72
25	169.33	136.10	33.24	3.94	208.72
30	181.30	145.91	35.39	3.94	208.72
35	187.28	150.92	36.36	3.94	208.72
40	188.73	152.14	36.59	3.94	208.72
45	198.94	160.58	38.36	3.94	208.72
50	206.46	166.78	39.68	3.94	208.72
55	215.68	174.43	41.25	3.94	208.72
60	222.09	179.74	42.35	3.94	208.72
65	224.77	182.07	42.70	3.94	208.72
70	223.91	181.41	42.50	3.94	208.72
75	229.14	185.79	43.35	3.94	208.72
80	231.39	187.66	43.73	3.94	208.72
85	235.34	191.00	44.33	3.94	208.72
90	235.78	191.35	44.42	3.94	208.72
95	241.91	196.43	45.48	3.94	208.72
100	245.35	199.23	46.12	3.94	208.72
Average	204.78	165.50	39.28	3.94	208.72

Figure 1: Baseline Carbon Stocks



Wood Products

The baseline growth and yield modeling produces a flow of wood products over the 100-year planning period. Table 9 below shows the average wood products generated over the 100-year period. Three average wood products numbers are presented: average wood products In-use, average wood products stored in landfills, and the average amount of carbon in standing live carbon stocks prior to delivery to a mill.

Table 9: Average Wood Products Carbon per acre Generated by the Baseline Harvest Scenario.

Woods Products		Mg C/ acre	Total Mg CO2e
Average Annual Carbon 100-year In-Use		0.149	964.69
Average Annual Carbon 100-year Landfill		0.096	623.25
Average Annual Carbon in Harvested Trees Prior to Delivery to the Mill		1.101	7,122.63

ATTACHMENT L

BRUSH CREEK INVENTORY METHODOLOGY (CONFIDENTIAL)

This document contains specifications for the collection of data in the field for the Brush Creek Timber Inventory, as well as the data to be collected and the standards for data collection and processing. Brush Creek includes approximately 1,994 of timberland characterized by Douglas-fir, Redwood and associated hardwood species. The Brush Creek Offset Project Boundary includes the following GHG emission sources, GHG sinks, and GHG reservoirs (SSRs or Carbon Pools) as defined in table 5.2 of the Compliance Offset Protocol U.S. Forest Projects, October 20, 2011:

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

This Forest Carbon Inventory at its core consists of a systematic sampling of the timber stands found on the Brush Creek Property. Sampling was conducted through the installation of sampling points on an 8 chain by 8 chain rectangular grid utilizing a random starting location. The standard procedures for collecting field measurements are detailed below and are generally aimed at the collection of tree data pertaining to the quantification of the IFM-1 and IFM-3 carbon pools. Carbon in carbon pools IFM7, IFM-8, IFM-14, and IFM-17 are calculated as described in the calculation methodologies section below.

Inventory Methodologies

A description of the inventory methodology for each of the carbon pools listed above is included in the initial OPDR under section VII (A) and is included herein by reference.

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 the initial OPDR under section VII (B) and is included herein by reference. 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 is extensively sorted and queried to look for data entry errors. This process results 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 (B) of the initial OPDR as referenced above.

Management of inventory data over the life of the Project will include archiving of retired inventory data as the data exceeds the maximum plot life requirements prescribed by the Protocol. Archived inventory data will also include a copy of each inventory database used to develop those carbon stock estimates reported in each
October 7, 2014

OPDR submitted for the Project. This series of archived inventory database files will serve as the repository of inventory data as it existed for each reporting period.

Definitions

The following definitions apply to this document. Definitions included in each of the above mentioned documents also apply to this document.

- Center of the Tree – the point where a line projected through the center of the tree at DBH is perpendicular to the line projected from plot center.
- “Breast Height Age (BHA)” – the age of a sampled tree at DBH, measured on site trees.
- “Diameter Breast Height (DBH)” – the diameter of a tree stem 4.5 feet above the natural ground line on the uphill side of the tree. Debris (logs, stumps, rocks, etc) lodged against the tree stem shall not be used to identify DBH.
- “Break DBH” – The Diameter Breast Height (DBH) to be included in the portion of the sample taken in any one of the nested fixed area plots. This is greater than 0.5” to 3.5” DBH for the 1/100 acre plot, 3.6” to 11.5” DBH for the 1/50 acre plot and 11.6” DBH and greater for the 1/10 acre plot on this cruise.
- “Defined Fixed Plot Sizes” – The size of the fixed plots in a fraction of an acre. This is 1/100 acre, 1/50 acre and 1/10 acre for all plots as a nested sample.
- “Defined Fixed Length Radius” – The length of the radius used for the fixed plot sizes. For this cruise this is 11.8 feet or 3.60 meters (1/100 acre) for the smallest of the nested plots, 16.7 feet or 5.09 meters (1/50 acre) and 37.25 feet or 11.35 meters (1/10 acre) for the largest.
- “DIB” – Diameter Inside Bark.
- “DOB” – Diameter Outside Bark.
- “Defect” – an estimate of the amount of fiber that is missing (carbon defect). This will be recorded for each 1/3 of the total height (butt 1/3, mid 1/3, top 1/3). For the purpose of taking defect by 1/3, the total height is estimated for trees with missing (broken) tops and missing portions deducted.
- “Measure Plot” – A plot that records all attributes - species, component code, DBH, count, height, crown and defect - for all trees sampled.
- “Measured Tree” – tree having species code, component code, DBH, total height, Site data, live crown data and tree defect data in the record (site data may be a subsample) for 1/50 and 1/10 acre plots. 1/100 acre fixed-plot tree having species code, component code, DBH and total height data in the record. For a tree to be measured the “Center of the Tree” at “DBH” must fall within the “Defined Fixed Length Radius” for the “Defined Fixed Plot Sizes” indicated above.
- “Plot (Plot Center)” – the point in the ground used as the center point for the cruise sample. For Fixed-plot sampling it is the center of the circle used to define the plot.
- “Site Tree” – a subsample of Measured Trees between 25 and 70 years of age that are dominant or co-dominant and exist in a “free to grow” condition. Total height and Breast Height Age (BHA) will be recorded.
- “Stand” – designation within the property boundary, based on dominant vegetation types and tree size. The property, for the purpose of this inventory, is broken up into 3 stands representing the major stand components.
- “Witness Flag” – any flagging placed around plot center, typically at eye-height to help locate the plot. Witness flags shall consist of two ribbons of different colors as noted in the field notes.
- “Monumented Plot” – each “Measure Plot” established shall be monumented for relocation. Bearing Trees (BTs) adjacent to the plot shall have an aluminum metal tag nailed below stump height with plot number, azimuth, and slope distance to the plot center shall be recorded on the tag. A GPS coordinate will also be recorded at each plot location.

Maps

Roads shown on the map are considered for the net acreage and are to be sampled as encountered. Make a note about road on the maps and in the comments.

The location of all plots is to be shown on the maps prior to beginning sampling. A rectangular grid (8 chains by 8 chains) is to be applied.

Cross out plots on the map you do not place, and add extra ones to the map as the prescribed 8 chain grid will allow. Comments may be written on the back of the map or on extra sheets of paper. Whenever you deviate from the Cruising Instructions, a brief explanation will usually suffice.

If plots must be added or dropped from the grid described, the map of property boundary may need adjustment. A clear note on a separate sheet shall detail the boundary or boundaries to be reviewed, a description of where the line should be placed (draw the line clearly on the map, except when it is a mapped road), and a description of the conditions or suggested boundary call.

All plots shall be located utilizing a GPS unit with hand compass utilized for general location. The actual GPS point and coordinates shall be taken and recorded for each plot.

Plot Placement

Plots must fall entirely within the property. Cruise to the proximity of the property line, even if that means dropping or adding a plot or two. Do not squeeze in an extra plot just because the map shows one, but do put in extra plots if there is room. Plots shall be a minimum of 37.25 feet (11.35 meters) perpendicular from any boundary. Where a boundary is obvious, no plot will be placed to include trees or area from the adjacent property. You may have to move the plot (change the spacing) or adjust the number of plots (drop or add plots) if the map boundaries do not match what is actually on the ground.

In cases where the plot falls on the property boundary the cruiser will move the plot up to 100 feet (1.5 chains) away from the boundary and place it. Also, if the plot falls in a mapped area that does not match the ground, and moving the plot up to 100 feet will keep it within the subject property, the cruiser shall so move the plot, rather than dropping it.

Sample Plot Procedures

The following standards apply.

Stand Information

Required information for each stand sampled includes:

1. Stand ID as indicated on the Timber Type Map
2. Cruiser's ID
3. Date of sampling
4. Fixed Plot sizes used

Plot Identification

Required information for each plot sampled includes:

1. Plot ID – described below.
2. GPS coordinates (recorded in GPS unit referenced to Plot ID and transferred to GIS).

Plot identification shall utilize a numerical sequence for all plots within the inventory. The plots shall be identified in a logical pattern on the map. Plot ID's as assigned must be used.

Never use the same Plot ID for two unique plots.

Plot centers on cruise plots shall be marked with flagging tied to a metal spike (or large nail) in the ground. ‘Witness Flags’ shall also be attached to a tree limb near plot center to aid in location of it. These witness flags should be at least 3 feet long and attached at eye level within 10 feet of plot center. In stands where eye-level stems do not exist within the 10-foot limit, attach one set of Witness Flags on the tree nearest plot center that is to be measured. Witness Flags of two different colors shall be utilized at each plot.

Write the plot number on the flag at plot center (on metal spike). Write the plot number, cruiser initials and date on the Witness Flag with a *permanent-ink* marker. The ink color for the marker shall contrast with the colors used in the ribbon.

In addition, each plot shall be considered a “Monumented Plot”. As such each plot established shall be monumented for relocation. BTs (Bearing Trees - 2) adjacent to the plot center shall have an aluminum metal tag nailed below stump height facing the plot center with plot number, azimuth, and slope distance to the plot recorded on the tag. Flagging shall be attached to such tags to assist in future relocation. GPS coordinates shall also be recorded at each plot location. All tag information shall be included in the field notes.

“Defined Fixed Length Radius” shall be utilized to determine whether trees are in or out of the plot. Radius measurement point will be at DBH and tally will begin from **true North** and commence in a **clockwise** manner.

Height Data

Height data shall be collected for each stand using the following guidelines:

- Height data shall be collected for each “Measured Tree” on each “Measure plot”.
- All trees with a broken top shall be measured for height (height to break and DOB at break)
Live crown percentage shall be taken for all trees.

Site Data

Site Tree data (age data) shall be collected for each stand using the following guidelines:

- Site trees will be selected from a subsample of “Measured Trees”. Site trees will be taken in every third plot with the first “Measured Tree” that meets the following criteria being measured:
- Such trees shall be between 25 and 70 years of age (12 inches to 24 inches DBH), dominant or co-dominant trees that are in a “free to grow” condition. They shall not include trees that make up a small portion of the stand and are significantly larger or smaller than the majority of the trees in the stand, ie, leftover seed trees or residual trees from highgrading. Only redwood or Douglas-fir Site Trees will be measured.
- BHA will be taken on all Site Trees.

Defect

Defect shall be coded to the nearest 5 percent of the volume of each 1/3 of the total height (butt 1/3, mid 1/3, top 1/3). This deduction will be taken for missing carbon volume. For trees with missing or broken tops the total height shall be estimated for the purpose of determining the defect by position (1/3s in tree).

Trees with broken or missing tops shall have the height taken to the break and a top diameter estimated.

Summary of Tree Data – All plots

Required information for each sample tree on the fixed area plots:

1. Species code – See “Species Code Table”.
2. Component code (default is “..” [Live-healthy]) – See “Component Code / Tree Condition Table”
3. DBH to nearest 1/10 inch.
4. Total height for each “Measure Tree”
Note: all trees with a broken top shall be measured for height (height to break and DOB).
5. Number (Count) of similar trees – 1 tree per record is recommended for Measured Trees. All species must be counted.
6. Percent of live Crown for all trees..
7. Defect data (carbon).
8. The following data shall be collected on Site trees (sub-sampled as indicated above) as follows:
 - a. Total height.
 - b. BHA is taken on a subsample of trees selected for Site Data as indicated.

In the 1/100th acre plot all trees in the 1-inch DBH class and larger ($> .5''$) that, in cruiser’s opinion, are vigorous enough to survive for one year following measurement, must be counted.

No Tally Plots

The proper data entries for a **No Tally** plot are:

Stand ID
Plot ID
Tree number
Species = ‘XX’
Component = ‘..’
DBH = 0
Count = 0

Height = 0 (1 or default entry for collection devices that do not accept zero (0) height for zero (0) DBH entries.)

Species Codes

<i>Species Code</i>	<i>Common Name</i>
DF	Douglas-fir
RW	Redwood
PP	Ponderosa Pine
SP	Sugar Pine
IC	Incense Cedar
GF	Grand Fir (White Fir)
CX	Misc. Conifers
PY	Pacific Yew
TO	Tanoak
PM	Pacific Madrone
WO	Oregon White Oak
BO	Black Oak
LO	Live Oak
RA	Red Alder
CL	California Laurel
GC	Golden Chinquapina
BM	Big Leaf Maple
BC	Black Cottonwood / Cottonwood Species
HX	Misc. Hardwoods
XX	No Tally Plot Species Record

Component Code

<i>Component Code</i>	<i>Classification within species</i>
..	Live, healthy tree
SN	Snag

- A Snag (SN) tree shall be tallied if a) they are in the plot as a “Measured tree” b) they are ≥ 5 ” DBH, and c) the tree is at least 10’ in height (actual height to total top or broken top). Record Species, Component code as “SN”, DBH, Count, Height, carbon defect and Decay Class as follows:

- 1 - Tree has recently died with leaves intact.
- 2 - Leaves mostly still attached, intact bark, fine twigs, and branches.
- 3 - Leaves mostly gone, fine branches mostly gone, bark loose and starting to fall off.
- 4 - A few large branches or stubs remain, bark falling off in large patches, softwood sloughing is evident.
- 5 - Highly decomposed, no branches, little bark, broken off top.
- 6 - Mostly decomposed, no branches, very little bark, broken off close to the ground.

SPECIFIC CRUISING PARAMETERS

Parameters to be used with this cruise:

The “Cruise area” is described in the attached maps.

Stand ID coding is: Stand ID as displayed on cruise maps.

Plot DBH Breaks (Min)	...	...	=	>.5”, 3.6” and 11.6”
Fixed Plot Sizes	...	...	=	1/100 acre (11.8’ or 3.60m radius)
				1/50 acre (16.7’ or 5.09m radius)
				1/10 acre (37.25’ or 11.35m radius)
Measure Height to	...	...	=	Tip of tree
Heights Recorded as	...	...	=	Feet
Top DIB	...	...	=	0 (zero) inches (Tip of tree)
Flagging	...	...	=	As directed

Monumented Plots - Special Marking

Plot centers on cruise plots shall be marked with flagging tied to a metal spike (or large nail) in the ground. ‘Witness Flags’ shall also be attached to a tree limb near plot center to aid in location of it. This witness flag should be at least 3 feet long and attached at eye level within 10 feet of plot center. In stands where eye-level stems do not exist within the 10-foot limit, attach one Witness Flag on the tree nearest plot center that is to be measured. Write the plot number on the flag at plot center (on metal spike). Write the plot number, cruiser initials and date on the Witness Flag with a ***permanent-ink*** marker. The ink color for the marker shall contrast with the colors used in the ribbon.

In addition each plot shall be considered a “Monumented Plot”. BTs (Bearing Trees) adjacent to the plot shall have an aluminum metal tag nailed below stump height facing the plot center with plot number, azimuth, and slope distance to plot recorded on the tag. Flagging shall be attached to such tags to assist in future relocation. GPS coordinates shall also be recorded at each plot location. All tag information shall be included in the field notes.

Equipment to be utilized:

Plot Location -	GPS unit capable of locating designated plot coordinates with hand compass to assist. (actual GPS Plot info to be recorded at each plot utilizing Garmin 60CSx, 62st or equivalent GPS Unit)
Plot Radius -	Measuring tape and/or laser range finder
DBH -	Diameter tape
Height -	Laser range finder or measuring tape and relaskop or clinometers (laser hypsometer acceptable)

Specific criteria pertaining to data collection

DBH – taken at 4.5 feet above the natural ground line on the uphill side of the tree (see “Definitions”). Measurement shall be taken perpendicular to the bole of the tree, avoiding abnormal bumps, burls, swells and scars. Should such abnormalities occur the measurement will be taken immediately above the abnormality as close to DBH as possible.

- Catface and scars (missing material at DBH) will be measured by extending the tape to represent normal circumference.
 - i. Adjust diameter tape to normally rounded position to allow for the missing material at DBH.

Trees with double stems (fused trees) or other situations where taped measurements around the bole cannot be obtained, will have the diameter measured for ½ of the bole and this number doubled.

Forked trees will be measured (cruised) as two trees if such trees will be felled as two separate trees when harvested and as one tree if they will be felled as one tree at the time of harvest (fork further up the bole).

- In application, trees that fork above DBH (see above) will be measured as one tree, trees that fork below DBH will be measured as two trees.
 - i. If you can see light between the two stems at DBH, measure as two trees.

Height – taken as near perpendicular to any lean as possible. Height trees shall not show evidence of crooks or forked tops in conifers or dead tops in all species.

Stratification Information –

The area was stratified into 5 dominant types utilizing the following criteria:

- Species dominance –
 - DF = 10
 - TO = 20
 - Other = 30
- DBH size Class
 - 0” - 11” DBH = 2
 - 12” – 22”+ DBH =3
- Secondary Species dominance
 - RW = 2
- Strata were indicated as “Stand_ID” in the Cruise Data as follows –
 - 103
 - 202
 - 1032

The above stratifications were based on the criteria indicated in “PNW Forest Typing System Stratum Labels”. Stratification was done utilizing aerial photos with GIS system polygon overlays. Vegetation strata were verified utilizing historic and current pre sampling field verification. Boundaries were established utilizing GIS overlays with sample stratification based on plot location within identified vegetation strata polygons. The strata boundaries were digitized into the Brush Creek Geographical Information System utilizing orthophoto imagery as a guide. A map of the timber stand boundaries is included as Attachment E to the initial OPDR.

The stratification resulted in the following project acreages:

Stand_ID	Acres
103	755.01
202	280.23
1032	728.17
Total	1763.41

Quality Assurance/Quality Control (QA/QC) –

To assure quality data collection and quality control –

- The cruise standards, sampling procedures and established plot locations within identified vegetative types (strata) are maintained by James L. Able Forestry Consultants, Inc. (JLA).
- Crew chief ensures that cruise standards, sampling requirements and maps with plot locations (including GPS coordinates) are coordinated with field crew (cruisers).
- Crew chief field check each cruiser upon startup, and systematically throughout the data collection period, to insure accurate adherence to required data collection procedures and documentation on field notes.
- Field notes (data) are collected by crew chief daily, along with map of the sample plots taken, and deposited at JLA office.
- Data entry personnel make a copy of all field notes and maps and place these in a secure file.
- Data entry personnel systematically enter field data into appropriate computer program to facilitate compiling of data.
- Data entry personnel compare computer plot list with field notes and edit for errors.
- Computer database is systematically backed up of minimize potential for loss of entered data.
- Complete database for all sample plots taken is given a final edit.
- JLA compiles list of Stand_ID and actual GPS plot location for each sample plot along with final plot location map.
- Plot data, Stand_ID and mapping information are backed up (archived) and provided for compilation and growth analysis.
- Procedures used in verifying the integrity of inventory data are described above under the heading “Data Management Systems and Data Processing”.

Inventory Monitoring

Updating the Inventory

As timber management activities take place on the Brush Creek Project Area or disturbance such as fire or mortality resulting from pathogens or other factors occurs, cruise plots installed in 2014 will be relocated and remeasured within areas that have been harvested, treated for hardwood reduction, or subject to other disturbance. By 2026, all of the plots installed in 2014 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, Brush Creek will maintain a forest inventory system that will meet the inventory specifications and requirements contained in Appendix A of the Compliance Offset Protocol U.S. Forest Projects, with plots which are no more than 12 years old.

Updating the Project’s carbon stocks from the end of the last reporting period to the end of the current reporting period will involve the following steps:

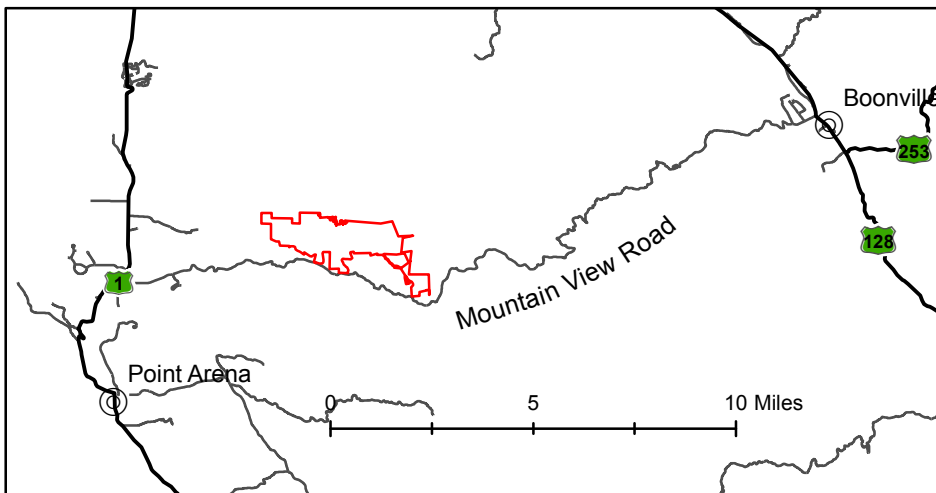
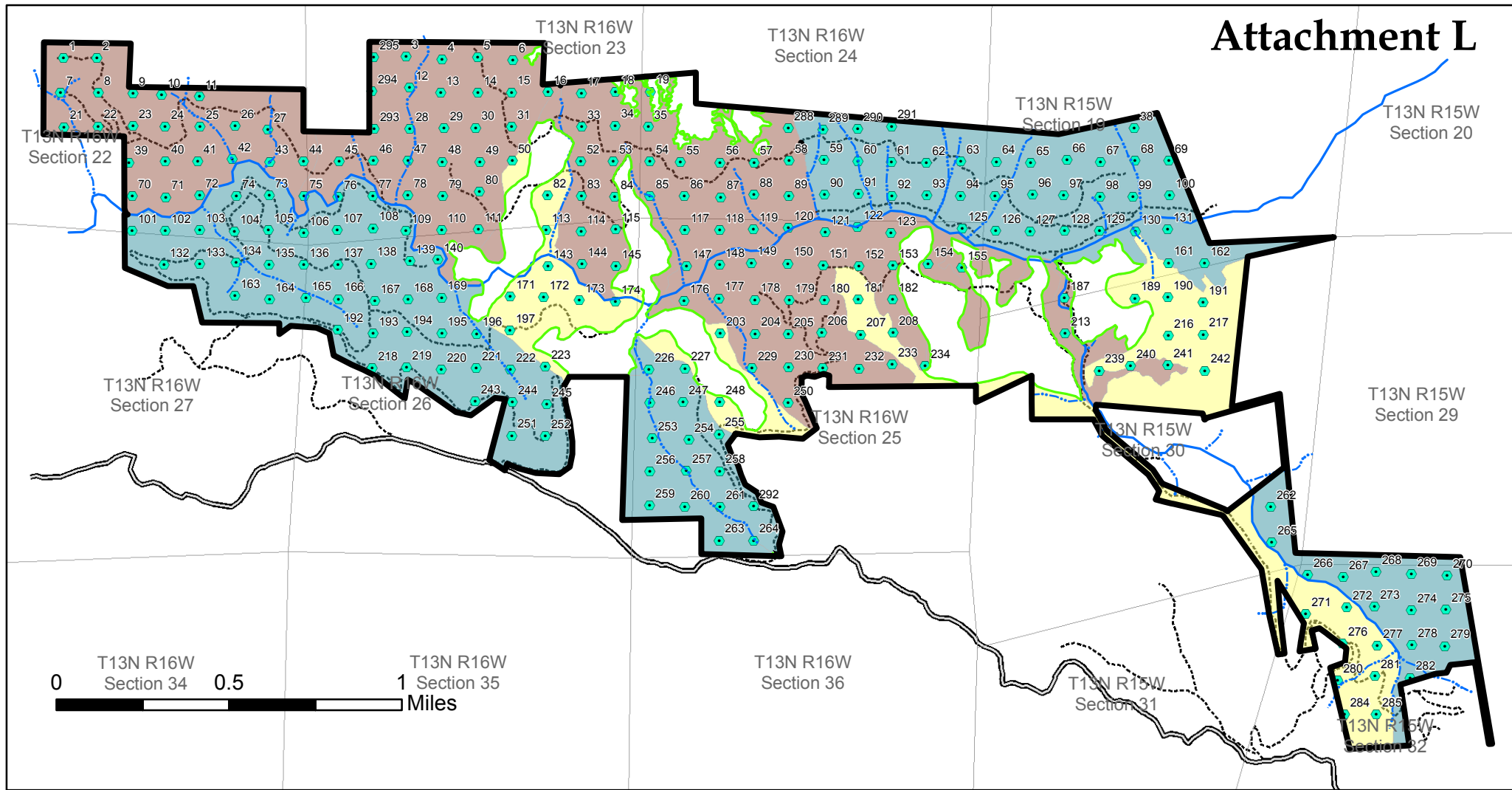
1. Any newly installed inventory plots will be incorporated into the inventory estimate. Newly installed plots will be grown forward to the end of the reporting period utilizing FORSEE as described in the modeling plan.
2. Existing inventory plots that are less than 12 years old will be updated using FORSEE as described in the modeling plan. This update process will involve adjusting the plot data one year forward either by using FORSEE’s “Inventory Update” tool, or through the application of average annual increment based on diameter and height increment predicted by FORSEE over the next-five year period.

3. Plots older than 12-years will be replaced in the database by new plot data collected at the same plot location. Retired plot data will be archived as described in the Data Management Systems section above.
4. Updating the forest inventory for harvests or disturbances will involve either the installation of new plots, or adjustments to previous plot data.
 - a. If new inventory plots are installed, they will be installed at randomly selected plot locations taken from a 4x4 chain grid tied to the initial 8x8 chain inventory plot grid within the harvested or disturbed portion of the Project Area. The number of randomly selected plots will be determined based on the size of the area harvested or disturbed, and estimated carbon stock variability within the harvested or disturbed area.
 - i. Existing inventory plot data within the harvested or disturbed area will be removed from the inventory database.
 - ii. Harvested or disturbed areas will be stratified based on the current inventory stratification, or may be placed into a new stratum representing the harvested area.
 - b. At the discretion of the OPO, inventory updates may involve adjustments to existing plot data (depletions) that will involve the following steps:
 - i. The carbon in harvested wood products delivered to the mill will be calculated using the "Harvested Wood Products Worksheet" provided by CAR, and included as Appendix E herein.
 - ii. Using the ratio of harvested wood carbon to harvested tree carbon calculated in Table 8 of the CAR worksheet. The carbon in harvested wood products will be multiplied by this ratio to determine the total amount of carbon subject to harvest. This carbon will be subtracted from the carbon stock estimate derived through the inventory stock estimate generated by updating the existing inventory data as described above.
5. Disturbances related to fire, insect or disease, and unauthorized harvest will be monitored through annual inspections of the Project Area by the OPO. Portions of the Project Area affected by fire, insect or disease, or unauthorized harvest will be mapped and reported in the OPDR. If the mapped disturbed portion of the Project Area is less than 5 acres in cumulative size, no adjustment to the carbon stock inventory will be performed. For mapped disturbances between 5 and 40 acres of cumulative size, a depletion of the inventory based on the average stocking and acreage of each stratum disturbed will be calculated, or at the discretion of the OPO, new inventory plots may be installed following the procedures described in step 4(a) above. For mapped disturbances larger than 40 acres in cumulative size, new inventory plots will be installed following the procedures described in step 4(a) above.
6. The field collection of updated inventory data following harvest or disturbance will be conducted prior to the next field verification, and at a minimum within 36months of the harvest or disturbance.
7. A revised inventory confidence deduction will be calculated following the update process in years when a verification will be conducted, otherwise the last verified inventory confidence deduction shall be applied.

Brush Creek Project Inventory Change Log

[illegible]

Attachment L



Brush Creek Project

Portions of sections 22, 23, 24, 25, 26, and 27 Township 13N Range 16W and sections 19, 30, 31, and 32 Township 13N Range 15W all Mount Diablo Baseline and Meridian

Legend



Property Boundary



Project Area



Inventory Plot

Stratum

103

202

1032

Class I Watercourse

Class II Watercourse

Public Road

Private Road



ATTACHMENT M

Volume estimation for the PNW-FIA Integrated Database

Cubic and board foot volumes (in Scribner and International 1/4" log rules) are calculated for softwood and hardwood trees measured on forest land. A variety of volumes are estimated including gross and net volume of the merchantable stem, gross and net volume of both the sawlog portion and the upper stem portion of the bole, gross total stem volume of the entire bole from ground to tip, current annual growth volume, and annual mortality volume. These volumes are calculated on different sized trees (in terms of diameter at breast height (DBH), depending on the specific type of volume.

All total stem volumes are calculated on all trees in the inventory that are larger than seedlings ($\geq 1"$ (2.5cm) DBH).

All other volumes (gross and net growing stock and sawtimber volumes) are calculated on the merchantable stem, originally for the purpose of providing timber information. This is the most common volume most users will see in published reports. Gross volume is generally the first output from volume equations and has not been adjusted for the presence of cull (rot and defect). Net volume is gross volume minus an estimate of volume lost due to rot, physical defect, and/or other damage.

Cubic volume is referred to as growing-stock volume, which is the volume of a tree, from a 1-foot stump to a 4" top, calculated on all trees $\geq 5"$ (12.5cm) DBH.

Board foot volume is referred to as sawtimber volume; for softwoods it is the volume of a tree from a 1-foot stump to a 6" top, calculated for softwood species $\geq 9"$ (22.5cm) DBH; and for hardwoods, it is the volume of a tree from a 1-foot stump to an 8" top, calculated for hardwood species $\geq 11"$ (27.5cm) DBH.

Note, that the sawlog and upper stem volumes are the cubic volume of sawtimber-sized trees, not to be confused with sawtimber (boardfoot) volume.

The log length for the log rule used in sawtimber (board-foot) calculations differs by species group and location, as follows:

On the west side of Oregon and Washington--

Scribner volume uses a 32-foot log rule for softwoods, and a 16-foot log rule for hardwoods;

International 1/4" volume uses a 16-foot log rule for softwoods, and an 8-foot log rule for hardwoods.

On the east side of Oregon and Washington, and all of California--

Scribner volume uses a 16-foot log rule for softwoods, and a 16-foot log rule for hardwoods;

International 1/4" volume uses a 16-foot log rule for softwoods, and an 8-foot log rule for hardwoods.

Board foot equations estimate volume of the fractional log up to the specified top diameter. The fractional log is the last log of the tree, which is less than the log rule specification.

The following volume names are used throughout the equations and are defined below:

CUBIC VOLUME (in cubic feet)

<u>Type of Volume</u>	<u>Calculated on trees with a DBH of:</u>	<u>Volume name in equations</u>
<u>All softwoods and hardwoods:</u>		
Volume of the total stem, ground to tip	>= 1" (2.5cm)	CVTS
Volume from a 1-foot stump to the tip	>= 1" (2.5cm)	CVT
Volume from a 1-foot stump to a 4-inch top	>= 5" (12.5cm)	CV4
<u>Softwood sawlog volume:</u>		
Volume from a 1-foot stump to a 6-inch top	>= 9" (22.5cm)	CV6
<u>Hardwood sawlog volume:</u>		
Volume from a 1-foot stump to an 8-inch top	>= 11" (27.5cm)	CV8

BOARD FOOT VOLUME (square feet)

<u>Type of Volume</u>	<u>Calculated on trees with a DBH of:</u>	<u>Volume name in equations</u>
<u>Softwoods:</u>		
Scribner volume, 16-foot log rule, 1-foot stump to a 6-inch top (Eastern OR; Eastern WA; CA)	>= 9" (22.5cm)	SV616
Scribner volume, 32-foot log rule, 1-foot stump to a 6-inch top (Western OR; Western WA)	>= 9" (22.5cm)	SV632
International 1/4" volume, 16-foot log rule, 1-foot stump to a 6-inch top (all states)	>= 9" (22.5cm)	XINT6
<u>Hardwoods:</u>		
Scribner volume, 16-foot log rule 1-foot stump to an 8-inch top (all states)	>= 11" (27.5cm)	SV816
International 1/4" volume, 8-foot log rule, 1-foot stump to an 8-inch top (all states)	>= 11" (27.5cm)	XINT8

PROCEDURES

The general procedure used to calculate volume is as follows:

- a.) estimate cubic volume first to produce CVTS, CVT, CV4, and the TARIF number;
- b.) estimate RATIO's from equations that use DBH and TARIF as inputs;
- c.) use the RATIO's to convert cubic volume to Scribner and International 1/4" board-foot volumes;
- d.) use the RATIO's to convert the Scribner 16-foot log rule to the Scribner 32-foot log rule.

There are three methods to calculate cubic volume, depending on the equation. Each method produces an estimate for CVTS, CVT, CV4, and TARIF. In cases where volume equations do not exist for a given species, a suitable equation has been chosen and assigned to each species.

After cubic volume is calculated, all species use the same set of equations to develop the RATIO's needed to produce the remaining volumes.

CUBIC VOLUME Method 1: The TARIF number is based on CVTS.
Softwood Eqns. 1,2,4,6-15,17,21,22,24
Hardwood Eqns. 1-7

1. Calculate CVTS from published or documented volume equations for the species.
 2. Calculate the TARIF number from CVTS, using the equation in DNR note #27.
 3. Calculate CV4 from the TARIF number and tree basal area.
 4. Calculate CVT from the TARIF number and DBH.
-

CUBIC VOLUME Method 2: The TARIF number is based on CV4.
Softwood Eqns. 3,5,16,18-20,23

5. Calculate CV4 directly from published equations, using DBH and height.
 6. Calculate the TARIF number from CV4 and tree basal area.
 7. If the tree ≥ 6 " DBH then Calculate CVTS from CV4.
 8. If the tree < 6 " DBH then adjust the TARIF before calculating CVTS.
 9. Calculate CVT from the TARIF number and DBH.
-

CUBIC VOLUME Method 3: The TARIF number is based on CV8.
Hardwood Eqns. 8-20

10. Calculate CVTS, CV4, and CV8 directly from published equations;
 11. Calculate TARIF from CV8.
 12. Calculate CVT from CV8.
-

For all trees:

13. CALCULATE CONVERSION RATIOS: After CVTS and CV4 have been estimated, use equations to calculate the ratios. These ratios are used to convert cubic to board foot volume, and 16 to 32-foot log rules as follows:

<u>RATIO</u>	<u>Used to convert:</u>
RC6	CV4 to CV6
RC8	CV4 to CV8 (if needed)
RS616	CV6 to SV616
RS816	SV616 to SV816
RS632	SV616 to SV632
RI6	CV6 to XINT6
RI8	XINT6 to XINT8

SOFTWOOD CUBIC VOLUME EQUATIONS

Volume equation numbers

Species Code	Species	Halfstate				
		WOR	WWA	EOR	EWA	CA
11	Pacific silver fir	11	11	10	10	--
14	Bristlecone fir	--	--	--	--	18
15	White fir	23	--	10	--	23
17	Grand fir	11	11	10	10	23
19	Subalpine fir	11	11	10	10	18
20	California red fir	--	--	--	--	18
21	Shasta red fir	18	18	18	18	18
22	Noble fir	11	11	10	10	18
41	Port-Orford-cedar	19	19	19	19	8
42	Alaska-cedar	9	9	8	8	8
50	Cypress	--	--	--	--	19
51	Arizona cypress	--	--	--	--	19
56	Mcnabb cypress	--	--	--	--	19
62	California juniper	--	--	--	--	21
64	Western juniper	21	21	21	21	21
65	Utah juniper	--	--	--	--	21
72	Subalpine larch	--	22	--	22	--
73	Western larch	--	22	22	22	--
81	Incense cedar	19	19	19	19	19
92	Brewer spruce	13	--	13	--	12
93	Engelmann spruce	13	13	12	12	12
98	Sitka spruce	13	13	--	--	12
101	Whitebark pine	15	15	15	15	20
102	Bristlecone pine	--	--	--	--	16
103	Knobcone pine	15	--	15	--	16
104	Foxtail pine	--	--	--	--	16
108	Lodgepole pine	15	15	15	15	16
109	Coulter pine	--	--	--	--	5
113	Limber pine	15	--	15	--	16
116	Jeffrey pine	5	--	4	--	5
117	Sugar pine	20	20	20	20	20
119	Western white pine	15	15	15	15	20
120	Bishop pine	--	--	--	--	16
122	Ponderosa pine	5	4*	4*	4*	5
124	Monterey pine	--	--	--	--	16
127	Gray pine	--	--	--	--	5
130	Scotch pine	17	17	17	17	17
133	Singleleaf pinyon	--	--	--	--	21
137	Washoe pine	--	--	--	--	5
201	Bigcone Douglas-fir	--	--	--	--	3
202	Douglas-fir	1	1	2	2	3
211	Redwood	24	--	--	--	24
212	Giant Sequoia	24	--	--	--	24
231	Pacific yew	9	9	8	8	8
242	Western redcedar	9	9	8	8	8
251	California nutmeg	--	--	--	--	8
263	Western hemlock	6	6	6	6	6
264	Mountain hemlock	17	17	17	17	17
298	Unknown Conifer	17	17	17	17	17

* Equation 5 was used for all trees < 5" dbh, in all states

There are 24 equations used to estimate softwood cubic-foot volume. Each equation below has been crosswalked to a particular tree species in the table above. A brief reference for each equation is listed below—the full citation is at the end of this document.

Click on an equation number to view the actual equation and procedure used to estimate volume.

EQUATION 1 DOUGLAS-FIR	(WEYERHAUSER-DNR RPT#24,1977)
EQUATION 2 DOUGLAS-FIR	(DNR MEMO--SUMMERFIELD,11/7/80)
EQUATION 3 DOUGLAS-FIR	(USDA-FS RES NOTE PNW-266)
EQUATION 4 PONDEROSA PINE	(DNR MEMO--SUMMERFIELD,11/7/80)
EQUATION 5 PONDEROSA PINE	(USDA-FS RES NOTE PNW-266)
EQUATION 5 PONDEROSA PINE	Used for all trees <5" dbh, in all states
EQUATION 6 W.HEMLOCK	(DNR NOTE 27,4/79)
EQUATION 7 W.HEMLOCK	(BROWN (1962) BC FOREST SERV,P33)
EQUATION 8 REDCEDAR	(REDCEDAR INTERIOR--DNR RPT#24,1977)
EQUATION 9 REDCEDAR	(REDCEDAR COAST--DNR RPT#24,1977)
EQUATION10 TRUE FIRS	(INTERIOR BALSAM--DNR RPT#24,1977)
EQUATION11 TRUE FIRS	(COAST BALSAM--DNR RPT#24,1977)
EQUATION12 SPRUCE	(SITKA SPRUCE INTERIOR--DNR RPT#24,1977)
EQUATION13 SPRUCE	(SITKA SPRUCE MATURE--DNR RPT#24,1977)
EQUATION15 LODGEPOLE PINE	(LODGEPOLE PINE--DNR RPT#24,1977)
EQUATION16 LODGEPOLE PINE	(USDA-FS RES NOTE PNW-266)
EQUATION17 MTN.HEMLOCK	(BELL, OSU RES.BULL 35)
EQUATION18 SHASTA RED FIR	(USDA-FS RES NOTE PNW-266)
EQUATION19 INCENSE CEDAR	(USDA-FS RES NOTE PNW-266)
EQUATION20 SUGAR PINE	(USDA-FS RES NOTE PNW-266)
EQUATION21 W.JUNIPER	(CHITTESTER,1984)
EQUATION22 W.LARCH	(LARCH--DNR RPT#24,1977)
EQUATION23 WHITE FIR	(USDA-FS RES NOTE PNW-266)
EQUATION24 REDWOOD	(Krumland, B.E. and L.E. Wensel. 1975.)

Softwood cubic volume equations

Equation 1

$$\begin{aligned} \text{CVTSL} = & -3.21809 + 0.04948 \times \log(\text{HT}) \times \log(\text{DBH}) - 0.15664 \times (\log(\text{DBH}))^2 \\ & + 2.02132 \times \log(\text{DBH}) + 1.63408 \times \log(\text{HT}) - 0.16185 \times (\log(\text{HT}))^2 \end{aligned} \quad (1)$$

$$\text{CVTS} = 10^{**} \text{CVTSL} \quad (2)$$

$$\text{TARIF} = \frac{(\text{CVTS} \times 0.912733)}{\left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{\text{DBH}}{10.0} \right) \right) \right) \right) \right) \times (\text{BA} + 0.087266) - 0.174533 \right)} \quad (3)$$

$$\text{CV4} = \frac{\text{TARIF} \times (\text{BA} - 0.087266)}{0.912733} \quad (4)$$

$$\text{CVT} = \frac{\text{TARIF} \times \left(0.9679 - 0.1051 \times 0.5523^{\text{DBH} - 1.5} \right) \times \left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{\text{DBH}}{10.0} \right) \right) \right) \right) \right) \times (\text{BA} + 0.087266) - 0.174533 \right)}{0.912733} \quad (5)$$

WHERE:

DBH (inches) = DBH (CM) CONVERTED TO INCHES (DBH/2.54)

HT (feet) = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA/ACRE (DBH IN INCHES) $BA = 0.005454154 \times \text{DBH}^2$

CVTSL = LOG BASE 10, CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

CVTS = CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

TARIF = TARIF NUMBER EQUATION (REF. DNR NOTE NO.27, P.2)

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME ABOVE STUMP, 4-INCH TOP

Equation 2

$$CVTSL = -6.110493 + 1.81306 \times \ln(DBH) + 1.083884 \times \ln(HT) \quad (1)$$

$$CVTS = \exp(CVTSL) \quad (2)$$

$$TARIF = \frac{(CVTS \times 0.912733)}{\left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp\left(-4.015292 \times \left(\frac{DBH}{10.0} \right) \right) \right) \right) \right) \times (BA + 0.087266) - 0.174533 \right)} \quad (3)$$

$$CV4 = \frac{TARIF \times (BA - 0.087266)}{0.912733} \quad (4)$$

$$CVT = \frac{TARIF \times \left(0.9679 - 0.1051 \times 0.5523^{DBH - 1.5} \right) \times \left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp\left(-4.015292 \times \left(\frac{DBH}{10.0} \right) \right) \right) \right) \right) \times (BA + 0.087266) - 0.174533 \right)}{0.912733} \quad (5)$$

WHERE:

DBH (inches) = DBH (CM) CONVERTED TO INCHES (DBH/2.54)

HT (feet) = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA/ACRE (DBH IN INCHES) $BA = 0.005454154 \times DBH^2$

CVTSL = LOG BASE 10, CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

CVTS = CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

TARIF = TARIF NUMBER EQUATION (REF. DNR NOTE NO.27, P.2)

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME ABOVE STUMP, 4-INCH TOP

Equation 3– (uses PNW 266 formulas from MacLean and Berger)

‘FOR THIS SET OF EQUATIONS CREATE A TEMPORARY DBH AND BA for trees less than 6”DBH

IF DBH < 6.0 THEN **TMP_DBH** = 6.0

‘CALCULATE BASAL AREA PER TREE USING DBH AND DBH_TEMP

BA = DBH**2 * 0.005454154

BA_TMP = TMP_DBH **2 * 0.005454154

‘CALCULATE A **CUBIC FORM FACTOR** (CF4) USING TMP_DBH and DBH

‘CF4 EQUATIONS VARY BY VOLUME EQUATION

CF4 = 0.248569 + 0.0253524*(HT/DBH) - 0.0000560175*(HT**2/ DBH)

IF(CF4 < 0.3) CF4 =0.3

IF(CF4 > 0.4) CF4 =0.4

CF4_TMP = 0.248569 + 0.0253524*(HT/TMP_DBH) - 0.0000560175*(HT**2/ TMP_DBH)

IF(CF4_TMP < 0.3) CF4_TMP=0.3

IF(CF4_TMP > 0.4) CF4_TMP=0.4

‘-----

‘For ease of use and to improve readability of equations, calculate the following term and use it

‘in the equations that follow. Note that actual DBH and BA are used for all trees.

‘Do not use TMP_DBH or BA_TMP here.

TERM = ((1.033 * (1.0 + 1.382937 * EXP(-4.015292 * (DBH/10.0)))) * (BA + 0.087266) - 0.174533)

‘-----

IF DBH >= 6.0 THEN

CV4 = CF4 * BA * HT

TARIF = (CV4 * 0.912733) / (BA - 0.087266)

IF (TARIF <= 0.0) TARIF=0.01

CVTS = (CV4 * TERM) / (BA - 0.087266)

CVT = TARIF * (0.9679 - 0.1051 * 0.5523**(DBH-1.5)) * TERM / 0.912733

ELSEIF

DBH < 6.0 THEN

CV4_TMP = CF4_TMP *BA_TMP * HT

TARIF_TMP = (CV4_TMP * 0.912733) / (BA_TMP - 0.087266)

IF (TARIF_TMP <= 0.0) TARIF_TMP = 0.01

‘CALCULATE An **ADJUSTED TARIF** FOR SMALL TREES (Both DBH and TMP_DBH are used)

TARIF = TARIF_TMP * (0.5 * (TMP_DBH - DBH)**2 + (1.0 + 0.063 * (TMP_DBH - DBH)**2))

IF (TARIF <= .0.0) TARIF = 0.01

CVTS = TARIF * TERM

CVT = TARIF * (0.9679 - 0.1051 * 0.5523**(DBH-1.5)) * TERM / 0.912733

CV4 = CF4 * BA * HT (calculated with actual DBH and BA)

END IF

IF DBH < 5.0 THEN CV4 = NULL

IF DBH >= 5.0 THEN KEEP CV4 (i.e. don't keep CV4_TMP)

WHERE:

DBH (inches) = DBH (CM) CONVERTED TO INCHES (DBH/2.54)

HT (feet) = HT (M) CONVERTED TO FEET (HT/0.3048)

CVTS = CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

TARIF = TARIF NUMBER EQUATION (REF. DNR NOTE # 27, P.2)

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME ABOVE STUMP, 4-INCH TOP

Equation 4

$$CVTSL = -8.521558 + 1.977243 \times \ln(DBH) - 0.105288 \times (\ln(HT))^2 + \frac{136.0489}{HT} + 1.99546 \times \ln(HT) \quad (1)$$

$$CVTS = \exp(CVTSL) \quad (2)$$

$$TARIF = \frac{(CVTS \times 0.912733)}{\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp(-4.015292 \times DBH) \right) \right) \times (BA + 0.087266) - 0.174533 \right)} \quad (3)$$

$$CV4 = \frac{TARIF \times (BA - 0.087266)}{0.912733} \quad (4)$$

$$CVT = \frac{TARIF \times \left(0.9679 - 0.1051 \times 0.5523^{DBH - 1.5} \right) \times \left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp\left(-4.015292 \times \left(\frac{DBH}{10.0}\right)\right) \right) \right) \times (BA + 0.087266) - 0.174533 \right)}{0.912733} \quad (5)$$

WHERE:

DBH (inches) = DBH (CM) CONVERTED TO INCHES (DBH/2.54)

HT (feet) = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA/ACRE (DBH IN INCHES) $BA = 0.005454154 \times DBH^2$

CVTSL = LOG BASE 10, CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

CVTS = CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

TARIF = TARIF NUMBER EQUATION (REF. DNR NOTE NO.27, P.2)

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME ABOVE STUMP, 4-INCH TOP

Equation 5 (uses PNW 266 formulas from MacLean and Berger)

'FOR THIS SET OF EQUATIONS CREATE A TEMPORARY DBH AND BA for trees less than 6"DBH

IF DBH < 6.0 THEN **TMP_DBH** = 6.0

'CALCULATE BASAL AREA PER TREE USING DBH AND DBH_TEMP

BA = DBH**2 * 0.005454154

BA_TMP = TMP_DBH **2 * 0.005454154

'CALCULATE A **CUBIC FORM FACTOR** (CF4) USING TMP_DBH and DBH

'CF4 EQUATIONS VARY BY VOLUME EQUATION

CF4 = 0.402060 - 0.899914 * (1/DBH)

IF(CF4 < 0.3) CF4=0.3

IF(CF4 > 0.4) CF4=0.4

CF4_TMP = 0.402060 - 0.899914 * (1/TMP_DBH)

IF(CF4_TMP < 0.3) CF4_TMP=0.3

IF(CF4_TMP > 0.4) CF4_TMP=0.4

'-----

'For ease of use and to improve readability of equations, calculate the following term and use it

'in the equations that follow. Note that actual DBH and BA are used for all trees.

'Do not use TMP_DBH or BA_TMP here.

TERM = ((1.033 * (1.0 + 1.382937 * EXP(-4.015292 * (DBH/10.0)))) * (BA + 0.087266) - 0.174533)

'-----

IF DBH >= 6.0 THEN

CV4 = CF4 * BA * HT

TARIF = (CV4 * 0.912733) / (BA - 0.087266)

IF (TARIF <= 0.0) TARIF=0.01

CVTS = (CV4 * TERM) / (BA - 0.087266)

CVT = TARIF * (0.9679 - 0.1051 * 0.5523**(DBH-1.5)) * TERM / 0.912733

ELSEIF

DBH < 6.0 THEN

CV4_TMP = CF4_TMP * BA_TMP * HT

TARIF_TMP = (CV4_TMP * 0.912733) / (BA_TMP - 0.087266)

IF (TARIF_TMP <= 0.0) TARIF_TMP = 0.01

'CALCULATE An **ADJUSTED TARIF** FOR SMALL TREES (Both DBH and TMP_DBH are used)

TARIF = TARIF_TMP * (0.5 * (TMP_DBH - DBH)**2 + (1.0 + 0.063 * (TMP_DBH - DBH)**2))

IF (TARIF <= .0.0) TARIF = 0.01

CVTS = TARIF * TERM

CVT = TARIF * (0.9679 - 0.1051 * 0.5523**(DBH-1.5)) * TERM / 0.912733

CV4 = CF4 * BA * HT (calculated with actual DBH and BA)

END IF

IF DBH < 5.0 THEN CV4 = NULL

IF DBH >= 5.0 THEN KEEP CV4 (i.e. don't keep CV4_TMP)

WHERE:

DBH (inches) = DBH (CM) CONVERTED TO INCHES (DBH/2.54)

HT (feet) = HT (M) CONVERTED TO FEET (HT/0.3048)

CVTS = CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

TARIF = TARIF NUMBER EQUATION (REF. DNR NOTE # 27, P.2)

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME ABOVE STUMP, 4-INCH TOP

Equation 6

$$CVTSL = -2.72170 + 2.00857 \times \log(DBH) + 1.08620 \times \log(HT) - 0.00568 \times (DBH) \quad (1)$$

$$CVTS = 10^{**} CVTSL \quad (2)$$

$$TARIF = \frac{(CVTS \times 0.912733)}{\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{DBH}{10.0} \right) \right) \right) \right) \times (BA + 0.087266) - 0.174533 \right)} \quad (3)$$

$$CV4 = \frac{TARIF \times (BA - 0.087266)}{0.912733} \quad (4)$$

$$CVT = \frac{TARIF \times \left(0.9679 - 0.1051 \times 0.5523^{DBH - 1.5} \right) \times \left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{DBH}{10.0} \right) \right) \right) \right) \times (BA + 0.087266) - 0.174533 \right)}{0.912733} \quad (5)$$

WHERE:

DBH (inches) = DBH (CM) CONVERTED TO INCHES (DBH/2.54)

HT (feet) = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA/ACRE (DBH IN INCHES) $BA = 0.005454154 \times DBH^2$

CVTSL = LOG BASE 10, CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

CVTS = CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

TARIF = TARIF NUMBER EQUATION (REF. DNR NOTE NO.27, P.2)

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME ABOVE STUMP, 4-INCH TOP

Equation 7

$$\text{CVTSL} = -2.663834 + 1.79023 \times \log(\text{DBH}) + 1.124873 \times \log(\text{HT}) \quad (1)$$

$$\text{CVTS} = 10^{**}\text{CVTSL} \quad (2)$$

$$\text{TARIF} = \frac{(\text{CVTS} \times 0.912733)}{\left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp\left(-4.015292 \times \left(\frac{\text{DBH}}{10.0} \right) \right) \right) \right) \right) \times (\text{BA} + 0.087266) - 0.174533 \right)} \quad (3)$$

$$\text{CV4} = \frac{\text{TARIF} \times (\text{BA} - 0.087266)}{0.912733} \quad (4)$$

$$\text{CVT} = \frac{\text{TARIF} \times \left(0.9679 - 0.1051 \times 0.5523^{\text{DBH} - 1.5} \right) \times \left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp\left(-4.015292 \times \left(\frac{\text{DBH}}{10.0} \right) \right) \right) \right) \right) \times (\text{BA} + 0.087266) - 0.174533 \right)}{0.912733} \quad (5)$$

WHERE:

DBH (inches) = DBH (CM) CONVERTED TO INCHES (DBH/2.54)

HT (feet) = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA/ACRE (DBH IN INCHES) $BA = 0.005454154 \times \text{DBH}^2$

CVTSL = LOG BASE 10, CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

CVTS = CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

TARIF = TARIF NUMBER EQUATION (REF. DNR NOTE NO.27, P.2)

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME ABOVE STUMP, 4-INCH TOP

Equation 8

$$CVTSL = -2.464614 + 1.701993 \times \log(DBH) + 1.067038 \times \log(HT) \quad (1)$$

$$CVTS = 10^{**} CVTSL \quad (2)$$

$$TARIF = \frac{(CVTS \times 0.912733)}{\left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{DBH}{10.0} \right) \right) \right) \right) \right) \times (BA + 0.087266) - 0.174533 \right)} \quad (3)$$

$$CV4 = \frac{TARIF \times (BA - 0.087266)}{0.912733} \quad (4)$$

$$CVT = \frac{TARIF \times \left(0.9679 - 0.1051 \times 0.5523^{DBH - 1.5} \right) \times \left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{DBH}{10.0} \right) \right) \right) \right) \right) \times (BA + 0.087266) - 0.174533 \right)}{0.912733} \quad (5)$$

WHERE:

DBH (inches) = DBH (CM) CONVERTED TO INCHES (DBH/2.54)

HT (feet) = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA/ACRE (DBH IN INCHES) $BA = 0.005454154 \times DBH^2$

CVTSL = LOG BASE 10, CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

CVTS = CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

TARIF = TARIF NUMBER EQUATION (REF. DNR NOTE NO.27, P.2)

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME ABOVE STUMP, 4-INCH TOP

Equation 9

$$\text{CVTSL} = -2.379642 + 1.682300 \times \log(\text{DBH}) + 1.039712 \times \log(\text{HT}) \quad (1)$$

$$\text{CVTS} = 10^{**}\text{CVTSL} \quad (2)$$

$$\text{TARIF} = \frac{(\text{CVTS} \times 0.912733)}{\left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp\left(-4.015292 \times \left(\frac{\text{DBH}}{10.0} \right) \right) \right) \right) \right) \times (\text{BA} + 0.087266) - 0.174533 \right)} \quad (3)$$

$$\text{CV4} = \frac{\text{TARIF} \times (\text{BA} - 0.087266)}{0.912733} \quad (4)$$

$$\text{CVT} = \frac{\text{TARIF} \times \left(0.9679 - 0.1051 \times 0.5523^{\text{DBH} - 1.5} \right) \times \left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp\left(-4.015292 \times \left(\frac{\text{DBH}}{10.0} \right) \right) \right) \right) \right) \times (\text{BA} + 0.087266) - 0.174533 \right)}{0.912733} \quad (5)$$

WHERE:

DBH (inches) = DBH (CM) CONVERTED TO INCHES (DBH/2.54)

HT (feet) = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA/ACRE (DBH IN INCHES) $BA = 0.005454154 \times \text{DBH}^2$

CVTSL = LOG BASE 10, CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

CVTS = CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

TARIF = TARIF NUMBER EQUATION (REF. DNR NOTE NO.27, P.2)

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME ABOVE STUMP, 4-INCH TOP

Equation 10

$$\text{CVTSL} = -2.502332 + 1.864963 \times \log(\text{DBH}) + 1.004903 \times \log(\text{HT}) \quad (1)$$

$$\text{CVTS} = 10^{**}\text{CVTSL} \quad (2)$$

$$\text{TARIF} = \frac{(\text{CVTS} \times 0.912733)}{\left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp\left(-4.015292 \times \left(\frac{\text{DBH}}{10.0} \right) \right) \right) \right) \right) \times (\text{BA} + 0.087266) - 0.174533 \right)} \quad (3)$$

$$\text{CV4} = \frac{\text{TARIF} \times (\text{BA} - 0.087266)}{0.912733} \quad (4)$$

$$\text{CVT} = \frac{\text{TARIF} \times \left(0.9679 - 0.1051 \times 0.5523^{\text{DBH} - 1.5} \right) \times \left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp\left(-4.015292 \times \left(\frac{\text{DBH}}{10.0} \right) \right) \right) \right) \right) \times (\text{BA} + 0.087266) - 0.174533 \right)}{0.912733} \quad (5)$$

WHERE:

DBH (inches) = DBH (CM) CONVERTED TO INCHES (DBH/2.54)

HT (feet) = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA/ACRE (DBH IN INCHES) $BA = 0.005454154 \times \text{DBH}^2$

CVTSL = LOG BASE 10, CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

CVTS = CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

TARIF = TARIF NUMBER EQUATION (REF. DNR NOTE NO.27, P.2)

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME ABOVE STUMP, 4-INCH TOP

Equation 11

$$\text{CVTSL} = -2.575642 + 1.806775 \times \log(\text{DBH}) + 1.094665 \times \log(\text{HT}) \quad (1)$$

$$\text{CVTS} = 10^{**}\text{CVTSL} \quad (2)$$

$$\text{TARIF} = \frac{(\text{CVTS} \times 0.912733)}{\left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp\left(-4.015292 \times \left(\frac{\text{DBH}}{10.0} \right) \right) \right) \right) \right) \times (\text{BA} + 0.087266) - 0.174533 \right)} \quad (3)$$

$$\text{CV4} = \frac{\text{TARIF} \times (\text{BA} - 0.087266)}{0.912733} \quad (4)$$

$$\text{CVT} = \frac{\text{TARIF} \times \left(0.9679 - 0.1051 \times 0.5523^{\text{DBH} - 1.5} \right) \times \left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp\left(-4.015292 \times \left(\frac{\text{DBH}}{10.0} \right) \right) \right) \right) \right) \times (\text{BA} + 0.087266) - 0.174533 \right)}{0.912733} \quad (5)$$

WHERE:

DBH (inches) = DBH (CM) CONVERTED TO INCHES (DBH/2.54)

HT (feet) = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA/ACRE (DBH IN INCHES) $BA = 0.005454154 \times \text{DBH}^2$

CVTSL = LOG BASE 10, CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

CVTS = CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

TARIF = TARIF NUMBER EQUATION (REF. DNR NOTE NO.27, P.2)

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME ABOVE STUMP, 4-INCH TOP

Equation 12

$$CVTSL = -2.539944 + 1.841226 \times \log(DBH) + 1.034051 \times \log(HT) \quad (1)$$

$$CVTS = 10^{**} CVTSL$$

$$TARIF = \frac{(CVTS \times 0.912733)}{\left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{DBH}{10.0} \right) \right) \right) \right) \right) \times (BA + 0.087266) - 0.174533 \right)} \quad (3)$$

$$CV4 = \frac{TARIF \times (BA - 0.087266)}{0.912733} \quad (4)$$

$$CVT = \frac{TARIF \times \left(0.9679 - 0.1051 \times 0.5523^{DBH - 1.5} \right) \times \left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{DBH}{10.0} \right) \right) \right) \right) \right) \times (BA + 0.087266) - 0.174533 \right)}{0.912733} \quad (5)$$

WHERE:

DBH (inches) = DBH (CM) CONVERTED TO INCHES (DBH/2.54)

HT (feet) = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA/ACRE (DBH IN INCHES) $BA = 0.005454154 \times DBH^2$

CVTSL = LOG BASE 10, CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

CVTS = CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

TARIF = TARIF NUMBER EQUATION (REF. DNR NOTE NO.27, P.2)

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME ABOVE STUMP, 4-INCH TOP

Equation 13

$$\text{CVTSL} = -2.700574 + 1.754171 \times \log(\text{DBH}) + 1.164531 \times \log(\text{HT}) \quad (1)$$

$$\text{CVTS} = 10^{**}\text{CVTSL} \quad (2)$$

$$\text{TARIF} = \frac{(\text{CVTS} \times 0.912733)}{\left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{\text{DBH}}{10.0} \right) \right) \right) \right) \right) \times (\text{BA} + 0.087266) - 0.174533 \right)} \quad (3)$$

$$\text{CV4} = \frac{\text{TARIF} \times (\text{BA} - 0.087266)}{0.912733} \quad (4)$$

$$\text{CVT} = \frac{\text{TARIF} \times \left(0.9679 - 0.1051 \times 0.5523^{\text{DBH} - 1.5} \right) \times \left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{\text{DBH}}{10.0} \right) \right) \right) \right) \right) \times (\text{BA} + 0.087266) - 0.174533 \right)}{0.912733} \quad (5)$$

WHERE:

DBH (inches) = DBH (CM) CONVERTED TO INCHES (DBH/2.54)

HT (feet) = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA/ACRE (DBH IN INCHES) $BA = 0.005454154 \times \text{DBH}^2$

CVTSL = LOG BASE 10, CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

CVTS = CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

TARIF = TARIF NUMBER EQUATION (REF. DNR NOTE NO.27, P.2)

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME ABOVE STUMP, 4-INCH TOP

Equation 14

NOT USED

Equation 15

$$CVTSL = -2.615591 + 1.847504 \times \log(DBH) + 1.085772 \times \log(HT) \quad (1)$$

$$CVTS = 10^{**} CVTSL$$

$$TARIF = \frac{(CVTS \times 0.912733)}{\left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{DBH}{10.0} \right) \right) \right) \right) \right) \times (BA + 0.087266) - 0.174533 \right)} \quad (3)$$

$$CV4 = \frac{TARIF \times (BA - 0.087266)}{0.912733} \quad (4)$$

$$CVT = \frac{TARIF \times \left(0.9679 - 0.1051 \times 0.5523^{DBH - 1.5} \right) \times \left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{DBH}{10.0} \right) \right) \right) \right) \right) \times (BA + 0.087266) - 0.174533 \right)}{0.912733} \quad (5)$$

WHERE:

DBH (inches) = DBH (CM) CONVERTED TO INCHES (DBH/2.54)

HT (feet) = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA/ACRE (DBH IN INCHES) $BA = 0.005454154 \times DBH^2$

CVTSL = LOG BASE 10, CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

CVTS = CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

TARIF = TARIF NUMBER EQUATION (REF. DNR NOTE NO.27, P.2)

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME ABOVE STUMP, 4-INCH TOP

Equation 16 (uses PNW 266 formulas from MacLean and Berger)

‘FOR THIS SET OF EQUATIONS CREATE A TEMPORARY DBH AND BA for trees less than 6”DBH

IF DBH < 6.0 THEN **TMP_DBH** = 6.0

‘CALCULATE BASAL AREA PER TREE USING DBH AND DBH_TEMP

BA = DBH**2 * 0.005454154

BA_TMP = TMP_DBH **2 * 0.005454154

‘CALCULATE A **CUBIC FORM FACTOR** (CF4) USING TMP_DBH and DBH

‘CF4 EQUATIONS VARY BY VOLUME EQUATION

CF4 = 0.422709 - 0.0000612236 * (HT**2/DBH)

IF(CF4 < 0.3) CF4=0.3

IF(CF4 > 0.4) CF4=0.4

CF4_TMP = 0.422709 - 0.0000612236 * (HT**2/TMP_DBH)

IF(CF4_TMP < 0.3) CF4_TMP=0.3

IF(CF4_TMP > 0.4) CF4_TMP=0.4

‘-----

‘For ease of use and to improve readability of equations, calculate the following term and use it

‘in the equations that follow. Note that actual DBH and BA are used for all trees.

‘Do not use TMP_DBH or BA_TMP here.

TERM = ((1.033 * (1.0 + 1.382937 * EXP(-4.015292 * (DBH/10.0)))) * (BA + 0.087266) - 0.174533)

‘-----

IF DBH >= 6.0 THEN

CV4 = CF4 * BA * HT

TARIF = (CV4 * 0.912733) / (BA - 0.087266)

IF (TARIF <= 0.0) TARIF=0.01

CVTS = (CV4 * TERM) / (BA - 0.087266)

CVT = TARIF * (0.9679 - 0.1051 * 0.5523**(DBH-1.5)) * TERM / 0.912733

ELSEIF

DBH < 6.0 THEN

CV4_TMP = CF4_TMP * BA_TMP * HT

TARIF_TMP = (CV4_TMP * 0.912733) / (BA_TMP - 0.087266)

IF (TARIF_TMP <= 0.0) TARIF_TMP = 0.01

‘CALCULATE An **ADJUSTED TARIF** FOR SMALL TREES (Both DBH and TMP_DBH are used)

TARIF = TARIF_TMP * (0.5 * (TMP_DBH - DBH)**2 + (1.0 + 0.063 * (TMP_DBH - DBH)**2))

IF (TARIF <= .0.0) TARIF = 0.01

CVTS = TARIF * TERM

CVT = TARIF * (0.9679 - 0.1051 * 0.5523**(DBH-1.5)) * TERM / 0.912733

CV4 = CF4 * BA * HT (calculated with actual DBH and BA)

END IF

IF DBH < 5.0 THEN CV4 = NULL

IF DBH >= 5.0 THEN KEEP CV4 (i.e. don't keep CV4_TMP)

WHERE:

DBH (inches) = DBH (CM) CONVERTED TO INCHES (DBH/2.54)

HT (feet) = HT (M) CONVERTED TO FEET (HT/0.3048)

CVTS = CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

TARIF = TARIF NUMBER EQUATION (REF. DNR NOTE # 27, P.2)

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME ABOVE STUMP, 4-INCH TOP

Equation 17

$$CVTS = 0.001106485 \times (DBH)^{1.8140497} \times (HT)^{1.2744923} \quad (1)$$

$$TARIF = \frac{(CVTS \times 0.912733)}{\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{DBH}{10.0} \right) \right) \right) \right) \times (BA + 0.087266) - 0.174533 \right)} \quad (2)$$

$$CV4 = \frac{TARIF \times (BA - 0.087266)}{0.912733} \quad (3)$$

$$CVT = \frac{TARIF \times \left(0.9679 - 0.1051 \times 0.5523^{DBH - 1.5} \right) \times \left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{DBH}{10.0} \right) \right) \right) \right) \times (BA + 0.087266) - 0.174533 \right)}{0.912733} \quad (5)$$

WHERE:

DBH (inches) = DBH (CM) CONVERTED TO INCHES (DBH/2.54)

HT (feet) = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA/ACRE (DBH IN INCHES) $BA = 0.005454154 \times DBH^2$

CVTSL = LOG BASE 10, CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

CVTS = CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

TARIF = TARIF NUMBER EQUATION (REF. DNR NOTE NO.27, P.2)

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME ABOVE STUMP, 4-INCH TOP

Equation 18 (uses PNW 266 formulas from MacLean and Berger)

‘FOR THIS SET OF EQUATIONS CREATE A TEMPORARY DBH AND BA for trees less than 6”DBH

IF DBH < 6.0 THEN **TMP_DBH** = 6.0

‘CALCULATE BASAL AREA PER TREE USING DBH AND DBH_TEMP

BA = DBH**2 * 0.005454154

BA_TMP = TMP_DBH **2 * 0.005454154

‘CALCULATE A **CUBIC FORM FACTOR** (CF4) USING TMP_DBH and DBH

‘CF4 EQUATIONS VARY BY VOLUME EQUATION

CF4 = 0.231237 + 0.028176 * (HT/DBH)

IF(CF4 < 0.3) CF4=0.3

IF(CF4 > 0.4) CF4=0.4

CF4_TMP = 0.231237 + 0.028176 * (HT/TMP_DBH)

IF(CF4_TMP < 0.3) CF4_TMP=0.3

IF(CF4_TMP > 0.4) CF4_TMP=0.4

‘-----

‘For ease of use and to improve readability of equations, calculate the following term and use it

‘in the equations that follow. Note that actual DBH and BA are used for all trees.

‘Do not use TMP_DBH or BA_TMP here.

TERM = ((1.033 * (1.0 + 1.382937 * EXP(-4.015292 * (DBH/10.0)))) * (BA + 0.087266) - 0.174533)

‘-----

IF DBH >= 6.0 THEN

CV4 = CF4 * BA * HT

TARIF = (CV4 * 0.912733) / (BA - 0.087266)

IF (TARIF <= 0.0) TARIF=0.01

CVTS = (CV4 * TERM) / (BA - 0.087266)

CVT = TARIF * (0.9679 - 0.1051 * 0.5523**(DBH-1.5)) * TERM / 0.912733

ELSEIF

DBH < 6.0 THEN

CV4_TMP = CF4_TMP * BA_TMP * HT

TARIF_TMP = (CV4_TMP * 0.912733) / (BA_TMP - 0.087266)

IF (TARIF_TMP <= 0.0) TARIF_TMP = 0.01

‘CALCULATE An **ADJUSTED TARIF** FOR SMALL TREES (Both DBH and TMP_DBH are used)

TARIF = TARIF_TMP * (0.5 * (TMP_DBH - DBH)**2 + (1.0 + 0.063 * (TMP_DBH - DBH)**2))

IF (TARIF <= .0.0) TARIF = 0.01

CVTS = TARIF * TERM

CVT = TARIF * (0.9679 - 0.1051 * 0.5523**(DBH-1.5)) * TERM / 0.912733

CV4 = CF4 * BA * HT (calculated with actual DBH and BA)

END IF

IF DBH < 5.0 THEN CV4 = NULL

IF DBH >= 5.0 THEN KEEP CV4 (i.e. don't keep CV4_TMP)

WHERE:

DBH (inches) = DBH (CM) CONVERTED TO INCHES (DBH/2.54)

HT (feet) = HT (M) CONVERTED TO FEET (HT/0.3048)

CVTS = CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

TARIF = TARIF NUMBER EQUATION (REF. DNR NOTE # 27, P.2)

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME ABOVE STUMP, 4-INCH TOP

Equation 19 (uses PNW 266 formulas from MacLean and Berger)

'FOR THIS SET OF EQUATIONS CREATE A TEMPORARY DBH AND BA for trees less than 6"DBH

IF DBH < 6.0 THEN **TMP_DBH** = 6.0

'CALCULATE BASAL AREA PER TREE USING DBH AND DBH_TEMP

BA = DBH**2 * 0.005454154

BA_TMP = TMP_DBH **2 * 0.005454154

'CALCULATE A **CUBIC FORM FACTOR** (CF4) USING TMP_DBH and DBH

'CF4 EQUATIONS VARY BY VOLUME EQUATION

CF4 = 0.225786 + 4.44236 * (1/HT)

IF(CF4 < .27) CF4=.27

CF4_TMP = 0.225786 + 4.44236 * (1/HT)

IF(CF4_TMP < .27) CF4_TMP=.27

'-----

'For ease of use and to improve readability of equations, calculate the following term and use it

'in the equations that follow. Note that actual DBH and BA are used for all trees.

'Do not use TMP_DBH or BA_TMP here.

TERM = ((1.033 * (1.0 + 1.382937 * EXP(-4.015292 * (DBH/10.0)))) * (BA + 0.087266) - 0.174533)

'-----

IF DBH >= 6.0 THEN

CV4 = CF4 * BA * HT

TARIF = (CV4 * 0.912733) / (BA - 0.087266)

IF (TARIF <= 0.0) TARIF=0.01

CVTS = (CV4 * TERM) / (BA - 0.087266)

CVT = TARIF * (0.9679 - 0.1051 * 0.5523**(DBH-1.5)) * TERM / 0.912733

ELSEIF

DBH < 6.0 THEN

CV4_TMP = CF4_TMP * BA_TMP * HT

TARIF_TMP = (CV4_TMP * 0.912733) / (BA_TMP - 0.087266)

IF (TARIF_TMP <= 0.0) TARIF_TMP = 0.01

'CALCULATE An **ADJUSTED TARIF** FOR SMALL TREES (Both DBH and TMP_DBH are used)

TARIF = TARIF_TMP * (0.5 * (TMP_DBH - DBH)**2 + (1.0 + 0.063 * (TMP_DBH - DBH)**2))

IF (TARIF <= .0.0) TARIF = 0.01

CVTS = TARIF * TERM

CVT = TARIF * (0.9679 - 0.1051 * 0.5523**(DBH-1.5)) * TERM / 0.912733

CV4 = CF4 * BA * HT (calculated with actual DBH and BA)

END IF

IF DBH < 5.0 THEN CV4 = NULL

IF DBH >= 5.0 THEN KEEP CV4 (i.e. don't keep CV4_TMP)

WHERE:

DBH (inches) = DBH (CM) CONVERTED TO INCHES (DBH/2.54)

HT (feet) = HT (M) CONVERTED TO FEET (HT/0.3048)

CVTS = CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

TARIF = TARIF NUMBER EQUATION (REF. DNR NOTE # .27, P.2)

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME ABOVE STUMP, 4-INCH TOP

Equation 20 – (uses PNW 266 formulas from MacLean and Berger)

‘FOR THIS SET OF EQUATIONS CREATE A TEMPORARY DBH AND BA for trees less than 6”DBH

IF DBH < 6.0 THEN **TMP_DBH** = 6.0

‘CALCULATE BASAL AREA PER TREE USING DBH AND DBH_TEMP

BA = DBH**2 * 0.005454154

BA_TMP = TMP_DBH **2 * 0.005454154

‘CALCULATE A **CUBIC FORM FACTOR** (CF4) USING TMP_DBH and DBH

‘CF4 EQUATIONS VARY BY VOLUME EQUATION

CF4 = 0.358550 - 0.488134 * (1/DBH)

IF(CF4 < 0.3) CF4=0.3

IF(CF4 > 0.4) CF4=0.4

CF4_TMP = 0.358550 - 0.488134 * (1/ TMP_DBH)

IF(CF4_TMP < 0.3) CF4_TMP=0.3

IF(CF4_TMP > 0.4) CF4_TMP=0.4

‘-----

‘For ease of use and to improve readability of equations, calculate the following term and use it

‘in the equations that follow. Note that actual DBH and BA are used for all trees.

‘Do not use TMP_DBH or BA_TMP here.

TERM = ((1.033 * (1.0 + 1.382937 * EXP(-4.015292 * (DBH/10.0)))) * (BA + 0.087266) - 0.174533)

‘-----

IF DBH >= 6.0 THEN

CV4 = CF4 * BA * HT

TARIF = (CV4 * 0.912733) / (BA - 0.087266)

IF (TARIF <= 0.0) TARIF=0.01

CVTS = (CV4 * TERM) / (BA - 0.087266)

CVT = TARIF * (0.9679 - 0.1051 * 0.5523**(DBH-1.5)) * TERM / 0.912733

ELSEIF

DBH < 6.0 THEN

CV4_TMP = CF4_TMP *BA_TMP * HT

TARIF_TMP = (CV4_TMP * 0.912733) / (BA_TMP - 0.087266)

IF (TARIF_TMP <= 0.0) TARIF_TMP = 0.01

‘CALCULATE An **ADJUSTED TARIF** FOR SMALL TREES (Both DBH and TMP_DBH are used)

TARIF = TARIF_TMP * (0.5 * (TMP_DBH - DBH)**2 + (1.0 + 0.063 * (TMP_DBH - DBH)**2))

IF (TARIF <= .0.0) TARIF = 0.01

CVTS = TARIF * TERM

CVT = TARIF * (0.9679 - 0.1051 * 0.5523**(DBH-1.5)) * TERM / 0.912733

CV4 = CF4 * BA * HT (calculated with actual DBH and BA)

END IF

IF DBH < 5.0 THEN CV4 = NULL

IF DBH >= 5.0 THEN KEEP CV4 (i.e. don't keep CV4_TMP)

WHERE:

DBH (inches) = DBH (CM) CONVERTED TO INCHES (DBH/2.54)

HT (feet) = HT (M) CONVERTED TO FEET (HT/0.3048)

CVTS = CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

TARIF = TARIF NUMBER EQUATION (REF. DNR NOTE # .27, P.2)

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME ABOVE STUMP, 4-INCH TOP

Equation 21

$$CVTS = 0.005454154 \times \left[0.30708901 + 0.00086157622 \times HT - 0.0037255243 \times DBH \times \frac{HT}{HT - 4.5} \right] \times DBH^2 \times HT \times \left(\frac{HT}{HT - 4.5} \right)^2 \quad (1)$$

$$TARIF = \frac{(CVTS \times 0.912733)}{\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{DBH}{10.0} \right) \right) \right) \right) \times (BA + 0.087266) - 0.174533 \right)} \quad (2)$$

$$CV4 = \frac{(CVTS + 3.48)}{(1.18052 + 0.32736 \times \exp(-0.1 \times DBH))} - 2.948 \quad (3)$$

$$CVT = \frac{TARIF \times \left(0.9679 - 0.1051 \times 0.5523^{DBH - 1.5} \right) \times \left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{DBH}{10.0} \right) \right) \right) \right) \times (BA + 0.087266) - 0.174533 \right)}{0.912733} \quad (5)$$

WHERE:

DBH (inches) = DBH (CM) CONVERTED TO INCHES (DBH/2.54)

HT (feet) = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA/ACRE (DBH IN INCHES) $BA = 0.005454154 \times DBH^2$

CVTS = CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

TARIF = TARIF NUMBER EQUATION (REF. DNR NOTE NO.27, P.2)

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME ABOVE STUMP, 4-INCH TOP

Equation 22

$$CVTSL = -2.624325 + 1.847123 \times \log(DBH) + 1.044007 \times \log(HT) \quad (1)$$

$$CVTS = \frac{CVTSL}{10.0} \quad (2)$$

$$TARIF = \frac{(CVTS \times 0.912733)}{\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{DBH}{10.0} \right) \right) \right) \right) \times (BA + 0.087266) - 0.174533 \right)} \quad (3)$$

$$CV4 = \frac{TARIF \times (BA - 0.087266)}{0.912733} \quad (4)$$

$$CVT = \frac{TARIF \times \left(0.9679 - 0.1051 \times 0.5523^{DBH - 1.5} \right) \times \left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{DBH}{10.0} \right) \right) \right) \right) \times (BA + 0.087266) - 0.174533 \right)}{0.912733} \quad (5)$$

WHERE:

DBH (inches) = DBH (CM) CONVERTED TO INCHES (DBH/2.54)

HT (feet) = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA/ACRE (DBH IN INCHES) $BA = 0.05454154 \times DBH^2$

CVTSL = LOG BASE 10, CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

CVTS = CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

TARIF = TARIF NUMBER EQUATION (REF. DNR NOTE NO.27, P.2)

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME ABOVE STUMP, 4-INCH TOP

Equation 23 (uses PNW 266 formulas from MacLean and Berger)

‘FOR THIS SET OF EQUATIONS CREATE A TEMPORARY DBH AND BA for trees less than 6”DBH

IF DBH < 6.0 THEN **TMP_DBH** = 6.0

‘CALCULATE BASAL AREA PER TREE USING DBH AND DBH_TEMP

BA = DBH**2 * 0.005454154

BA_TMP = TMP_DBH **2 * 0.005454154

‘CALCULATE A **CUBIC FORM FACTOR** (CF4) USING TMP_DBH and DBH

‘CF4 EQUATIONS VARY BY VOLUME EQUATION

CF4 = 0.299039 + 1.91272 * (1/HT) + 0.0000367217 * (HT**2/DBH)

IF(CF4 < 0.3) CF4=0.3

IF(CF4 > 0.4) CF4=0.4

CF4_TMP = 0.299039 + 1.91272 * (1/HT) + 0.0000367217 * (HT**2/TMP_DBH)

IF(CF4_TMP < 0.3) CF4_TMP=0.3

IF(CF4_TMP > 0.4) CF4_TMP=0.4

‘-----

‘For ease of use and to improve readability of equations, calculate the following term and use it

‘in the equations that follow. Note that actual DBH and BA are used for all trees.

‘Do not use TMP_DBH or BA_TMP here.

TERM = ((1.033 * (1.0 + 1.382937 * EXP(-4.015292 * (DBH/10.0)))) * (BA + 0.087266) - 0.174533)

‘-----

IF DBH >= 6.0 THEN

CV4 = CF4 * BA * HT

TARIF = (CV4 * 0.912733) / (BA - 0.087266)

IF (TARIF <= 0.0) TARIF=0.01

CVTS = (CV4 * TERM) / (BA - 0.087266)

CVT = TARIF * (0.9679 - 0.1051 * 0.5523**(DBH-1.5)) * TERM / 0.912733

ELSEIF

DBH < 6.0 THEN

CV4_TMP = CF4_TMP * BA_TMP * HT

TARIF_TMP = (CV4_TMP * 0.912733) / (BA_TMP - 0.087266)

IF (TARIF_TMP <= 0.0) TARIF_TMP = 0.01

‘CALCULATE An **ADJUSTED TARIF** FOR SMALL TREES (Both DBH and TMP_DBH are used)

TARIF = TARIF_TMP * (0.5 * (TMP_DBH - DBH)**2 + (1.0 + 0.063 * (TMP_DBH - DBH)**2))

IF (TARIF <= .0.0) TARIF = 0.01

CVTS = TARIF * TERM

CVT = TARIF * (0.9679 - 0.1051 * 0.5523**(DBH-1.5)) * TERM / 0.912733

CV4 = CF4 * BA * HT (calculated with actual DBH and BA)

END IF

IF DBH < 5.0 THEN CV4 = NULL

IF DBH >= 5.0 THEN KEEP CV4 (i.e. don't keep CV4_TMP)

WHERE:

DBH (inches) = DBH (CM) CONVERTED TO INCHES (DBH/2.54)

HT (feet) = HT (M) CONVERTED TO FEET (HT/0.3048)

CVTS = CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

TARIF = TARIF NUMBER EQUATION (REF. DNR NOTE # 27, P.2)

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME ABOVE STUMP, 4-INCH TOP

Equation 24

$$CVTS = \exp(-6.2597 + 1.9967 \times \ln(DBH) + 0.9642 \times \ln(HT)) \quad (1)$$

$$TARIF = \frac{(CVTS \times 0.912733)}{\left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp\left(-4.015292 \times \left(\frac{DBH}{10.0}\right)\right)\right) \right) \right) \times (BA + 0.087266) - 0.174533 \right)} \quad (2)$$

$$CV4 = \frac{(CVTS + 3.48)}{(1.18052 + 0.32736 \times \exp(-0.1 \times DBH))} - 2.948 \quad (3)$$

$$CVT = \frac{TARIF \times \left(0.9679 - 0.1051 \times 0.5523^{DBH - 1.5} \right) \times \left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp\left(-4.015292 \times \left(\frac{DBH}{10.0}\right)\right)\right) \right) \right) \times (BA + 0.087266) - 0.174533 \right)}{0.912733} \quad (4)$$

WHERE:

DBH (inches) = DBH (CM) CONVERTED TO INCHES (DBH/2.54)

HT (feet) = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA/ACRE (DBH IN INCHES) $BA = 0.05454154 \times DBH^2$

CVTS = CUBIC FOOT VOLUME, INCLUDING TOP AND STUMP

TARIF = TARIF NUMBER EQUATION (REF. DNR NOTE NO.27, P.2)

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME ABOVE STUMP, 4-INCH TOP

SOFTWOOD BOARDFOOT VOLUME EQUATIONS

$$RC6 = 0.993 - \left(0.993 \times 0.62^{(DBH-6.0)} \right)$$

$$CV6 = RC6 \times CV4$$

$$\text{IF } CV6 > CV4 \text{ THEN } CV6 = CV4$$

$$CUBUS = CV4 - CV6$$

$$B4 = \frac{TARIF}{0.912733}$$

$$RS616L = 0.174439 + 0.117594 \times \log(DBH) \times \log(B4) - \frac{8.210585}{DBH^2} + 0.236693 \times \log(B4) - 0.00001345 \times (B4)^2 - 0.00001937 \times DBH^2$$

$$RS616 = 10.0^{RS616L}$$

$$RS632 = 1.001491 - \frac{6.924097}{TARIF} + 0.00001351 \times DBH^2$$

$$SV616 = RS616 \times CV6$$

$$SV632 = RS632 \times SV616$$

$$SCRIB = SV632$$

note: West-side Scribner conifer volumes are based on 32 foot logs, for areas other than western Oregon and western Washington $SCRIB = sv616$

$$RI6 = -2.904154 + 3.466328 \times \log(DBH \times TARIF) - 0.02765985 \times DBH - 0.00008205 \times TARIF^2 + \frac{11.29598}{DBH^2}$$

$$XINT6 = RI6 \times CV6$$

Where:

B4 = BINGO FACTOR

CUBUS = CUBIC FOOT VOLUME, UPPER-STEM PORTION

RC6 = RATIO TO CONVERT CUBIC 4-INCH TOP TO CUBIC 6-INCH TOP

CV6 = CUBIC FOOT VOLUME, 6-INCH TOP (SAWLOG)

RS616 = RATIO TO CONVERT CUBIC 6-INCH TOP TO SCRIB 6-INCH TOP IN 16-FT LOGS

RS632 = RATIO TO CONVERT SCRIB 6-INCH TOP IN 16-FT LOGS TO SCRIB 6-INCH TOP IN 32-FT LOGS (WEST-SIDE ONLY)

SV632 = SCRIBNER VOLUME--6-INCH TOP (IN 32-FT LOGS) (WEST-SIDE ONLY)

SV616 = SCRIBNER VOLUME--6-INCH TOP (IN 16-FT LOGS)

RI6 = RATIO TO CONVERT CUBIC 6-INCH TOP TO INTERNATIONAL ¼ INCH 6-INCH TOP

XINT6 = INTERNATIONAL ¼ INCH VOLUME--6-INCH TOP (IN 16-FT LOGS)

SOFTWOOD VOLUME EQUATION SOURCES

- Brackett, Michael. 1977. Notes on TARIF tree-volume computation. DNR report #24. State of Washington, Department of Natural Resources, Olympia, WA. 132p. (see Weyerhaeuser Eqn. #4, page 6)
- Summerfield, Edward. 1980. In-house memo describing equations for Douglas-fir and ponderosa pine. State of Washington, Department of Natural Resources. On file with the PNW Research Station.
- MacLean, Colin and John M. Berger. 1976. Softwood tree-volume equations for major California species. PNW Research Note, PNW-266. Pacific Northwest Forest and Range Experiment Station, Portland Oregon. 34p. (see page 4)
- Chambers, Charles and Bruce Foltz. 1979. The TARIF system--revisions and additions. DNR Note #27. State of Washington, Department of Natural Resources. (see page 2)
- Bell, J.F., Marshall, D.D. and Johnson G.P. 1981. Tarif tables for mountain hemlock: developed from an equation of total stem cubic-foot volume. Research Bulletin #35. Forest Research Lab, School of Forestry, Oregon State University, Corvallis, OR. (see page 6)
- Chittester, Judith and Colin MacLean. 1984. Cubic-foot tree-volume equations and tables for western juniper. Research Note, PNW_420. Pacific Northwest Forest and Range Experiment Station. Portland, Oregon. 8p. (see page 4)
- Krumland, B.E. and L.E. Wensel. 1975. Preliminary young growth volume tables for coastal California conifers. Research Note #1. In-house memo. Co-op Redwood Yield Research Project. Department of Forestry and Conservation, College of Natural Resources, U of Cal, Berkeley. On file with the PNW Research Station. (see Table 1, page 4)

HARDWOOD CUBIC VOLUME EQUATIONS

Species Code	Species	Halfstate				
		WOR	WWA	EOR	EWA	CA
312	Bigleaf maple	37	26	37	26	37
313	Boxelder	--	--	--	--	38
321	Rocky Mountain maple	--	--	--	--	--
322	Bigtooth maple	--	--	--	--	--
330	California buckeye	--	--	--	--	43
341	Tree of heaven	--	--	--	--	26
351	Red alder	26	25	26	25	26
352	White alder	26	--	26	--	26
361	Pacific madrone	40	26	40	26	40
374	Water birch	--	--	--	--	26
375	Paper birch	--	--	--	--	--
376	Western paper birch	--	26	--	26	--
431	Golden chinkapin	32	26	--	26	32
475	Curlleaf mountain-mahogany	--	--	45	--	45
492	Pacific dogwood	--	26	--	26	26
500	Hawthorn	--	--	--	--	--
510	Eucalyptus	26	--	--	--	31
542	Oregon ash	38	26	38	26	38
590	Holly	26	26	26	26	26
600	Walnut	26	26	26	--	38
631	Tanoak	34	--	--	--	34
660	Apple	26	26	26	26	42
730	California sycamore	26	26	26	26	42
740	Cottonwood and poplar	--	--	--	--	--
741	Balsam poplar	--	--	--	--	--
742	Eastern cottonwood	--	--	--	--	--
745	Plains cottonwood	--	--	--	--	--
746	Quaking aspen	26	26	26	26	28
747	Black cottonwood	26	26	26	26	27
748	Fremont poplar	--	--	--	--	27
755	Mesquite	--	--	--	--	--
760	Cherry	26	26	26	26	26
800	Oak-deciduous	--	--	--	--	43
801	California live oak	--	--	--	--	43
805	Canyon live oak	42	--	--	--	42
807	Blue oak	--	--	--	--	39
810	Emory oak	--	--	--	--	--
811	Englemann oak	--	--	--	--	36
815	Oregon white oak	41	26	41	26	41
818	California black oak	41	--	41	26	41
821	California white oak	--	--	--	--	35
839	Interior live oak	--	--	--	--	44
901	Black locust	--	--	--	--	41
920	Willow	26	26	26	26	40
981	California-laurel	33	--	--	--	33
998	Unknown hardwood	26	26	26	26	41
999	Unknown Tree	26	26	26	26	41

HARDWOOD VOLUME EQUATION SOURCE

EQUATION 25	ALDER	(CURTIS/BRUCE, PNW-56)
EQUATION 26	ALDER	(BC-ALDER--DNR RPT#24,1977)
EQUATION 27	COTTONWOOD	(BC-COTTONWOOD--DNR RPT#24,1977)
EQUATION 28	ASPEN	(BC-ASPEN--DNR RPT#24,1977)
EQUATION 29	BIRCH	(BC-BIRCH--DNR RPT#24,1977)
EQUATION 30	BIGLEAF MAPLE	(BC-MAPLE--DNR RPT#24,1977)
EQUATION 31	EUCALYPTUS	(MEMO,COLIN D. MacLEAN 1/27/83,(REVISED 2/7/83))
EQUATION 32	G.CHINQUAPIN	(PILLSBURY (H,D), CHARLES BOLSINGER 1/3/83)
EQUATION 33	C.LAUREL	(PILLSBURY (H,D), CHARLES BOLSINGER 1/3/83)
EQUATION34	TANOAK	(PILLSBURY (H,D), CHARLES BOLSINGER 1/3/83)
EQUATION35	CALIF WHITE OAK	(PILLSBURY (H,D), CHARLES BOLSINGER 1/3/83)
EQUATION36	ENGELMANN OAK	(PILLSBURY (H,D), CHARLES BOLSINGER 1/3/83)
EQUATION37	BIGLEAF MAPLE	(PILLSBURY (H,D,FC), CHARLES BOLSINGER 1/3/83)
EQUATION38	CALIF BLACK OAK	(PILLSBURY (H,D,FC), CHARLES BOLSINGER 1/3/83)
EQUATION39	BLUE OAK	(PILLSBURY (H,D,FC), CHARLES BOLSINGER 1/3/83)
EQUATION40	PACIFIC MADRONE	(PILLSBURY (H,D,FC), CHARLES BOLSINGER 1/3/83)
EQUATION41	ORE WHITE OAK	(PILLSBURY (H,D,FC), CHARLES BOLSINGER 1/3/83)
EQUATION42	CANYON LIVE OAK	(PILLSBURY (H,D,FC), CHARLES BOLSINGER 1/3/83)
EQUATION43	COAST LIVE OAK	(PILLSBURY (H,D,FC), CHARLES BOLSINGER 1/3/83)
EQUATION44	INT LIVE OAK	(PILLSBURY (H,D,FC), CHARLES BOLSINGER 1/3/83)
EQUATION45	MTN. MAHOGANY	(Chojnacky, 1985)

HARDWOOD CUBIC VOLUME EQUATIONS

EQUATION 25

$$\begin{aligned}
 F = & 0.3651 \times Z^{2.5} - 7.9032 \times Z^{2.5} \frac{DBH}{1000.0} + 3.295 \times Z^{2.5} \times \frac{HT}{1000.0} \\
 & - 1.9856 \times Z^{2.5} \times HT \times \frac{DBH}{100000.0} - 2.9668 \times Z^{2.5} \times \frac{HT^2}{1000000.0} \\
 & + 1.5092 \times Z^{2.5} \times \frac{HT^{0.5}}{1000.0} + 4.9395 \times Z^4 \times \frac{DBH}{1000.0} \\
 & - 2.05937 \times Z^4 \times \frac{HT}{1000.0} + 1.5042 \times Z^{33} \times HT \times \frac{DBH}{1000000.0} \\
 & - 1.1433 \times Z^{33} \times \frac{HT^{0.5}}{10000.0} + 1.809 \times Z^{41} \times \frac{HT^2}{10000000.0}
 \end{aligned} \tag{1}$$

Where: $Z = \frac{\left(HT - 0.5 - \frac{DBH}{24.0} \right)}{HT - 4.5}$

$$CVT = 0.00545415 \times (DBH)^2 \times (HT - 4.5) \times F \tag{2}$$

$$\begin{aligned}
 & (CVT \times 0.912733) \\
 \text{TARIF} = & \frac{\left(\left(0.9679 - 0.1051 \times 0.5523^{(DBH-1.5)} \right) \times \left(\left(1.0330 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{DBH}{10.0} \right) \right) \right) \times (BA + 0.087266) - 0.174533 \right) \right) \right)}{0.912733}
 \end{aligned} \tag{3}$$

$$\begin{aligned}
 & \left(\left(1.0330 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{DBH}{10.0} \right) \right) \right) \right) \times (BA + 0.087266) - 0.174533 \right) \\
 CVTS = \text{TARIF} \times & \frac{}{0.912733}
 \end{aligned} \tag{4}$$

$$CV4 = \frac{\text{TARIF} \times (BA - 0.087266)}{0.912733} \tag{5}$$

$$RC8 = 0.983 - (0.983 \times 0.65^{(DBH-8.6)})$$

$$CV8 = RC8 \times CV4 \tag{6}$$

$$CV4X = CV4$$

WHERE:

DBH = DBH(CM) CONVERTED TO INCHES (DBH/2.54)

HT = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA

CVTS = CUBIC FOOT VOLUME, TOTAL STEM, WITH TOP AND STUMP

TARIF = TARIF NUMBER EQUATION

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME, 4-IN TOP

CV8 = CUBIC FOOT VOLUME, SAWLOG (8-IN TOP)

EQUATION 26

$$\mathbf{CVTSL} = -2.672775 + 1.920617 \times \log(DBH) + 1.074024 \times \log(HT) \quad (1)$$

$$\mathbf{CVTS} = 10^{**} \mathbf{CVTSL} \quad (2)$$

$$\mathbf{TARIF} = \frac{(CVTS \times 0.912733)}{\left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{DBH}{10.0} \right) \right) \right) \right) \right) \times (BA + 0.087266) - 0.174533 \right)} \quad (3)$$

$$\mathbf{CVT} = \frac{TARIF \times \left(0.9679 - 0.1051 \times 0.5523^{DBH - 1.5} \right) \times \left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{DBH}{10.0} \right) \right) \right) \right) \right) \times (BA + 0.087266) - 0.174533 \right)}{0.912733} \quad (4)$$

$$\mathbf{CV4} = \frac{TARIF \times (BA - 0.087266)}{0.912733} \quad (5)$$

$$\mathbf{RC8} = 0.983 - (0.983 \times 0.65^{(DBH - 8.6)})$$

$$\mathbf{CV8} = RC8 \times CV4 \quad (6)$$

$$\mathbf{CV4X} = CV4$$

WHERE

DBH = DBH(CM) CONVERTED TO INCHES (DBH/2.54)

HT = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA

CVTSL = LOG BASE 10, CUBIC FOOT VOLUME, TOP AND STUMP

CVTS = CUBIC FOOT VOLUME, TOTAL STEM, WITH TOP AND STUMP

TARIF = TARIF NUMBER EQUATION

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME, 4-IN TOP

CV8 = CUBIC FOOT VOLUME, SAWLOG (8-IN TOP)

EQUATION 27

$$\text{CVTSL} = -2.945047 + 1.803973 \times \log(\text{DBH}) + 1.238853 \times \log(\text{HT}) \quad (1)$$

$$\text{CVTS} = 10^{**}\text{CVTSL} \quad (2)$$

$$\text{TARIF} = \frac{(\text{CVTS} \times 0.912733)}{\left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{\text{DBH}}{10.0} \right) \right) \right) \right) \right) \times (\text{BA} + 0.087266) - 0.174533 \right)} \quad (3)$$

$$\text{CVT} = \frac{\text{TARIF} \times \left(0.9679 - 0.1051 \times 0.5523^{\text{DBH} - 1.5} \right) \times \left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{\text{DBH}}{10.0} \right) \right) \right) \right) \right) \times (\text{BA} + 0.087266) - 0.174533 \right)}{0.912733} \quad (4)$$

$$\text{CV4} = \frac{\text{TARIF} \times (\text{BA} - 0.087266)}{0.912733} \quad (5)$$

$$\text{RC8} = 0.983 - (0.983 \times 0.65^{(\text{DBH} - 8.6)})$$

$$\text{CV8} = \text{RC8} \times \text{CV4} \quad (6)$$

$$\text{CV4X} = \text{CV4}$$

WHERE

DBH = DBH(CM) CONVERTED TO INCHES (DBH/2.54)

HT = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA

CVTSL = LOG BASE 10, CUBIC FOOT VOLUME, TOP AND STUMP

CVTS = CUBIC FOOT VOLUME, TOTAL STEM, WITH TOP AND STUMP

TARIF = TARIF NUMBER EQUATION

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME, 4-IN TOP

CV8 = CUBIC FOOT VOLUME, SAWLOG (8-IN TOP)

EQUATION 28

$$\text{CVTSL} = -2.635360 + 1.946034 \times \log(\text{DBH}) + 1.024793 \times \log(\text{HT}) \quad (1)$$

$$\text{CVTS} = 10^{**}\text{CVTSL} \quad (2)$$

$$\text{TARIF} = \frac{(\text{CVTS} \times 0.912733)}{\left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp\left(-4.015292 \times \left(\frac{\text{DBH}}{10.0} \right) \right) \right) \right) \right) \times (\text{BA} + 0.087266) - 0.174533 \right)} \quad (3)$$

$$\text{CVT} = \frac{\text{TARIF} \times \left(0.9679 - 0.1051 \times 0.5523^{\text{DBH} - 1.5} \right) \times \left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp\left(-4.015292 \times \left(\frac{\text{DBH}}{10.0} \right) \right) \right) \right) \right) \times (\text{BA} + 0.087266) - 0.174533 \right)}{0.912733} \quad (4)$$

$$\text{CV4} = \frac{\text{TARIF} \times (\text{BA} - 0.087266)}{0.912733} \quad (5)$$

$$\text{RC8} = 0.983 - (0.983 \times 0.65^{(\text{DBH} - 8.6)})$$

$$\text{CV8} = \text{RC8} \times \text{CV4} \quad (6)$$

$$\text{CV4X} = \text{CV4}$$

WHERE

DBH = DBH(CM) CONVERTED TO INCHES (DBH/2.54)

HT = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA

CVTSL = LOG BASE 10, CUBIC FOOT VOLUME, TOP AND STUMP

CVTS = CUBIC FOOT VOLUME, TOTAL STEM, WITH TOP AND STUMP

TARIF = TARIF NUMBER EQUATION

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME, 4-IN TOP

CV8 = CUBIC FOOT VOLUME, SAWLOG (8-IN TOP)

EQUATION 29

$$\text{CVTSL} = -2.757813 + 1.911681 \times \log(\text{DBH}) + 1.105403 \times \log(\text{HT}) \quad (1)$$

$$\text{CVTS} = 10^{**}\text{CVTSL} \quad (2)$$

$$\text{TARIF} = \frac{(\text{CVTS} \times 0.912733)}{\left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{\text{DBH}}{10.0} \right) \right) \right) \right) \right) \times (\text{BA} + 0.087266) - 0.174533 \right)} \quad (3)$$

$$\text{CVT} = \frac{\text{TARIF} \times \left(0.9679 - 0.1051 \times 0.5523^{\text{DBH} - 1.5} \right) \times \left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{\text{DBH}}{10.0} \right) \right) \right) \right) \right) \times (\text{BA} + 0.087266) - 0.174533 \right)}{0.912733} \quad (4)$$

$$\text{CV4} = \frac{\text{TARIF} \times (\text{BA} - 0.087266)}{0.912733} \quad (5)$$

$$\text{RC8} = 0.983 - (0.983 \times 0.65^{(\text{DBH} - 8.6)})$$

$$\text{CV8} = \text{RC8} \times \text{CV4} \quad (6)$$

$$\text{CV4X} = \text{CV4}$$

WHERE

DBH = DBH(CM) CONVERTED TO INCHES (DBH/2.54)

HT = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA

CVTSL = LOG BASE 10, CUBIC FOOT VOLUME, TOP AND STUMP

CVTS = CUBIC FOOT VOLUME, TOTAL STEM, WITH TOP AND STUMP

TARIF = TARIF NUMBER EQUATION

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME, 4-IN TOP

CV8 = CUBIC FOOT VOLUME, SAWLOG (8-IN TOP)

EQUATION 30

$$\text{CVTSL} = -2.770324 + 1.885813 \times \log(\text{DBH}) + 1.119043 \times \log(\text{HT}) \quad (1)$$

$$\text{CVTS} = 10^{**}\text{CVTSL} \quad (2)$$

$$\text{TARIF} = \frac{(\text{CVTS} \times 0.912733)}{\left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{\text{DBH}}{10.0} \right) \right) \right) \right) \right) \times (\text{BA} + 0.087266) - 0.174533 \right)} \quad (3)$$

$$\text{CVT} = \frac{\text{TARIF} \times \left(0.9679 - 0.1051 \times 0.5523^{\text{DBH} - 1.5} \right) \times \left(\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{\text{DBH}}{10.0} \right) \right) \right) \right) \right) \times (\text{BA} + 0.087266) - 0.174533 \right)}{0.912733} \quad (4)$$

$$\text{CV4} = \frac{\text{TARIF} \times (\text{BA} - 0.087266)}{0.912733} \quad (5)$$

$$\text{RC8} = 0.983 - (0.983 \times 0.65^{(\text{DBH} - 8.6)})$$

$$\text{CV8} = \text{RC8} \times \text{CV4} \quad (6)$$

$$\text{CV4X} = \text{CV4}$$

WHERE

DBH = DBH(CM) CONVERTED TO INCHES (DBH/2.54)

HT = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA

CVTSL = LOG BASE 10, CUBIC FOOT VOLUME, TOP AND STUMP

CVTS = CUBIC FOOT VOLUME, TOTAL STEM, WITH TOP AND STUMP

TARIF = TARIF NUMBER EQUATION

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME, 4-IN TOP

CV8 = CUBIC FOOT VOLUME, SAWLOG (8-IN TOP)

EQUATION 31

$$CVTS = 0.0016144 \times DBH^2 \times HT \quad (1)$$

$$TARIF = \frac{(CVTS \times 0.912733)}{\left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{DBH}{10.0} \right) \right) \right) \right) \times (BA + 0.087266) - 0.174533 \right)} \quad (2)$$

$$CVT = \frac{TARIF \times \left(0.9679 - 0.1051 \times 0.5523^{DBH-1.5} \right) \times \left(\left(1.033 \times \left(1.0 + 1.382937 \times \exp \left(-4.015292 \times \left(\frac{DBH}{10.0} \right) \right) \right) \right) \times (BA + 0.087266) - 0.174533 \right)}{0.912733} \quad (3)$$

$$CV4 = \frac{TARIF \times (BA - 0.087266)}{0.912733} \quad (4)$$

$$RC8 = 0.983 - (0.983 \times 0.65^{(DBH-8.6)})$$

$$CV8 = RC8 \times CV4 \quad (5)$$

$$CV4X = CV4$$

WHERE

DBH = DBH(CM) CONVERTED TO INCHES (DBH/2.54)

HT = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA

CVTS = CUBIC FOOT VOLUME, TOTAL STEM, WITH TOP AND STUMP

TARIF = TARIF NUMBER EQUATION

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME, 4-IN TOP

CV8 = CUBIC FOOT VOLUME, SAWLOG (8-IN TOP)

EQUATION 32

$$CVTS = 0.0120372263 \times DBH^{2.02232} \times HT^{0.68638} \quad (1)$$

$$CV4 = 0.0055212937 \times DBH^{2.07202} \times HT^{0.77467} \quad (2)$$

$$CV8 = 0.0018985111 \times DBH^{2.38285} \times HT^{0.77105} \quad (3)$$

$$CVT = CVTS * RTS \quad (4)$$

$$RTS = 0.9679 - 0.1051 \times 0.5523^{(DBH-1.5)}$$

$$CV4X = CVT \times \left(0.99875 - \frac{43.336}{DBH^3} - \frac{124.717}{DBH^4} + \frac{(0.193437 \times HT)}{DBH^3} + \frac{479.83}{(DBH^3 \times HT)} \right) \quad (5)$$

$$TARIF = \frac{(CV8 \times 0.912733)}{\left(\left((0.983 - 0.983 \times 0.65^{(DBH-8.6)}) \times (BA - 0.087266) \right) \right)} \quad (6)$$

WHERE

DBH = DBH(CM) CONVERTED TO INCHES (DBH/2.54)

HT = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA

CVTS = CUBIC FOOT VOLUME, TOTAL STEM, WITH TOP AND STUMP

TARIF = TARIF NUMBER EQUATION

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME, 4-IN TOP

CV8 = CUBIC FOOT VOLUME, SAWLOG (8-IN TOP)

EQUATION 33

$$CVTS = 0.0057821322 \times DBH^{1.94553} \times HT^{0.88389} \quad (1)$$

$$CV4 = 0.0016380753 \times DBH^{2.05910} \times HT^{1.05293} \quad (2)$$

$$CV8 = 0.0007741517 \times DBH^{2.23009} \times HT^{1.03700} \quad (3)$$

$$CVT = CVTS * RTS \quad (4)$$

$$RTS = 0.9679 - 0.1051 \times 0.5523^{(DBH-1.5)}$$

$$CV4X = CVT \times \left(0.99875 - \frac{43.336}{DBH^3} - \frac{124.717}{DBH^4} + \frac{(0.193437 \times HT)}{DBH^3} + \frac{479.83}{(DBH^3 \times HT)} \right) \quad (5)$$

$$TARIF = \frac{(CV8 \times 0.912733)}{\left(\left((0.983 - 0.983 \times 0.65^{(DBH-8.6)}) \right) \times (BA - 0.087266) \right)} \quad (6)$$

WHERE

DBH = DBH(CM) CONVERTED TO INCHES (DBH/2.54)

HT = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA

CVTS = CUBIC FOOT VOLUME, TOTAL STEM, WITH TOP AND STUMP

TARIF = TARIF NUMBER EQUATION

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME, 4-IN TOP

CV8 = CUBIC FOOT VOLUME, SAWLOG (8-IN TOP)

EQUATION 34

$$CVTS = 0.0058870024 \times DBH^{1.94165} \times HT^{0.86562} \quad (1)$$

$$CV4 = 0.0005774970 \times DBH^{2.19576} \times HT^{1.14078} \quad (2)$$

$$CV8 = 0.0002526443 \times DBH^{2.30949} \times HT^{1.21069} \quad (3)$$

$$CVT = CVTS * RTS \quad (4)$$

$$RTS = 0.9679 - 0.1051 \times 0.5523^{(DBH-1.5)}$$

$$CV4X = CVT \times \left(0.99875 - \frac{43.336}{DBH^3} - \frac{124.717}{DBH^4} + \frac{(0.193437 \times HT)}{DBH^3} + \frac{479.83}{(DBH^3 \times HT)} \right) \quad (5)$$

$$TARIF = \frac{(CV8 \times 0.912733)}{\left(\left((0.983 - 0.983 \times 0.65^{(DBH-8.6)}) \times (BA - 0.087266) \right) \right)} \quad (6)$$

WHERE

DBH = DBH(CM) CONVERTED TO INCHES (DBH/2.54)

HT = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA

CVTS = CUBIC FOOT VOLUME, TOTAL STEM, WITH TOP AND STUMP

TARIF = TARIF NUMBER EQUATION

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME, 4-IN TOP

CV8 = CUBIC FOOT VOLUME, SAWLOG (8-IN TOP)

EQUATION 35

$$CVTS = 0.0042870077 \times DBH^{2.33631} \times HT^{0.74872} \quad (1)$$

$$CV4 = 0.0009684363 \times DBH^{2.39565} \times HT^{0.98878} \quad (2)$$

$$CV8 = 0.0001880044 \times DBH^{1.87346} \times HT^{1.62443} \quad (3)$$

$$CVT = CVTS * RTS \quad (4)$$

$$RTS = 0.9679 - 0.1051 \times 0.5523^{(DBH-1.5)} \quad (4)$$

$$CV4X = CVT \times \left(0.99875 - \frac{43.336}{DBH^3} - \frac{124.717}{DBH^4} + \frac{(0.193437 \times HT)}{DBH^3} + \frac{479.83}{(DBH^3 \times HT)} \right) \quad (5)$$

$$TARIF = \frac{(CV8 \times 0.912733)}{\left(\left((0.983 - 0.983 \times 0.65^{(DBH-8.6)}) \right) \times (BA - 0.087266) \right)} \quad (6)$$

WHERE

DBH = DBH(CM) CONVERTED TO INCHES (DBH/2.54)

HT = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA

CVTS = CUBIC FOOT VOLUME, TOTAL STEM, WITH TOP AND STUMP

TARIF = TARIF NUMBER EQUATION

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME, 4-IN TOP

CV8 = CUBIC FOOT VOLUME, SAWLOG (8-IN TOP)

EQUATION 36

$$CVTS = 0.0191453191 \times DBH^{2.40248} \times HT^{0.28060} \quad (1)$$

$$CV4 = 0.0053866353 \times DBH^{2.61268} \times HT^{0.31103} \quad (2)$$

$$CV8 = CV4 \quad (3)$$

$$CVT = CVTS * RTS \quad (4)$$

$$RTS = 0.9679 - 0.1051 \times 0.5523^{(DBH-1.5)} \quad (4)$$

$$CV4X = CVT \times \left(0.99875 - \frac{43.336}{DBH^3} - \frac{124.717}{DBH^4} + \frac{(0.193437 \times HT)}{DBH^3} + \frac{479.83}{(DBH^3 \times HT)} \right) \quad (5)$$

$$TARIF = \frac{(CV8 \times 0.912733)}{\left(\left((0.983 - 0.983 \times 0.65^{(DBH-8.6)}) \right) \times (BA - 0.087266) \right)} \quad (6)$$

WHERE

DBH = DBH(CM) CONVERTED TO INCHES (DBH/2.54)

HT = HT (M) CONVERTED TO FEET (HT/0.3048)

BA = BASAL AREA

CVTS = CUBIC FOOT VOLUME, TOTAL STEM, WITH TOP AND STUMP

TARIF = TARIF NUMBER EQUATION

CVT = CUBIC FOOT VOLUME ABOVE STUMP

CV4 = CUBIC FOOT VOLUME, 4-IN TOP

CV8 = CUBIC FOOT VOLUME, SAWLOG (8-IN TOP)

EQUATION 37

$$\mathbf{CVTS} = 0.0101786350 \times DBH^{2.22462} \times HT^{0.57561} \quad (1)$$

$$CV4 = 0.0034214162 \times DBH^{2.35347} \times HT^{0.69586} \quad (2)$$

$$\mathbf{CV8} = 0.0004236332 \times DBH^{2.10316} \times HT^{1.08584} \times FC^{0.40017} \quad (3)$$

$$CVT = CVTS * RTS \quad (4)$$

$$RTS = 0.9679 - 0.1051 \times 0.5523^{(DBH-1.5)} \quad (4)$$

$$\mathbf{CV4X} = CVT \times \left(0.99875 - \frac{43.336}{DBH^3} - \frac{124.717}{DBH^4} + \frac{(0.193437 \times HT)}{DBH^3} + \frac{479.83}{(DBH^3 \times HT)} \right) \quad (5)$$

$$\mathbf{TARIF} = \frac{(CV8 \times 0.912733)}{\left(\left((0.983 - 0.983 \times 0.65^{(DBH-8.6)}) \right) \times (BA - 0.087266) \right)} \quad (6)$$

WHERE

DBH = DBH(CM) CONVERTED TO INCHES (DBH/2.54)
 HT = HT (M) CONVERTED TO FEET (HT/0.3048)
 BA = BASAL AREA
 FC =HARDWOOD FORM CLASS
 CVTS = CUBIC FOOT VOLUME, TOP AND STUMP
 TARIF = TARIF NUMBER EQUATION
 CVT = CUBIC FOOT VOLUME ABOVE STUMP
 CV4 = CUBIC FOOT VOLUME, 4-IN TOP
 CV8 = CUBIC FOOT VOLUME, SAWLOG (8-IN TOP)

EQUATION 38

$$CVTS = 0.0070538108 \times DBH^{1.97437} \times HT^{0.85034} \quad (1)$$

$$CV4 = 0.0036795695 \times DBH^{2.12635} \times HT^{0.83339} \quad (2)$$

$$CV8 = 0.0012478663 \times DBH^{2.68099} \times HT^{0.42441} \times FC^{0.28385} \quad (3)$$

$$CVT = CVTS * RTS \quad (4)$$

$$RTS = 0.9679 - 0.1051 \times 0.5523^{(DBH-1.5)} \quad (4)$$

$$CV4X = CVT \times \left(0.99875 - \frac{43.336}{DBH^3} - \frac{124.717}{DBH^4} + \frac{(0.193437 \times HT)}{DBH^3} + \frac{479.83}{(DBH^3 \times HT)} \right) \quad (5)$$

$$TARIF = \frac{(CV8 \times 0.912733)}{\left(\left((0.983 - 0.983 \times 0.65^{(DBH-8.6)}) \right) \times (BA - 0.087266) \right)} \quad (6)$$

WHERE

DBH = DBH(CM) CONVERTED TO INCHES (DBH/2.54)
 HT = HT (M) CONVERTED TO FEET (HT/0.3048)
 BA = BASAL AREA
 FC =HARDWOOD FORM CLASS
 CVTS = CUBIC FOOT VOLUME, TOP AND STUMP
 TARIF = TARIF NUMBER EQUATION
 CVT = CUBIC FOOT VOLUME ABOVE STUMP
 CV4 = CUBIC FOOT VOLUME, 4-IN TOP
 CV8 = CUBIC FOOT VOLUME, SAWLOG (8-IN TOP)

EQUATION 39

$$CVTS = 0.0125103008 \times DBH^{2.33089} \times HT^{0.46100} \quad (1)$$

$$CV4 = 0.0042324071 \times DBH^{2.53987} \times HT^{0.50591} \quad (2)$$

$$CV8 = 0.0036912408 \times DBH^{1.79732} \times HT^{0.83884} \times FC^{0.15958} \quad (3)$$

$$CVT = CVTS * RTS \quad (4)$$

$$RTS = 0.9679 - 0.1051 \times 0.5523^{(DBH-1.5)} \quad (4)$$

$$CV4X = CVT \times \left(0.99875 - \frac{43.336}{DBH^3} - \frac{124.717}{DBH^4} + \frac{(0.193437 \times HT)}{DBH^3} + \frac{479.83}{(DBH^3 \times HT)} \right) \quad (5)$$

$$TARIF = \frac{(CV8 \times 0.912733)}{\left(\left((0.983 - 0.983 \times 0.65^{(DBH-8.6)}) \right) \times (BA - 0.087266) \right)} \quad (6)$$

WHERE

DBH = DBH(CM) CONVERTED TO INCHES (DBH/2.54)
 HT = HT (M) CONVERTED TO FEET (HT/0.3048)
 BA = BASAL AREA
 FC =HARDWOOD FORM CLASS
 CVTS = CUBIC FOOT VOLUME, TOP AND STUMP
 TARIF = TARIF NUMBER EQUATION
 CVT = CUBIC FOOT VOLUME ABOVE STUMP
 CV4 = CUBIC FOOT VOLUME, 4-IN TOP
 CV8 = CUBIC FOOT VOLUME, SAWLOG (8-IN TOP)

EQUATION 40

$$CVTS = 0.0067322665 \times DBH^{1.96628} \times HT^{0.83458} \quad (1)$$

$$CV4 = 0.0025616425 \times DBH^{1.99295} \times HT^{1.01532} \quad (2)$$

$$CV8 = 0.0006181530 \times DBH^{1.72635} \times HT^{1.26462} \times FC^{0.37868} \quad (3)$$

$$CVT = CVTS * RTS \quad (4)$$

$$RTS = 0.9679 - 0.1051 \times 0.5523^{(DBH-1.5)} \quad (4)$$

$$CV4X = CVT \times \left(0.99875 - \frac{43.336}{DBH^3} - \frac{124.717}{DBH^4} + \frac{(0.193437 \times HT)}{DBH^3} + \frac{479.83}{(DBH^3 \times HT)} \right) \quad (5)$$

$$TARIF = \frac{(CV8 \times 0.912733)}{\left(\left((0.983 - 0.983 \times 0.65^{(DBH-8.6)}) \right) \times (BA - 0.087266) \right)} \quad (6)$$

WHERE

DBH = DBH(CM) CONVERTED TO INCHES (DBH/2.54)
 HT = HT (M) CONVERTED TO FEET (HT/0.3048)
 BA = BASAL AREA
 FC =HARDWOOD FORM CLASS
 CVTS = CUBIC FOOT VOLUME, TOP AND STUMP
 TARIF = TARIF NUMBER EQUATION
 CVT = CUBIC FOOT VOLUME ABOVE STUMP
 CV4 = CUBIC FOOT VOLUME, 4-IN TOP
 CV8 = CUBIC FOOT VOLUME, SAWLOG (8-IN TOP)

EQUATION 41

$$CVTS = 0.0072695058 \times DBH^{2.14321} \times HT^{0.74220} \quad (1)$$

$$CV4 = 0.0024277027 \times DBH^{2.25575} \times HT^{0.87108} \quad (2)$$

$$CV8 = 0.0008281647 \times DBH^{2.10651} \times HT^{0.91215} \times FC^{0.32652} \quad (3)$$

$$CVT = CVTS * RTS \quad (4)$$

$$RTS = 0.9679 - 0.1051 \times 0.5523^{(DBH-1.5)} \quad (4)$$

$$CV4X = CVT \times \left(0.99875 - \frac{43.336}{DBH^3} - \frac{124.717}{DBH^4} + \frac{(0.193437 \times HT)}{DBH^3} + \frac{479.83}{(DBH^3 \times HT)} \right) \quad (5)$$

$$TARIF = \frac{(CV8 \times 0.912733)}{\left(\left((0.983 - 0.983 \times 0.65^{(DBH-8.6)}) \right) \times (BA - 0.087266) \right)} \quad (6)$$

WHERE

DBH = DBH(CM) CONVERTED TO INCHES (DBH/2.54)
 HT = HT (M) CONVERTED TO FEET (HT/0.3048)
 BA = BASAL AREA
 FC =HARDWOOD FORM CLASS
 CVTS = CUBIC FOOT VOLUME, TOP AND STUMP
 TARIF = TARIF NUMBER EQUATION
 CVT = CUBIC FOOT VOLUME ABOVE STUMP
 CV4 = CUBIC FOOT VOLUME, 4-IN TOP
 CV8 = CUBIC FOOT VOLUME, SAWLOG (8-IN TOP)

EQUATION 42

$$CVTS = 0.0097438611 \times DBH^{2.20527} \times HT^{0.61190} \quad (1)$$

$$CV4 = 0.0031670596 \times DBH^{2.32519} \times HT^{0.74348} \quad (2)$$

$$CV8 = 0.0006540144 \times DBH^{2.24437} \times HT^{0.81358} \times FC^{0.43381} \quad (3)$$

$$CVT = CVTS * RTS \quad (4)$$

$$RTS = 0.9679 - 0.1051 \times 0.5523^{(DBH-1.5)} \quad (4)$$

$$CV4X = CVT \times \left(0.99875 - \frac{43.336}{DBH^3} - \frac{124.717}{DBH^4} + \frac{(0.193437 \times HT)}{DBH^3} + \frac{479.83}{(DBH^3 \times HT)} \right) \quad (5)$$

$$TARIF = \frac{(CV8 \times 0.912733)}{\left(\left((0.983 - 0.983 \times 0.65^{(DBH-8.6)}) \right) \times (BA - 0.087266) \right)} \quad (6)$$

WHERE

DBH = DBH(CM) CONVERTED TO INCHES (DBH/2.54)
 HT = HT (M) CONVERTED TO FEET (HT/0.3048)
 BA = BASAL AREA
 FC =HARDWOOD FORM CLASS
 CVTS = CUBIC FOOT VOLUME, TOP AND STUMP
 TARIF = TARIF NUMBER EQUATION
 CVT = CUBIC FOOT VOLUME ABOVE STUMP
 CV4 = CUBIC FOOT VOLUME, 4-IN TOP
 CV8 = CUBIC FOOT VOLUME, SAWLOG (8-IN TOP)

EQUATION 43

$$CVTS = 0.0065261029 \times DBH^{2.31958} \times HT^{0.62528} \quad (1)$$

$$CV4 = 0.0024574847 \times DBH^{2.53284} \times HT^{0.60764} \quad (2)$$

$$CV8 = 0.0006540144 \times DBH^{2.24437} \times HT^{0.81358} \times FC^{0.43381} \quad (3)$$

$$CVT = CVTS * RTS \quad (4)$$

$$RTS = 0.9679 - 0.1051 \times 0.5523^{(DBH-1.5)} \quad (4)$$

$$CV4X = CVT \times \left(0.99875 - \frac{43.336}{DBH^3} - \frac{124.717}{DBH^4} + \frac{(0.193437 \times HT)}{DBH^3} + \frac{479.83}{(DBH^3 \times HT)} \right) \quad (5)$$

$$TARIF = \frac{(CV8 \times 0.912733)}{\left(\left((0.983 - 0.983 \times 0.65^{(DBH-8.6)}) \right) \times (BA - 0.087266) \right)} \quad (6)$$

WHERE

DBH = DBH(CM) CONVERTED TO INCHES (DBH/2.54)
 HT = HT (M) CONVERTED TO FEET (HT/0.3048)
 BA = BASAL AREA
 FC =HARDWOOD FORM CLASS
 CVTS = CUBIC FOOT VOLUME, TOP AND STUMP
 TARIF = TARIF NUMBER EQUATION
 CVT = CUBIC FOOT VOLUME ABOVE STUMP
 CV4 = CUBIC FOOT VOLUME, 4-IN TOP
 CV8 = CUBIC FOOT VOLUME, SAWLOG (8-IN TOP)

EQUATION 44

$$CVTS = 0.0136818837 \times DBH^{2.02989} \times HT^{0.63257} \quad (1)$$

$$CV4 = 0.0041192264 \times DBH^{2.14915} \times HT^{0.77843} \quad (2)$$

$$CV8 = 0.0006540144 \times DBH^{2.24437} \times HT^{0.81358} \times FC^{0.43381} \quad (3)$$

$$CVT = CVTS * RTS \quad (4)$$

$$RTS = 0.9679 - 0.1051 \times 0.5523^{(DBH-1.5)} \quad (4)$$

$$CV4X = CVT \times \left(0.99875 - \frac{43.336}{DBH^3} - \frac{124.717}{DBH^4} + \frac{(0.193437 \times HT)}{DBH^3} + \frac{479.83}{(DBH^3 \times HT)} \right) \quad (5)$$

$$TARIF = \frac{(CV8 \times 0.912733)}{\left(\left((0.983 - 0.983 \times 0.65^{(DBH-8.6)}) \right) \times (BA - 0.087266) \right)} \quad (6)$$

WHERE

DBH = DBH(CM) CONVERTED TO INCHES (DBH/2.54)
 HT = HT (M) CONVERTED TO FEET (HT/0.3048)
 BA = BASAL AREA
 FC =HARDWOOD FORM CLASS
 CVTS = CUBIC FOOT VOLUME, TOP AND STUMP
 TARIF = TARIF NUMBER EQUATION
 CVT = CUBIC FOOT VOLUME ABOVE STUMP
 CV4 = CUBIC FOOT VOLUME, 4-IN TOP
 CV8 = CUBIC FOOT VOLUME, SAWLOG (8-IN TOP)

EQUATION 45

$$CVTS = (A + B \times DSXH^{.3333} + C \times D)^3$$

WHERE

A = -0.13363

B = 0.128222

C = 0 .080208

D = 1

$DSXH = DRC \times DRC \div THT$ DRC is diameter at root collar and THT is total height

Mountain mahogany

Cubic foot volume of all wood and bark to a 1.5 inch branch diameter

From INT-339, Chojnacky, 1985

Pinyon-Juniper Volume Equations for the Central Rocky Mountain States

HARDWOOD BOARDFOOT VOLUME EQUATIONS

$$\text{CUBUS} = \text{CV4} - \text{CV8} \quad (1)$$

$$\text{RC6} = 0.993 - 0.993 \times 0.62^{(\text{DBH}-6.0)} \quad (2)$$

IF EQN < 8 THEN CV4X = CVT

TARIFX = TARIF

$$\text{CV4X} = \text{CVT} \times 0.99875 - \frac{43.336}{\text{DBH}^3} - \frac{124.717}{\text{DBH}^4} + \frac{0.193437 \times \text{HT}}{\text{DBH}^3} + \frac{479.83}{\text{DBH}^3 \times \text{HT}}$$

$$\text{TARIFX} = \frac{\text{CV8} \times 0.912733}{0.983 - 0.983 \times 0.65^{\text{DBH}-8.6} \times \text{BA} - 0.087266}$$

$$\text{CV6} = \text{RC6} \times \text{CV4X} \quad (3)$$

$$\text{B4} = \frac{\text{TARIF}}{0.912733}$$

$$\text{RS616L} = 0.174439 + 0.117594 \times \log(\text{DBH}) \times \log(\text{B4}) - \frac{8.210585}{\text{DBH}^2} + 0.236693 \times \log(\text{B4}) - 0.00001345 \times (\text{B4})^2 - 0.00001937 \times \text{DBH}^2 \quad (4)$$

$$\text{RS616} = 10.0^{\text{RS616L}} \quad (5)$$

$$\text{SV616} = \text{RS616} \times \text{CV6}$$

$$\text{R16} = -2.904154 + 3.466328 \times \log(\text{DBH} \times \text{TARIF}) - 0.02765985 \times \text{DBH} - 0.00008205 \times \text{TARIF}^2 + \frac{11.29598}{\text{DBH}^2} \quad (6)$$

$$\text{XINT6} = \text{R16} \times \text{CV6} \quad (7)$$

$$\text{RS616} = 0.990 - 0.58 \times \left(0.484^{\text{DBH}-9.5} \right) \quad (8)$$

$$\text{SV816} = \text{RS816} \times \text{SV616} \quad (9)$$

$$\text{R18} = 0.990 - 0.55 \times \left(0.485^{\text{DBH}-9.5} \right) \quad (10)$$

$$\text{XINT8} = \text{XINT6} \times \text{R18} \quad (11)$$

WHERE

B4 = BINGO FACTOR
 CUBUS = CUBIC FOOT VOLUME, UPPER-STEM PORTION
 RC6 = RATIO TO CONVERT CUBIC 4-INCH TOP TO CUBIC 6-INCH TOP
 CV6 = CUBIC FOOT VOLUME, 6-INCH TOP (SAWLOG)
 RS616 = RATIO TO CONVERT CUBIC 6-INCH TOP TO SCRIB 6-INCH TOP IN 16-FT LOGS
 SV616 = SCRIBNER VOLUME--6-INCH TOP (IN 16-FT LOGS)
 RS816 = RATIO TO CONVERT CUBIC 6-INCH TOP TO SCRIB 8-INCH TOP IN 16-FT LOGS
 SV816 = SCRIBNER VOLUME--8-INCH TOP (IN 16-FT LOGS)
 XINT6 = INTERNATIONAL ¼ INCH VOLUME--6-INCH TOP (IN 8-FT LOGS)
 R18 = RATIO TO CONVERT INTERNATIONAL ¼ INCH 6-INCH TOP TO INTERNATIONAL ¼ INCH 8-INCH TOP
 XINT8 = INTERNATIONAL ¼ INCH VOLUME--8-INCH TOP (IN 8-FT LOGS)

HARDWOOD VOLUME EQUATION SOURCES

Curtis, Robert O., Bruce, David, and Caryanne VanCoevinger. 1968. Volume and taper tables for red alder. US Forest Serv. Res. Pap. PNW-56. PNW Forest & Range Exp. Sta., Portland, Oregon. 35p.

Brackett, Michael. 1977. Notes on TARIF tree-volume computation. DNR report #24. State of Washington, Department of Natural Resources, Olympia, WA. 132p. (see page 5)

Colin MacLean and Tom Farrenkopf. 1983. Eucalyptus volume equation. In-house memo describing the volume equation for CVTS, to be used for all species of Eucalyptus. The equation was developed from 111 trees. On file at the PNW Research Station, Portland, OR

Pillsbury, Norman H. and Michael L. Kirkley. 1984. Equations for Total, Wood, and Saw-log Volume for Thirteen California Hardwoods. PNW Research Note, PNW-414. Pacific Northwest Research Station, Portland Oregon. 52p.

REGIONAL BIOMASS EQUATIONS USED BY FIA TO ESTIMATE BOLE, BARK, AND BRANCHES

BIOMASS OF THE TREE STEM

Tree stem biomass, regardless of whether it is merchantable bole or total stem, is calculated from cubic volume estimates and the wood density factor (in tables below) as follows:

Cubic volume = green cubic volume in cubic feet (ft³)

Wood density = (Specific gravity of a tree species) * (62.4 lbs/ft³)

Weight of water = 62.4 pounds/cubic foot

Biomass of the tree stem (in tons) = (cubic foot volume * wood density) / 2000

The tables below contain specific gravity and wood density values for many species.

BIOMASS EQUATIONS AND PROCEDURES

Softwoods

Code	Species	Specific gravity	Wood density
11	Pacific silver fir	0.4	24.96
14	Bristlecone fir	0.36	22.46
15	White fir	0.37	23.09
17	Grand fir	0.35	21.84
19	Subalpine fir	0.31	19.34
20	California red fir	0.36	22.46
21	Shasta red fir	0.36	22.46
22	Noble fir	0.37	23.09
41	Port-Orford-cedar	0.39	24.34
42	Alaska-cedar	0.42	26.21
50	Cypress	0.67	41.81
56	McNabb cypress	.67	41.81
62	California juniper	0.54	33.7
64	Western juniper	0.54	33.7
65	Utah juniper	0.54	33.7
72	Subablpine larch	0.48	29.95
73	Western larch	0.48	29.95
81	Incense cedar	0.35	21.84
92	Brewer spruce	0.35	21.84
93	Engelmann spruce	0.33	20.59
98	Sitka spruce	0.37	23.09
101	Whitebark pine	0.37	23.09
102	Bristlecone pine	0.37	23.09
103	Knobcone pine	0.37	23.09
104	Foxtail pine	0.37	23.09
108	Lodgepole pine	0.38	23.71
109	Coulter pine	0.43	26.83
113	Limber pine	0.37	23.09
116	Jeffrey pine	0.38	23.71
117	Sugar pine	0.34	21.22
119	Western white pine	0.35	21.84
120	Bishop pine	0.43	26.83
122	Ponderosa pine	0.38	23.71
124	Monterey pine	0.35	21.84
127	Gray pine	0.43	26.83
133	Singleleaf pinyon	0.37	23.09
137	Washoe pine	.37	23.09
201	Bigcone Douglas-fir	0.46	28.7
202	Douglas-fir	0.46	28.7
211	Redwood	0.34	21.22
212	Giant Sequoia	0.38	23.71
231	Pacific yew	0.67	41.81
242	Western redcedar	0.31	19.34
251	California nutmeg	0.51	31.82
263	Western hemlock	0.42	26.21
264	Mountain hemlock	0.42	26.21
298	Unknown softwood	0.41	25.58

Hardwoods

Code	Species	Specific gravity	Wood density
312	Bigleaf maple	0.44	27.46
313	Boxelder		19.34
330	California buckeye	0.38	23.71
341	Tree of heaven	0.3	18.72
351	Red alder	0.37	23.09
352	White alder	0.37	23.09
361	Pacific madrone	0.69	43.06
374	Water birch	0.3	18.72
376	Western paper birch	0.3	18.72
431	Golden chinkapin	0.48	29.95
475	Curlleaf mountain-mahogany		
492	Pacific dogwood	0.7	43.68
510	Eucalyptus	0.8	49.92
542	Oregon ash	0.5	31.2
590	Holly		37.44
600	Walnut	0.51	31.82
631	Tanoak	0.58	36.19
660	Apple	0.58	36.19
730	California sycamore	0.46	28.7
740	Cottonwood and poplar		
746	Quaking aspen	0.35	21.84
747	Black cottonwood	0.31	19.34
748	Fremont poplar	0.31	19.34
760	Cherry		29.32
801	California live oak	0.8	49.92
805	Canyon live oak	0.8	49.92
807	Blue oak	0.6	37.44
811	Englemann oak	0.6	37.44
815	Oregon white oak	0.6	37.44
818	California black oak	0.56	34.94
821	California white oak	0.6	37.44
839	Interior live oak	0.8	49.92
920	Willow	0.36	22.46
981	California-laurel	0.59	36.82
998	Unknown hardwood	0.51	31.82
999	Unknown tree	0.45	28.08

SOFTWOOD BIOMASS EQUATION ASSIGNMENTS

BIOMASS OF BARK

Code	Species	Halfstate				CA
		WOR	WWA	EOR	EWA	
11	Pacific silver fir	22	22	22	22	--
14	Bristlecone fir	--	--	--	--	2
15	White fir	1	1	1	1	1
17	Grand fir	2	2	2	2	2
18	Corkbark fir	--	--	--	--	0
19	Subalpine fir	3	3	3	3	3
20	California red fir	--	--	--	--	4
21	Shasta red fir	4	4	4	4	4
22	Noble fir	5	5	5	5	5
41	Port-Orford-cedar	13	13	13	13	13
42	Alaska-cedar	23	23	23	23	13
50	Cypress	--	--	--	--	13
51	Arizona cypress	--	--	--	--	0
56	Mcnabb cypress	--	--	--	--	13
58	Pinchot juniper	--	--	--	--	0
59	Redberry juniper	--	--	--	--	0
62	California juniper	--	--	--	--	16
63	Alligator juniper	--	--	--	--	0
64	Western juniper	16	16	16	16	16
65	Utah juniper	--	--	--	--	16
66	Rocky Mountain juniper	--	--	--	--	0
69	Oneseed juniper	--	--	--	--	0
72	Subalpine larch	24	24	24	24	--
73	Western larch	24	24	24	24	--
81	Incense cedar	12	12	12	12	12
92	Brewer spruce	7	7	7	7	7
93	Engelmann spruce	7	7	7	7	7
94	White spruce	--	--	--	--	0
96	Blue spruce	--	--	--	--	0
98	Sitka spruce	6	6	6	6	6
101	Whitebark pine	11	11	11	11	14
102	Bristlecone pine	--	--	--	--	14
103	Knobcone pine	14	14	14	14	14
104	Foxtail pine	--	--	--	--	14
106	Twoneedle pinyon	--	--	--	--	0
108	Lodgepole pine	14	14	14	14	14
109	Coulter pine	--	--	--	--	9
112	Apache pine	--	--	--	--	0
113	Limber pine	--	--	--	--	14
114	Southwestern white pine	--	--	--	--	0
116	Jeffrey pine	9	9	9	9	9

SOFTWOOD BIOMASS EQUATION ASSIGNMENTS
--continued--
BIOMASS OF BARK

Code	Species	WOR	WWA	Halfstate		CA
				EOR	EWA	
117	Sugar pine	10	10	10	10	10
118	Chihuahuan pine	--	--	--	--	0
119	Western white pine	11	11	11	11	11
120	Bishop pine	--	--	--	--	14
122	Ponderosa pine	9	9	9	9	9
124	Monterey pine	--	--	--	--	14
127	Gray pine	--	--	--	--	9
130	Scotch pine	0	0	0	0	0
133	Singleleaf pinyon	--	--	--	--	14
134	Border pinyon	--	--	--	--	0
135	Arizona pine	--	--	--	--	0
137	Washoe pine	--	--	--	--	9
201	Bigcone Douglas-fir	--	--	--	--	8
202	Douglas-fir	8	8	25	25	8
211	Redwood	17	17	17	17	17
212	Giant Sequoia	17	17	17	17	17
231	Pacific yew	13	13	13	13	13
242	Western redcedar	13	13	13	13	13
251	California nutmeg	--	--	--	--	13
263	Western hemlock	26	26	26	26	15
264	Mountain hemlock	21	21	21	21	21
298	Unknown Conifer	21	21	21	21	21

SOFTWOOD BIOMASS EQUATION ASSIGNMENTS

BIOMASS OF LIVE BRANCHES

Code	Species	Halfstate				CA
		WOR	WWA	EOR	EWA	
11	Pacific silver fir	18	18	18	18	--
14	Bristlecone fir	--	--	--	--	1
15	White fir	1	1	1	1	1
17	Grand fir	1	1	1	1	1
18	Corkbark fir	--	--	--	--	0
19	Subalpine fir	2	2	2	2	2
20	California red fir	--	--	--	--	3
21	Shasta red fir	3	3	3	3	3
22	Noble fir	3	3	3	3	3
41	Port-Orford-cedar	10	10	10	10	10
42	Alaska-cedar	19	19	19	19	10
50	Cypress	--	--	--	--	10
51	Arizona cypress	--	--	--	--	0
56	Mcnabb cypress	--	--	--	--	10
58	Pinchot juniper	--	--	--	--	0
59	Redberry juniper	--	--	--	--	0
62	California juniper	--	--	--	--	13
63	Alligator juniper	--	--	--	--	0
64	Western juniper	13	13	13	13	13
65	Utah juniper	--	--	--	--	13
66	Rocky Mountain juniper	--	--	--	--	0
69	Oneseed juniper	--	--	--	--	0
72	Subalpine larch	20	20	20	20	--
73	Western larch	20	20	20	20	--
81	Incense cedar	10	10	10	10	10
92	Brewer spruce	4	4	4	4	4
93	Engelmann spruce	4	4	4	4	4
94	White spruce	--	--	--	--	0
96	Blue spruce	--	--	--	--	0
98	Sitka spruce	5	5	5	5	5
101	Whitebark pine	9	9	9	9	11
102	Bristlecone pine	--	--	--	--	11
103	Knobcone pine	11	11	11	11	11
104	Foxtail pine	--	--	--	--	11
106	Twoneedle pinyon	--	--	--	--	0
108	Lodgepole pine	11	11	11	11	11
109	Coulter pine	--	--	--	--	7
112	Apache pine	--	--	--	--	0
113	Limber pine	--	--	--	--	11
114	Southwestern white pine	--	--	--	--	0
116	Jeffrey pine	7	7	7	7	7
117	Sugar pine	8	8	8	8	8
118	Chihuahuan pine	--	--	--	--	0

SOFTWOOD BIOMASS EQUATION ASSIGNMENTS
--continued--
BIOMASS OF LIVE BRANCHES

Code	Species	Halfstate				CA
		WOR	WWA	EOR	EWA	
119	Western white pine	9	9	9	9	9
120	Bishop pine	--	--	--	--	11
122	Ponderosa pine	7	7	7	7	7
124	Monterey pine	--	--	--	--	11
127	Gray pine	--	--	--	--	7
130	Scotch pine	--	--	--	--	0
133	Singleleaf pinyon	--	--	--	--	11
134	Border pinyon	--	--	--	--	0
135	Arizona pine	--	--	--	--	0
137	Washoe pine	--	--	--	--	7
201	Bigcone Douglas-fir	--	--	--	--	6
202	Douglas-fir	6	6	22	22	6
211	Redwood	10	10	10	10	10
212	Giant Sequoia	10	10	10	10	10
231	Pacific yew	10	10	10	10	10
242	Western redcedar	10	10	10	10	10
251	California nutmeg	--	--	--	--	10
263	Western hemlock	23	23	23	23	12
264	Mountain hemlock	24	24	24	24	17
298	Unknown Conifer	24	24	24	24	17

HARDWOOD BIOMASS EQUATION ASSIGNMENTS

BIOMASS OF BARK

Code	Species	Halfstate				CA
		WOR	WWA	EOR	EWA	
300	Acacia	--	--	--	--	0
312	Bigleaf maple	29	29	29	29	--
313	Boxelder	--	--	--	--	--
321	Rocky Mountain maple	--	--	--	--	0
322	Bigtooth maple	--	--	--	--	0
330	California buckeye	--	--	--	--	0
341	Tree of heaven	20	20	20	20	20
351	Red alder	20	20	20	20	20
352	White alder	20	20	20	20	20
361	Pacific madrone	34	34	34	34	--
374	Water birch	20	20	20	20	20
375	Paper birch	--	--	--	--	0
376	Western paper birch	--	--	--	--	0
431	Golden chinkapin	32	32	32	32	--
475	Curlleaf mountain-mahogany	--	--	--	--	0
476	True mountain-mahogany	--	--	--	--	0
477	Hairy mountain-mahogany	--	--	--	--	0
478	Birchleaf mountain-mahogany	--	--	--	--	0
479	Littleleaf mountain-mahogany	--	--	--	--	0
492	Pacific dogwood	29	--	29	29	--
500	Hawthorn	--	--	--	--	0
510	Eucalyptus	--	--	--	--	0
542	Oregon ash	20	20	20	20	--
590	Holly	27	27	27	27	--
600	Walnut	30	30	30	30	--
631	Tanoak	36	36	36	36	--
660	Apple	31	31	31	31	--
730	California sycamore	--	--	--	--	0
740	Cottonwood and poplar	--	--	--	--	0
741	Balsam poplar	--	--	--	--	0
742	Eastern cottonwood	--	--	--	--	0
745	Plains cottonwood	--	--	--	--	0
746	Quaking aspen	18	18	18	18	18
747	Black cottonwood	28	28	28	28	18
748	Fremont poplar	18	18	18	18	18
755	Mesquite	--	--	--	--	0
760	Cherry	27	27	27	27	--
800	Oak-deciduous	--	--	--	--	0
801	California live oak	--	--	--	--	0
805	Canyon live oak	31	31	31	31	31

Code	Species	Halfstate				CA
		WOR	WWA	EOR	EWA	
807	Blue oak	--	--	--	--	0
810	Emory oak	--	--	--	--	0
811	Englemann oak	--	--	--	--	0
814	Gambel oak	--	--	--	--	0
815	Oregon white oak	35	35	35	35	--
818	California black oak	30	30	30	30	--
821	California white oak	--	--	--	--	0
829	Mexican blue oak	--	--	--	--	0
839	Interior live oak	--	--	--	--	0
843	Silverleaf oak	--	--	--	--	0
850	Oak-evergreen	--	--	--	--	0
901	Black locust	--	--	--	--	0
902	New Mexico locust	--	--	--	--	0
920	Willow	34	34	34	34	--
981	California-laurel	33	33	33	33	--
990	Tesota (Arizona ironwood)	--	--	--	--	0
998	Unknown hardwood	20	20	20	20	20
999	Unknown Tree	35	35	35	35	0

HARDWOOD BIOMASS EQUATION ASSIGNMENTS

BIOMASS OF LIVE BRANCHES

Code	Species	WOR	WWA	Halfstate		CA
				EOR	EWA	
300	Acacia	--	--	--	--	0
312	Bigleaf maple	--	--	--	--	--
313	Boxelder	--	--	--	--	0
321	Rocky Mountain maple	--	--	--	--	0
322	Bigtooth maple	--	--	--	--	0
330	California buckeye	--	--	--	--	0
341	Tree of heaven	14	14	14	14	14
351	Red alder	16	16	16	16	16
352	White alder	16	16	16	16	16
361	Pacific madrone	--	--	--	--	--
374	Water birch	14	14	14	14	14
375	Paper birch	--	--	--	--	0
376	Western paper birch	25	25	25	25	3
431	Golden chinkapin	--	--	--	--	--
475	Curleaf mountain-mahogany	--	--	--	--	0
476	True mountain-mahogany	--	--	--	--	0
477	Hairy mountain-mahogany	--	--	--	--	0
478	Birchleaf mountain-mahogany	--	--	--	--	0
479	Littleleaf mountain-mahogany	--	--	--	--	0
492	Pacific dogwood	--	--	--	--	--
500	Hawthorn	--	--	--	--	0
510	Eucalyptus	--	--	--	--	0
542	Oregon ash	--	--	--	--	--
590	Holly	25	25	25	25	0
600	Walnut	--	--	--	--	--
631	Tanoak	--	--	--	--	--
660	Apple	--	--	--	--	0
730	California sycamore	--	--	--	--	0
740	Cottonwood and poplar	--	--	--	--	0
741	Balsam poplar	--	--	--	--	0
742	Eastern cottonwood	--	--	--	--	0
745	Plains cottonwood	--	--	--	--	0
746	Quaking aspen	14	14	14	14	14
747	Black cottonwood	15	15	15	15	15
748	Fremont poplar	5	5	5	5	5
755	Mesquite	--	--	--	--	0
760	Cherry	25	25	25	25	0
800	Oak-deciduous	--	--	--	--	0
801	California live oak	--	--	--	--	--
805	Canyon live oak	--	--	--	--	--
807	Blue oak	--	--	--	--	--
810	Emory oak	0	0	0	0	0
811	Englemann oak	0	0	0	0	0

Code	Species	WOR	WWA	Halfstate		CA
				EOR	EWA	
814	Gambel oak	--	--	--	--	0
815	Oregon white oak	--	--	--	--	--
818	California black oak	--	--	--	--	--
821	California white oak	--	--	--	--	--
829	Mexican blue oak	--	--	--	--	0
839	Interior live oak	--	--	--	--	--
843	Silverleaf oak	--	--	--	--	0
850	Oak-evergreen	--	--	--	--	0
901	Black locust	--	--	--	--	0
902	New Mexico locust	--	--	--	--	0
920	Willow	--	--	--	--	--
981	California-laurel	--	--	--	--	--
990	Tesota (Arizona ironwood)	--	--	--	--	--
998	Unknown hardwood	16	16	16	16	16
999	Unknown Tree	16	16	16	16	16

SPECIES 312, 330, 361, 431, 492, 600, 631, 801, 805, 807, 811, 815, 818, 821, 839, 920, and 981 hardwood volumes are calculated with Pillsbury equations; this means that total stem volume includes branches and bark, thus bark biomass and live branch biomass are not available as separate components of biomass.

BIOMASS EQUATIONS

BIOMASS OF BARK

**All equations produce Biomass of Bark in Kilograms ---
to convert to tons multiply by 0.0011023**

Log in the equations is = NATURAL LOG

EQUATION 1

BIOPAK EQUATION 379

$$BB = \frac{\exp(2.1069 + 2.7271 \times \log(DBH))}{1000}$$

EQUATION 2

BIOPAK EQUATION 887

$$BB = 0.6 + 16.4 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 3

BIOPAK EQUATION 917

$$BB = 1.0 + 17.2 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 4

BIOPAK EQUATION 382

$$BB = \frac{\exp(1.47146 + 2.8421 \times \log(DBH))}{1000}$$

EQUATION 5

BIOPAK EQUATION 251

$$BB = \frac{\exp(2.79189 + 2.4313 \times \log(DBH))}{1000}$$

EQUATION 6

BIOPAK EQUATION 845

$$BB = 1.3 + 12.6 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 7

BIOPAK EQUATION 875

$$BB = 4.5 + 9.3 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 8

BIOPAK EQUATION 5

$$BB = \exp(-4.3103 + 2.4300 \times \log(DBH))$$

EQUATION 9

BIOPAK EQUATION 705

$$BB = \exp(-3.6263 + 1.34077 \times \log(DBH) + 0.8567 \times \log(HT))$$

EQUATION 10

BIOPAK EQUATION 391

$$BB = \frac{\exp(2.183174 + 2.6610 \times \log(DBH))}{1000}$$

EQUATION 11

BIOPAK EQUATION 899

$$BB = 1.2 + 11.2 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 12 (updated)

BIOPAK EQUATION 385

$$BB = \frac{\exp(-13.3146 + 2.8594 \times \log(DBH)) * 1000}{1000}$$

EQUATION 13

BIOPAK EQUATION 461

$$BB = 0.336 + 0.00058 \times DBH^2 \times HT$$

EQUATION 14

BIOPAK EQUATION 904

$$BB = 3.2 + 9.1 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 15

$$BB = \exp(-4.371 + 2.259 \times \log(DBH))$$

EQUATION 16

BIOPAK EQUATION 54

$$BB = \exp(-10.175 + 2.6333 \times \log(DBH \times \pi))$$

EQUATION 17

BIOPAK EQUATION 394

$$BB = \frac{\exp(7.189689 + 1.5837 \times \log(DBH))}{1000}$$

EQUATION 18

BIOPAK EQUATION 942

$$BB = 1.3 + 27.6 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 19

$$BB = 0.0$$

EQUATION 20

BIOPAK EQUATION 275

$$BB = \exp(-4.6424 + 2.4617 \times \log(DBH))$$

EQUATION 21

BIOPAK EQUATION 911

$$BB = 0.9 + 27.4 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 22

BIOPAK EQUATION 881

$$BB = 1.0 + 15.6 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 23

BIOPAK EQUATION 923

$$BB = 1.8 + 9.6 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 24

BIOPAK EQUATION 893

$$BB = 2.4 + 15.0 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 25

BIOPAK EQUATION 857

$$BB = 3.6 + 18.2 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 26

Weyerhaeuser Co Equation

$$BB = -0.025 + 0.00134 \times DBH^2 \times HT$$

EQUATION 27

$$BB = -1.2 + 29.1 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 28

BIOPAK EQUATION 930

$$BB = 1.2 + 15.5 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 29 (Bigleaf maple)

$$ADBH = \frac{(DBH - 0.21235)}{0.94782} \quad 1$$

$$OUTERVOL = 0.0000246916 \times (ADBH^{2.354347} (HT^{0.69586})) \quad 2$$

$$INNERVOL = 0.0000246916 \times (DBH^{2.354347} (HT^{0.69586})) \quad 3$$

$$BB = (OUTERVOL - INNERVOL) \times 35.30 \times DENSFAC / 2.2046 \quad 4$$

EQUATION 30 (California Black Oak)

$$ADBH = \frac{(DBH + 0.68133)}{0.95767} \quad 1$$

$$OUTERVOL = 0.0000386403 \times (ADBH^{2.12635} (HT^{0.83339})) \quad 2$$

$$INNERVOL = 0.0000386403 \times (DBH^{2.12635} (HT^{0.83339})) \quad 3$$

$$BB = (OUTERVOL - INNERVOL) \times 35.30 \times DENSFAC / 2.2046 \quad 4$$

EQUATION 31 (Canyon Live Oak)

$$ADBH = \frac{(DBH + 0.48584)}{0.96147} \quad 1$$

$$OUTERVOL = 0.0000248325 \times (ADBH^{2.32519} (HT^{0.74348})) \quad 2$$

$$INNERVOL = 0.0000248325 \times (DBH^{2.32519} (HT^{0.74348})) \quad 3$$

$$BB = (OUTERVOL - INNERVOL) \times 35.30 \times DENSFAC / 2.2046 \quad 4$$

EQUATION 32 (Golden Chinkapin)

$$ADBH = \frac{(DBH - 0.39534)}{0.90182} \quad 1$$

$$OUTERVOL = 0.000056884 \times (ADBH^{2.07202} (HT^{0.77467})) \quad 2$$

$$INNERVOL = 0.000056884 \times (DBH^{2.07202} (HT^{0.77467})) \quad 3$$

$$BB = (OUTERVOL - INNERVOL) \times 35.30 \times DENSFAC / 2.2046 \quad 4$$

EQUATION 33 (California Laurel)

$$ADBH = \frac{(DBH + 0.32491)}{0.96579} \quad 1$$

$$OUTERVOL = 0.0000237733 \times (ADBH^{2.05910} (HT^{1.05293})) \quad 2$$

$$INNERVOL = 0.0000237733 \times (DBH^{2.05910} (HT^{1.05293})) \quad 3$$

$$BB = (OUTERVOL - INNERVOL) \times 35.30 \times DENSFAC / 2.2046 \quad 4$$

EQUATION 34 (Pacific Madrone)

$$ADBH = \frac{(DBH + 0.03425)}{0.98155} \quad 1$$

$$OUTERVOL = 0.0000378129 \times (ADBH^{1.99295} (HT^{1.01532})) \quad 2$$

$$INNERVOL = 0.0000378129 \times (DBH^{1.99295} (HT^{1.01532})) \quad 3$$

$$BB = (OUTERVOL - INNERVOL) \times 35.30 \times DENSFAC / 2.2046 \quad 4$$

EQUATION 35 (Oregon White Oak)

$$ADBH = \frac{(DBH + 0.78034)}{0.95956} \quad 1$$

$$OUTERVOL = 0.0000236325 \times (ADBH^{2.25575} (HT^{0.87108})) \quad 2$$

$$INNERVOL = 0.0000236325 \times (DBH^{2.25575} (HT^{0.87108})) \quad 3$$

$$BB = (OUTERVOL - INNERVOL) \times 35.30 \times DENSFAC / 2.2046 \quad 4$$

EQUATION 36 (Tanoak)

$$ADBH = \frac{(DBH + 4.1177)}{0.95354} \quad 1$$

$$OUTERVOL = 0.0000081905 \times (ADBH^{2.19576} (HT^{1.14078})) \quad 2$$

$$INNERVOL = 0.0000081905 \times (DBH^{2.19576} (HT^{1.14078})) \quad 3$$

$$BB = (OUTERVOL - INNERVOL) \times 35.30 \times DENSFAC / 2.2046 \quad 4$$

WHERE

Log	= NATURAL LOG
DBH	= DIAMETER OF TREE IN CENTIMETERS
HT	= HEIGHT OF TREE IN METERS
DENSFAC	= DENSITY FACTOR FOR SPECIES
BB	= BIOMASS OF BARK, WEIGHT IN KILOGRAMS, OF THE BARK ON THE TREE BOLE
π	= 3.141593

BIOMASS EQUATIONS

BIOMASS OF LIVE BRANCHES

**All equations produce Biomass of Live Branches in Kilograms ---
to convert to tons multiply by 0.0011023**

Log in the equations is = NATURAL LOG

Log = natural log

EQUATION 1

BIOPAK EQUATION 889

$$BLB = 13.0 + 12.4 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 2

BIOPAK EQUATION 919

$$BLB = 3.6 + 44.2 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 3

BIOPAK EQUATION 28

$$BLB = \exp(-4.1817 + 2.3324 \times \log(DBH))$$

EQUATION 4

BIOPAK EQUATION 877

$$BLB = 16.8 + 14.4 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 5

BIOPAK EQUATION 847

$$BLB = 9.7 + 22.0 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 6

BIOPAK EQUATION 2

$$BLB = \exp(-3.6941 + 2.1382 \times \log(DBH))$$

EQUATION 7

BIOPAK EQUATION 702

$$BLB = \exp(-4.1068 + 1.5177 \times \log(DBH) + 1.0424 \times \log(HT))$$

EQUATION 8

$$BLB = \exp(-7.637 + 3.3648 \times \log(DBH))$$

EQUATION 9

BIOPAK EQUATION 901

$$BLB = 9.5 + 16.8 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 10

BIOPAK EQUATION 459

$$BLB = 0.199 + 0.00381 \times DBH^2 \times HT$$

EQUATION 11

BIOPAK EQUATION 907

$$BLB = 7.8 + 12.3 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 12

$$BLB = \exp(-4.570 + 2.271 \times \log(DBH))$$

EQUATION 13

BIOPAK EQUATION 51

$$BLB = \exp(-7.2775 + 2.3337 \times \log(DBH \times \pi))$$

EQUATION 14

BIOPAK EQUATION 944

$$BLB = 1.7 + 26.2 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 15

BIOPAK EQUATION 932

$$BLB = 2.5 + 36.8 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 16

$$BLB = \exp(-4.5648 + 2.6232 \times \log(DBH)) - BF$$

$$\text{where: } BF = (\exp(-4.5648 + 2.6232 \times \log(DBH))) \times \frac{1}{(2.7638 + 0.062 \times DBH^{1.3364})}$$

EQUATION 17

$$BLB = \exp(-5.2581 + 2.6045 \times \log(DBH))$$

EQUATION 18

BIOPAK EQUATION 883

$$BLB = 4.5 + 22.7 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 19

BIOPAK EQUATION 925

$$BLB = 5.3 + 9.7 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 20

BIOPAK EQUATION 895

$$BLB = 20.4 + 7.7 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 21

BIOPAK EQUATION 446

$$BLB = 0.626 + 0.00079 \times DBH^2 \times HT$$

EQUATION 22

BIOPAK EQUATION 859

$$BLB = 12.6 + 23.5 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 23

Weyerhaeuser Co Equation

$$BLB = 0.047 + 0.00413 \times DBH^2 \times HT$$

EQUATION 24

BIOPAK EQUATION 913

$$BLB = 4.2 + 17.4 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

EQUATION 25

BIOPAK EQUATION 950

$$BLB = -0.6 + 45.1 \times \left(\frac{DBH}{100} \right)^2 \times HT$$

WHERE

Log = NATURAL LOG

DBH = DIAMETER OF TREE IN CENTIMETERS

HT = HEIGHT OF TREE IN METERS

BLB = BIOMASS OF LIVE BRANCHES,
WEIGHT IN KILOGRAMS, OF THE WOOD AND BARK OF LIVE BRANCHES IN THE CROWN

π = 3.141593

ATTACHMENT N

Brush Creek Improved Forest Management Project

Financial Analysis of Baseline Scenario

This analysis is provided per section 6.2.1.3 (1) of Compliance Offset Protocol U.S. Forest Projects, October 20, 2011, and is designed to demonstrate that the baseline growth and harvest regime is financially feasible. This analysis is overly conservative given that the test is simply financial feasibility. If herbicide treatments, tree planting and logging costs were significantly increased, the analysis would still demonstrate that the baseline growth and harvest is financially feasible. Delivered log values are below trended values based on Board of Equalization values, yet still demonstrate financial feasibility.

Model Inputs:

Discount Rate	8.0%
Inflation	0.0%
Real price appreciation for delivered log values	0.0%
Yield Tax	2.9% MBF

Production Costs:

Item	Cost per acre	Quantity ¹	Total Cost	Cost per MBF
THP Preparation	\$100	1,780	\$ 178,041	\$12.95
Logging Supervision				\$15.00
Property Management				\$25.00
Logging and Hauling (Derived from BOE Stumpage Values)				\$0.00
Total				\$52.95

Herbicide Treatment of Hardwoods:

Period	Cost per acre	% of Acres Treated	Total Cost	Cost per MBF
1	\$ 230.00	65%	\$266,172	\$19.35
2	\$ 230.00	33%	\$135,133	\$26.78
3	\$ 230.00	20%	\$81,899	\$15.62
4	\$ 230.00	20%	\$81,899	\$11.92
5	\$ 230.00	20%	\$81,899	\$13.29
6	\$ 230.00	20%	\$81,899	\$11.31
7	\$ 230.00	20%	\$81,899	\$8.56
8	\$ 230.00	20%	\$81,899	\$10.02
9	\$ 230.00	20%	\$81,899	\$10.04
10	\$ 230.00	20%	\$81,899	\$10.35

Tree Planting: (\$1 per tree cost)

Period	Cost per acre	% of Acres Treated	Total Cost	Cost per MBF
1	\$ 200.00	50%	\$178,041	\$12.95
2	\$ 200.00	25%	\$89,021	\$17.64
3	\$ 200.00	20%	\$71,217	\$13.58
4	\$ 200.00	20%	\$71,217	\$10.37
5	\$ 200.00	20%	\$71,217	\$11.56
6	\$ 200.00	20%	\$71,217	\$9.84
7	\$ 200.00	20%	\$71,217	\$7.44
8	\$ 200.00	20%	\$71,217	\$8.71
9	\$ 200.00	20%	\$71,217	\$8.73
10	\$ 200.00	20%	\$71,217	\$9.00

Financial Analysis of Baseline Scenario

Calculation of Net Present Value of Harvest Stream

Logging system mix estimated as 30% tractor, 70% cable.
Production costs per MBF are estimates based upon logging system mix.
0% Real price appreciation applied to delivered log values.
All calculations in constant dollars without inflation.
Discount Rate 8.0% Real.

Year	Annual Harvest Volume				Stumpage Values per MBF				Production Costs \$ / MBF	Herbicide Treatment \$ / MBF	Tree Planting \$ / MBF	Yield Taxes \$ / MBF	Net Value \$ / MBF	Total Net Value	Present Net Value
	RW MBF	DF MBF	OC MBF	Totals MBF	RW \$ / MBF	DF \$ / MBF	OC \$ / MBF	Camprun \$ / MBF							
2007	492	826	57	1,375	400.00	100.00	50.00	205.34	52.95	19.35	12.95	5.95	114.14	156,984	145,356
2008	492	826	57	1,375	400.00	100.00	50.00	205.34	52.95	19.35	12.95	5.95	114.14	156,984	134,589
2009	492	826	57	1,375	400.00	100.00	50.00	205.34	52.95	19.35	12.95	5.95	114.14	156,984	124,619
2010	492	826	57	1,375	400.00	100.00	50.00	205.34	52.95	19.35	12.95	5.95	114.14	156,984	115,388
2011	492	826	57	1,375	400.00	100.00	50.00	205.34	52.95	19.35	12.95	5.95	114.14	156,984	106,841
2012	492	826	57	1,375	400.00	100.00	50.00	205.34	52.95	19.35	12.95	5.95	114.14	156,984	98,927
2013	492	826	57	1,375	400.00	100.00	50.00	205.34	52.95	19.35	12.95	5.95	114.14	156,984	91,599
2014	492	826	57	1,375	400.00	100.00	50.00	205.34	52.95	19.35	12.95	5.95	114.14	156,984	84,814
2015	492	826	57	1,375	400.00	100.00	50.00	205.34	52.95	19.35	12.95	5.95	114.14	156,984	78,531
2016	492	826	57	1,375	400.00	100.00	50.00	205.34	52.95	19.35	12.95	5.95	114.14	156,984	72,714
2017	140	348	16	505	400.00	100.00	50.00	181.48	52.95	26.78	17.64	5.26	78.85	39,783	17,062
2018	140	348	16	505	400.00	100.00	50.00	181.48	52.95	26.78	17.64	5.26	78.85	39,783	15,798
2019	140	348	16	505	400.00	100.00	50.00	181.48	52.95	26.78	17.64	5.26	78.85	39,783	14,628
2020	140	348	16	505	400.00	100.00	50.00	181.48	52.95	26.78	17.64	5.26	78.85	39,783	13,545
2021	140	348	16	505	400.00	100.00	50.00	181.48	52.95	26.78	17.64	5.26	78.85	39,783	12,541
2022	140	348	16	505	400.00	100.00	50.00	181.48	52.95	26.78	17.64	5.26	78.85	39,783	11,612
2023	140	348	16	505	400.00	100.00	50.00	181.48	52.95	26.78	17.64	5.26	78.85	39,783	10,752
2024	140	348	16	505	400.00	100.00	50.00	181.48	52.95	26.78	17.64	5.26	78.85	39,783	9,956
2025	140	348	16	505	400.00	100.00	50.00	181.48	52.95	26.78	17.64	5.26	78.85	39,783	9,218
2026	140	348	16	505	400.00	100.00	50.00	181.48	52.95	26.78	17.64	5.26	78.85	39,783	8,535
2027	111	400	13	524	400.00	100.00	50.00	162.08	52.95	15.62	13.58	4.70	75.23	39,436	7,834
2028	111	400	13	524	400.00	100.00	50.00	162.08	52.95	15.62	13.58	4.70	75.23	39,436	7,254
2029	111	400	13	524	400.00	100.00	50.00	162.08	52.95	15.62	13.58	4.70	75.23	39,436	6,717
2030	111	400	13	524	400.00	100.00	50.00	162.08	52.95	15.62	13.58	4.70	75.23	39,436	6,219
2031	111	400	13	524	400.00	100.00	50.00	162.08	52.95	15.62	13.58	4.70	75.23	39,436	5,758
2032	111	400	13	524	400.00	100.00	50.00	162.08	52.95	15.62	13.58	4.70	75.23	39,436	5,332
2033	111	400	13	524	400.00	100.00	50.00	162.08	52.95	15.62	13.58	4.70	75.23	39,436	4,937
2034	111	400	13	524	400.00	100.00	50.00	162.08	52.95	15.62	13.58	4.70	75.23	39,436	4,571
2035	111	400	13	524	400.00	100.00	50.00	162.08	52.95	15.62	13.58	4.70	75.23	39,436	4,233
2036	111	400	13	524	400.00	100.00	50.00	162.08	52.95	15.62	13.58	4.70	75.23	39,436	3,919
2037	166	487	34	687	400.00	100.00	50.00	170.11	52.95	11.92	10.37	4.93	89.94	61,769	5,684
2038	166	487	34	687	400.00	100.00	50.00	170.11	52.95	11.92	10.37	4.93	89.94	61,769	5,263
2039	166	487	34	687	400.00	100.00	50.00	170.11	52.95	11.92	10.37	4.93	89.94	61,769	4,873
2040	166	487	34	687	400.00	100.00	50.00	170.11	52.95	11.92	10.37	4.93	89.94	61,769	4,512
2041	166	487	34	687	400.00	100.00	50.00	170.11	52.95	11.92	10.37	4.93	89.94	61,769	4,178
2042	166	487	34	687	400.00	100.00	50.00	170.11	52.95	11.92	10.37	4.93	89.94	61,769	3,868
2043	166	487	34	687	400.00	100.00	50.00	170.11	52.95	11.92	10.37	4.93	89.94	61,769	3,582
2044	166	487	34	687	400.00	100.00	50.00	170.11	52.95	11.92	10.37	4.93	89.94	61,769	3,316
2045	166	487	34	687	400.00	100.00	50.00	170.11	52.95	11.92	10.37	4.93	89.94	61,769	3,071
2046	166	487	34	687	400.00	100.00	50.00	170.11	52.95	11.92	10.37	4.93	89.94	61,769	2,843
2047	148	437	32	616	400.00	100.00	50.00	169.43	52.95	13.29	11.56	4.91	86.72	53,440	2,278
2048	148	437	32	616	400.00	100.00	50.00	169.43	52.95	13.29	11.56	4.91	86.72	53,440	2,109
2049	148	437	32	616	400.00	100.00	50.00	169.43	52.95	13.29	11.56	4.91	86.72	53,440	1,953
2050	148	437	32	616	400.00	100.00	50.00	169.43	52.95	13.29	11.56	4.91	86.72	53,440	1,808
2051	148	437	32	616	400.00	100.00	50.00	169.43	52.95	13.29	11.56	4.91	86.72	53,440	1,674
2052	148	437	32	616	400.00	100.00	50.00	169.43	52.95	13.29	11.56	4.91	86.72	53,440	1,550
2053	148	437	32	616	400.00	100.00	50.00	169.43	52.95	13.29	11.56	4.91	86.72	53,440	1,435
2054	148	437	32	616	400.00	100.00	50.00	169.43	52.95	13.29	11.56	4.91	86.72	53,440	1,329
2055	148	437	32	616	400.00	100.00	50.00	169.43	52.95	13.29	11.56	4.91	86.72	53,440	1,231
2056	148	437	32	616	400.00	100.00	50.00	169.43	52.95	13.29	11.56	4.91	86.72	53,440	1,139
2057-2106															20,745
														Total	1,312,239