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RED RIVER FORESTS, LLC MANAGEMENT PLAN

July 7, 2023

Contents

I. Timber Assessment

I.A. Current Inventory

I.A.1. Assessment Area

A vicinity map showing the RRF ownerships is included in Figure 1. In 2021 legal title was deeded from Red River Forests LLC to six different sub-LLCs, as shown on the map. The ownerships are further broken into separate tracts. Stand polygons of different land and timber types were originally delineated in the GIS for a previous timber assessment. They have been updated since that time, through the end of the year 2022, to account for harvests, natural disturbance, and property and land-type boundary adjustments. Table 1 shows the number of stand polygons and gross and net acres by land type for the ownership.

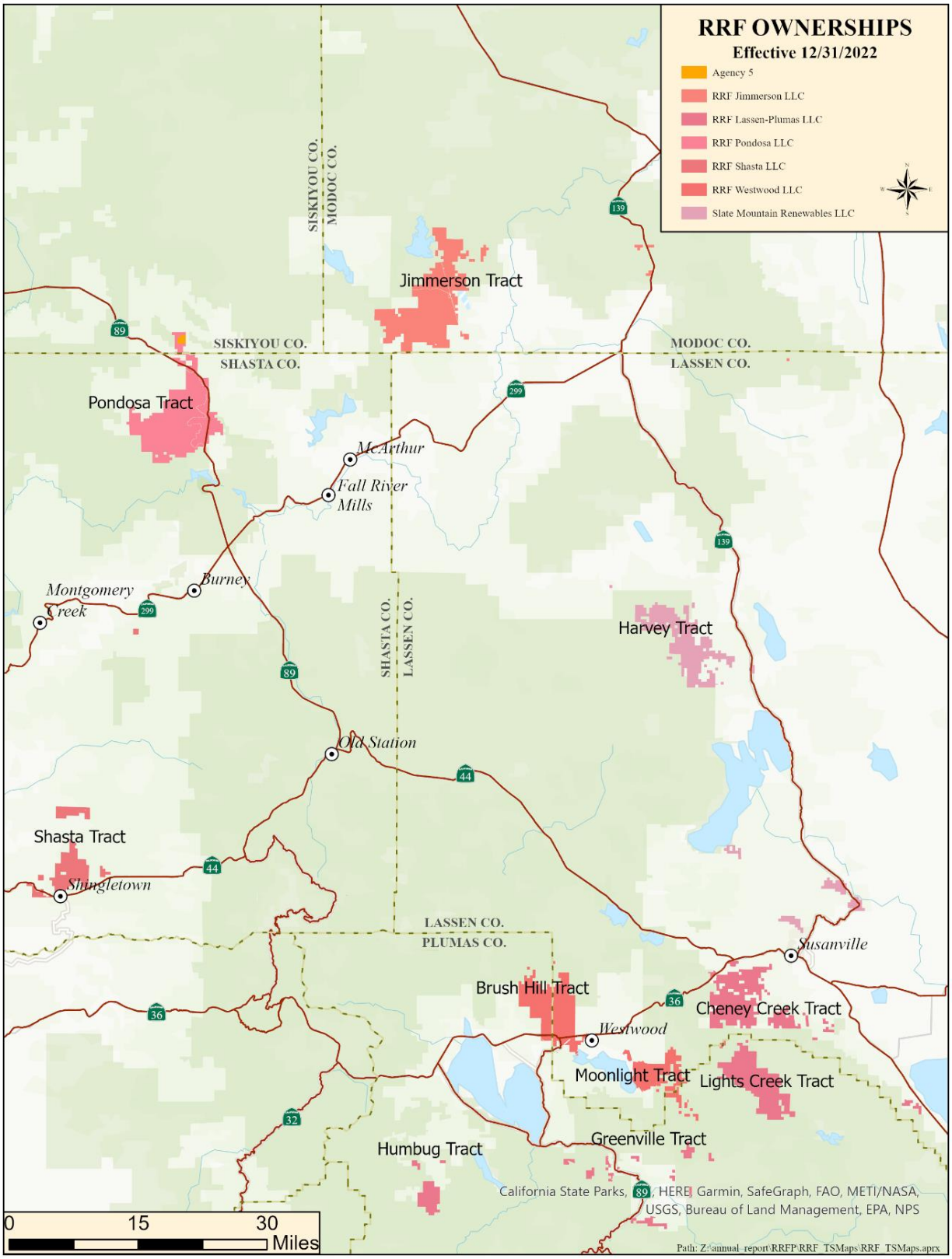
Table 1. Number of stand polygons and gross and net acres by land type.

Land Type	Number of Stands	Gross Acres	Net Acres
Stocked Timberland	795	69,725	69,284
Young Plantation	269	30,122	30,070
Non-stocked Timberland	144	20,715	20,647
Non-forest	407	13,737	13,600
Total	1,615	134,299	133,600

Stocked timberland is natural forest with at least 10% cover of commercial[1] conifer trees. Young plantation consists of planted stands less than 30 years old. Non-stocked timberland is land capable of growing timber but currently not stocked with trees and will likely be planted within three years. Non-forest types are areas of rock outcrop, brush, meadow, non-commercial species, water, or clearing for transportation or utility corridors. All polygons range in size from one to 1,017 acres and average 83 acres, and stocked, plantation, and non-stocked timberland stands range in size from four to 625 acres and average 98 acres. All acres are derived from ESRI ArcGIS, WGS 1984 Web Mercator Auxiliary Sphere.

[1] Group A species as per "commercial species" in 14 CCR 895.1.

Figure 1. Vicinity map of the RRF ownerships showing the ten major tracts.



Gross acres are reduced to net acres to account for the area that is not harvested due to the protection of Class I and II watercourse zones. Water courses are buffered in the GIS by the distances shown in Table 2 to quantify these protection areas. This is a way of estimating operable area in the model and does not relate to on-the-ground protection measures. The area covered by roads and landings were included in the cruise (plots could be mapped and cruised in these areas) and therefore included in the forested area.

Table 2. The distance from watercourse centerlines to create protection buffers.

	Watershed Type	
Watercourse class	Non-ASP	ASP
I	15	75
II	7	30

I.A.2. Inventory Data

The inventory design is in a state of transition, from a system of cruise plots on a systematic grid across all stocked timberland areas to a system based on stand polygons, strata, and sub-sampling. Prior to full implementation of the strata-based system, the older plots on the systematic grid are grown to date and used for the stands that have not been cruised with the new system. The older grown plots are adjusted based on a comparison of the old and the new system, where a direct comparison is available on 66 stands, each containing several plots. The old plots are adjusted with the results of the comparison, in Table 3, by using the adjustment factor multiplied by the trees per acre for each tree record in the inventory. These results are thought to be the result of several years of drought that has affected the growth (downward) and mortality (upward) of the more shade-tolerant species.

Table 3. The percentage difference between the new cruise and the old cruise, and the adjustment factors, by species, used to adjust the old data.

	PP	SP	DF	WF	IC
Percent difference	-5.1%	6.7%	10.4%	14.2%	8.7%
Adjustment factor	1.051	0.933	0.896	0.858	0.913

The new system stratifies all stands into approximately 30 different strata groups based on its location and habitat type (CWHR) and sub-samples a portion of the stands in each stratum, using a random selection process. The new system started in the year 2020, and since then approximately 1,500 plots in 159 stands have been cruised. All cruise plots are temporary survey points established with flagging. Plots are established by trained and supervised forest technicians working under a Registered Professional Forester.

Most plots are variable radius, with a basal area factor of 20, 28, or 40 depending on the predicted stand density. On each plot trees 6 inches in diameter at breast height (DBH) and larger are counted by prism sweep, and a one one-hundredth acre fixed radius plot is used for smaller trees. A minor number of plots in planted stands use fixed radius plots for all trees. All plot sizes are designed to obtain a sample of five to eight trees per plot. A sub-sample of plots are check-cruised for accuracy. All technicians use modern equipment and geo-referenced stand-level maps showing GPS plot locations. Cruisers record every tree that is at least one-inch DBH with its species code, DBH, and the percentage of each 16-foot log that contains visible defect. On approximately one-third of all plots, data is also collected for total height and height to the crown base.

All selection harvest areas that were harvested after being sampled are adjusted in the inventory by reducing the trees per acre by the estimated number of trees harvested (using marking tallies). For even-aged harvest units, stand boundaries are adjusted so that new non-stocked stands are created from the harvest units. All plot data

were grown through the 2022 growing year using FORSEE[2], or for planted stands less than 20 years old using CONIFERS (Ritchie 2010).

I.A.3. Missing Data Estimation

Approximately two-thirds of cruised trees are missing total height and live crown information. Missing total heights are filled in using custom procedures based on the work in the CACTOS STAG program (Biging et. Al., 1994). A linear regression on sampled heights for each DBH and species, with adjustments for basal area per acre and elevation, is used for each stand. When stand level samples are weak the pseudo-Bayesian method is used whereby measured heights from a larger area are used to supplement the local sample.

The missing live crown ratio is filled in using a ratio that is developed between observed live crown and predicted (based on an ownership-wide dataset of measured live crown by species). The ratio is stand and species-specific and is dependent on total height and basal area per acre. Crown width is not field measured. Crown width for all trees is filled in with estimates based on species and DBH, using a model and coefficients from a large dataset of measurements on nearby lands (Gill et al, 2000).

I.A.4. Volume and Defect

Scribner volume is generated in the FORSEE compiler using Wensel and Olsen tree taper equations to an eight-inch top diameter. Only commercial conifers that are greater than or equal to 11 inches DBH count for volume. Volume for the current inventory reports is net of log defect from the cruise.

I.A.5. Site Index

Base age 50 site index (Biging and Wensel 1984) is provided to the growth models for each species and each stand. Approximately 3,400 site trees were measured across the ownership during timber cruises dating back to 1995 and up until 2014. Site trees were selected from (or nearby) the cruise plot locations, and total height was recorded along with breast height age. A dominant species site index is first computed by averaging the site index for that species within each stand. This species is generally the most sampled and best suited to the area. A tract-based multiple regression was developed (using FPS and several additional environmental attributes by stand) to fill in Site_Phys for all stands without site index. Other species are estimated using the average difference from the Site_Phys for a wider area.

Table 4. The number of measured site trees, by species and tract, for use in developing stand site index.

	PP	SP	DF	WF	IC	Total
Brush Hill	142	75	0	222	6	445
Cheney Creek	174	10	34	20	12	250
Greenville	45	9	121	28	1	204
Harvey	400	0	1	67	0	468
Humbug	2	2	8	23	0	35
Jimmerson	533	44	2	57	23	659
Lights Creek	39	10	0	28	3	80
Moonlight	49	18	27	26	5	125
Pondosa	228	72	346	195	43	884
Shasta	138	11	77	22	25	273
Total	1750	251	616	688	118	3423

[2] Windows and Microsoft Access based distance independent individual tree growth and harvest simulator. Version 3 Build 29 (9/6/2017), by the California Growth and Yield Cooperative. Uses CACTOS growth equations (Wensel et al 1987).

An additional 260 trees were measured within planted stands using the height intercept method (Powers and Oliver 1978). This method uses a four-year internode length above DBH to convert to base-age 50 site index. For plantations that are too young to be measured, site index is assigned from the previous natural stand and then adjusted upward. Because site trees from the previous stand likely had some competitive stress above DBH (Newton and Hanson 1998), site index is increased by 15% to reflect the change in site productivity due to stocking and brush control and, in some cases, superior seed quality. The 15% level was chosen because plantation growth with this increased site index was a good match with measured plantation growth.

I.A.6. FORSEE Growth Calibration

I.A.6.a. Previous Calibration. W. M. Beaty foresters have been studying and calibrating tree growth on RRF for many years. Calibrations for the original SYP made use of CACTOS growth plots installed in 1979 and 1980. More re-measurement data on those same plots, plus additional growth results from 14 plots established around the year 2000 and re-measured in 2008 resulted in the calibration factors for the 2010 SYP update.

I.A.6.b. Growth Study 2020. Beginning in 2010 additional permanent growth plots were established, targeting areas not previously covered by the CACTOS plots, specifically in the Brush Hill, Cheney Creek, and Moonlight tracts. These plots and others were re-measured in 2019 and 2020. All plots use the same format, where all trees greater than 2 inches DBH are measured on a 1/40th-acre plot, greater than 5 inches DBH on a 1/10th-acre plot, and greater than 11 inches DBH on a 1/5th-acre plot. Plots established since the year 2000 use a three or four-plot cluster.

The objective of the growth study is to arrive at values with which to calibrate FORSEE and accurately predict growth, using the proportional adjustment page in the 'Configure' growth model section of the software. A subset of the above-mentioned plots was selected because they are on or close to RRF and are relatively evenly spread across the ownership. This includes 39 plots at 17 cluster locations, as shown on the map in Appendix A. Detailed methodology and results are shown in Appendix A. As a result of the growth study, several stand site indexes were adjusted downward, and a growth reduction factor of 90% of normal diameter and height growth is used for both updating cruise data for the current inventory and for all future projections for this assessment.

I.A.7. Current Inventory

Table 5 and 6 show some compiled inventory output for the ownerships combined, by species, for stocked timberland. The sampling error for total net volume is 1.1% at the 95% accuracy level. From the FORSEE compiler the periodic annual increment for net volume less mortality is 3.37%.

Table 5. Net thousand board foot volume and standard error for the ownership, by species.

	PP	SP	DF	WF	IC	LP	Total
MBF	340,672	53,062	160,221	150,706	45,583	636	750,881
St. Error	3,353	1,405	2,238	2,239	896	143	4,241

Table 6. Trees per acre, basal area per acre, and quadratic mean diameter for each species group.

Species Grp.	TPA	BA	QMD
PP	66	48	11.6
SP	4	5	14.8
DF	23	18	12.0
WF	49	21	8.8
IC	40	14	8.1

LP	0	0	10.5
Conifers	185	108	10.3
Hardwoods	21	8	8.0
Totals	206	115	10.1

I.B. Projection Methodology

I.B.1. Landowner Objectives

The RRF timber management objectives are long-standing and continue forward, as listed below:

- Provide an annual, sustained level of commercial timber to local area mills.
- Provide a stable annual revenue compatible with the landowner's expectations.
- Sustain or increase asset value over time through timberland acquisition, stand improvement, and compatible uses that provide income diversification.
- Provide for a healthy forest ecosystem, which maintains soil productivity and provides non-timber attributes such as clean water, wildlife habitat, livestock forage, aesthetic enjoyment, and recreational opportunities.

To meet RRF objectives, WBA foresters will use various intensities of uneven-aged and even aged silvicultural methods. Uneven-aged methods will be used predominantly. Even-aged methods will be used primarily where there are forest health issues or where there are areas of insufficient regeneration, where long term uneven-aged management is difficult to sustain.

Uneven-aged treatments will focus on creating or encouraging regeneration while keeping healthy trees of all age classes. To provide for adequate regeneration foresters will use their education, experience, and creativity to emulate small-scale disturbance resulting in a diversity of species, structure, and age classes, and they will take advantage of advanced regeneration and create individual tree, gap, and group openings. Treatments will be applied appropriately in various sites and conditions. In most cases group openings will be site prepped and planted and the competing vegetation will be controlled. In some cases, density will be reduced aggressively to adjust species mix and stocking levels for better resiliency to future drought and climate change.

There are no processing facilities owned by RRF. Forest products to be harvested include mostly larger diameter sawlogs (minimum 8 inches small end diameter on 32-foot lengths) that are further processed into dimension lumber, studs, fencing, veneer, and other products. Smaller sawlogs, logs for export, poles, chip logs, fuel chips, and pulp chips may also be produced in some years and are minor in comparison.

I.B.2. Existing Plantation Projection

For the purposes of projection, all planted stands 20 years old or less, despite having been sampled or not, are assigned to one of eight plantation data sets. All plantations 10 years old and less (15,334 acres) are assigned to the 5-year age class, and 11 to 20-year-old stands (10,189 acres) are assigned to the 15-year age class of one of the eight types. Which data set type depends on the stand's location (species mix and site quality).

These data sets were carefully constructed using the CONIFERS young stand growth model up to 30 years of age and then with FORSEE after that. Input from various plantation sampling results was used to build the yield data sets (see the last two paragraphs of Appendix A). These stands are also used for future yield sets as discussed in section I.B.6.

I.B.3. Ingrowth

The number, size, and species composition of the ingrowth that is added during the simulation projections is derived from an assessment of small trees in the current inventory and then adjusted based on our estimates of future management results. For all ingrowth areas the trees are set at 4-inches in diameter and have a 20-year

grow-up interval after the initial ingrowth call. Total height is 15 feet for pines and fir and 13 feet for other species, and live crown ratio is 60 percent.

The number of trees added to existing stand data varies by treatment type, as described in I.B.4, and by forest type. The number of ingrowth trees that are added during model simulation is different for westside types and eastside types. This is because, in general, based on inventory database queries there is less regeneration in the pine-dominated eastside types.

The species mix of the ingrowth that is added to a stand during simulation depends on which area the stand is in. There are 15 regeneration areas that have been identified across the ownership. Each stand in the inventory belongs to one of these areas. In anticipation of our efforts to encourage shade-intolerant species, slightly more ponderosa pine and Douglas-fir are added than exist in the current inventory. This adjustment has been made for some of the forest types in areas where group openings are likely to be established.

I.B.4. Silvicultural Treatments

All projections are built within the FORSEE batch processing mode using VB Script. Output is provided in 10-year periods with harvests occurring at the midpoint of periods. The planning horizon length is 10 periods. This is a stand-specific model where each stand is projected independently and stand identities are maintained throughout the model.

Most of the silvicultural treatments listed below have different harvest intensities for larger trees (referred to as Large Tree hereafter). The size of Large Tree is described by the diameter at breast height (DBH) in inches. What constitutes a large tree depends on the tract, as follows:

- 32 inches for the Brush Hill and Moonlight tracts
- 30 inches for the Pondosa, Shasta, Lights Creek, Greenville, and Humbug tracts
- 28 inches for the Jimmerson and Cheney Creek tracts
- 26 inches for the Harvey tract

I.B.4.a. Clearcut. This treatment involves the removal of a stand in one harvest. This will likely occur on stands with health problems, or where uneven-aged methods do not conform with the objectives of 14 CCR 933.

I.B.4.a.1 Variable Retention. Since 2000 and the implementation of the RRF SYP (00-002), a goal of variable retention has been to enhance the current and future forest stand structure and create more complex wildlife habitat. To achieve this goal, an objective of variable retention is to retain aggregate or dispersed Habitat Retention Areas (HRAs) within clearcut silviculture. These HRA's are effective as retaining forest habitat elements like wildlife trees, snags, large down woody debris and unique understory species including rare plants. Specifically, where clearcut silviculture is proposed, the implementation of variable retention will incorporate the following guidelines:

(1) Approximately 1 to 3% of each area treated with clearcut silviculture will be designated for retention.

(2) HRAs will be between 0.1 and 1.2 acres in size and will take into consideration landscape habitat conditions, size of the clearcut unit in acres and existing habitat features within unit.

(3) When practical, clearcuts shall be irregularly shaped and variable in size to mimic natural patterns and features in the landscape.

(4) Forest disease and pests will be considered in meeting retention guidelines.

(5) Specifics will be described in each timber harvest plan and the standards in 14 CCR 933.1(a) will be met.

To a limited degree, any of the seed tree or shelterwood steps, or the rehabilitation of understocked areas prescription, may be used and will comply with the rules specific to those treatments. For the purposes of this assessment, these treatments along with clearcut and variable retention will be considered clearcut.

The model simulation removes all trees from 95% of the area. Five percent of the area that is clearcut is withheld from harvest, continues to grow, and is available for harvest after a five-period lock (50 years). This functionality is explained in more detail in Section I.C.2.

I.B.4.b. Fuelbreak. The Fuelbreak prescription will be applied in areas commonly used by the public, such as along main roads. Creating defensible space is the objective in this treatment, where all trees greater than or equal to Large Tree are harvested, followed by a thinning of all trees two inches DBH to Large Tree, down to a residual stocking of 50 square feet basal area per acre (BA). Ingrowth of 40 TPA, or 30 on eastside types, are added every 20 years after a successful harvest. This is repeated on average every 10 years in some areas, and on average every 20 years in other areas. Actual entry cycle length may vary from 7 to 13 years for the 10-year areas, and from 17 to 23 years in the 20-year areas.

I.B.4.c. Selection on a 10-Year Entry. This treatment is most often used in lower elevation areas where brush is prevalent and more likely to inhibit conifer establishment and growth, and in other areas that are more difficult to regenerate naturally. Trees are removed individually or in small groups sized from .25 acres to 2.5 acres. Trees of different age classes are retained, and provision is made for adequate regeneration. Specifics will be detailed in individual THPs. Post-harvest stocking standards shall meet or exceed standards in 14 CCR 933.2(a)(2).

This section refers to both the selection and the group selection systems. It also covers the much less likely use of the Transition, Commercial Thinning, or Sanitation-salvage methods. Details will be provided in individual THPs and post-harvest stocking will meet or exceed the standards specified in the rules for the specific silvicultural method.

The computer simulation harvests all commercial conifers greater than or equal to Large Tree plus 7 (for example 37 inches DBH on the Shasta Tract). If there is more than 10 BA of hardwoods, then 25% of the BA 6 inches DBH and larger of hardwoods is thinned. For commercial conifers 12 DBH to Large Tree plus 7, a maximum of 28% of the BA for these trees is thinned using a diminution quotient of 1.2 on two-inch DBH classes, with a priority on the lowest live crown ratio trees. The harvest intensity is reduced if required to leave a minimum of 75 BA of conifers, or higher for habitat stands (see section III.B. below). Trees from Large Tree to Large Tree plus 7 are harvested 25% more, and white fir trees are harvested 30% more, compared to the overall percentage, while keeping the total intensity constant.

Twenty TPA, or 15 for eastside types, is added every 10 years after successful harvests, except for habitat stands which receive 13 TPA, or 10 TPA for eastside types. If a stand does not meet the minimum post-harvest BA requirements, then no harvest is applied. This treatment is repeated on average every 10 years, but actual entry cycle length may vary from 7 to 13 years.

Although group openings may amount to as much as 30% of harvest areas, most harvests contain less group openings as a percent of the total area. FORSEE does not have a provision to model group openings with selection. Both the growth calibration (as in Appendix A) and ingrowth settings (as in II.B.3) were developed with the assumption that there would be some group openings.

I.B.4.d. Selection on a 20-Year Entry. This treatment is the same as the Selection on a 10-Year Entry, except the maximum harvest is 56% instead of 28%, as described above, and 25 TPA, or 20 TPA eastside, is added as ingrowth every 20 years. This treatment is repeated on average every 20 years starting in either the first period or the second period, but actual entry cycle length may vary from 17 to 23 years.

I.B.4.e. Variable Density Selection. This treatment will be used on most of the ownership to represent both selection and group selection systems. Trees are removed individually or in small groups sized from .25 acres to 2.5 acres. Trees of different age classes are retained, and provision is made for adequate regeneration. Specifics

will be detailed in individual THPs. Post-harvest stocking standards shall meet or exceed standards in 14 CCR 933.2(a)(2).

For the computer simulation, harvests are conducted according to the following priority:

(1) If there is more than 10 BA of hardwoods, cut 50% of the BA of hardwoods 6 DBH and larger.
(2) Cut all merchantable conifers greater than or equal to Large Tree plus 7.
(3) Cut white fir trees greater than or equal to Large Tree.
(4) Thin other commercial conifers greater than or equal to Large Tree to Large Tree plus 7 leaving at least 20% BA of these trees.
(5) Cut white fir trees 12 DBH to Large Tree using a diminution quotient of 1.3 on two-inch DBH classes leaving a minimum of 30% of these trees.
(6) Cut other commercial conifers 12 DBH to Large Tree using a diminution quotient of 1.3 on two-inch DBH classes leaving the minimum requirements.

The modeled minimum post-harvest BA of all commercial conifers is 75, 100, or 125, and a minimum of 40 BA in commercial conifers greater than or equal to 12 DBH. If at any point the residual requirements are not met after harvest, the remaining steps are skipped, and the current harvest is adjusted to meet the post-harvest requirements. Forty ingrowth trees are added, or 30 for eastside types, after harvest. This treatment is repeated on average every 20 years, but actual entry cycle length may vary from 17 to 23 years.

Although group openings may amount to as much as 30% of harvest areas, most harvests contain less group openings as a percent of the total area. FORSEE does not have a provision to model group openings with selection. Both the growth calibration and ingrowth settings were developed with the assumption that there will be some group openings.

I.B.4.f. Reforestation. The current stands in the non-stocked timberland condition are converted to plantation in the first period. Stands transition to one of the eight plantation yield sets depending on its location, then are available to be clearcut after reaching 5 MBF/acre of volume, or for the variable density selection regime with thinning treatments in even or odd periods.

I.B.5. The Yield Table

A yield table is built from all the growth and yield projections for use with the harvest scheduler. The yield table includes the following: the stand number, several stand attributes, MBF inventory, MBF harvest, and financial metrics for each period. The yield table has one record (one line in the file) for each stand, each period, and each of the potential silvicultural treatments that could be applied to that stand. The stand attributes in the yield table are period mid-point values.

A simple growth projection is included in the yield table for all stands. It does not include any treatment or any ingrowth. This projection is not used often but is included in the yield table for the following purposes:

- For high conservation value forest types that receive no treatment
- For portions of stands that are clearcut that remain as habitat retention
- For any stand that is not harvested by the harvest scheduler (not common)

Because FORSEE growth equations were built from data on second growth managed forests it does not perform well for extended periods without harvests. For the grow-only projection the growth is calibrated downward when stands reach BA thresholds during simulation. If a stand basal area in any period is above 205 the growth is calibrated to 40% of normal growth, and to 20% of normal growth above 230. These calibration values result in stand volume per acre maximums that match our experience and expectations.

Stands are identified if they are within THP areas to be logged within the next two or three years, so that they are scheduled in the first period with the planned silviculture.

I.B.6. Future Plantations

Any stand or portion of a stand that is clearcut transitions to one of eight future plantation types depending on its location. Table 7 shows the planted species mix, planted trees per acre, base age 50 site index, and percent of ownership area for these eight future plantation types. All are assumed to be free of competing vegetation and optimally spaced. The CONIFERS growth model was used to grow these types for the first 30 years. CONIFERS tree tables are then re-formatted and simulated in FORSEE for the balance of the planning horizon.

Table 7. The planted species mix, planted trees per acre, base age 50 site index, and percent of ownership area.

	Percent by Species							Owner
Type	PP	SP	DF	WF	IC	TPA	SI 50	Pcnt
1	90%	0%	0%	5%	5%	135	58	17
2	85%	0%	0%	8%	8%	135	65	11
3	90%	0%	0%	5%	5%	135	79	5
4	55%	6%	24%	12%	4%	178	67	17
5	55%	4%	24%	12%	6%	178	80	27
6	55%	4%	24%	12%	6%	178	92	9
7	45%	4%	24%	24%	4%	178	87	6
8	48%	4%	4%	31%	13%	167	83	8

These yields will be achieved through high standards for reforestation. W. M. Beaty & Associates maintains a reforestation forester position responsible for new plantation establishment. This position carries the Pest Control Advisor License, obtains continuing education, and provides site and time specific treatment recommendations. Modern best practices in vegetation control, planting, seed stock, and spacing control are used to re-establish diverse, healthy, and vigorous forests. Improved seed stock is used where available along with cone collection for locally adapted seed.

There are three yield sets built for each plantation type. The first is a grow only projection, which is the same as that described in Section I.B.5, except that there is a commercial thinning at age 45, reducing BA to 75. The other two projections are Variable Density Selection treatments as described above, with the post-harvest residual density set at 75 BA in either even or odd periods.

I.B.7. California Wildlife Habitat Relationship (CWHR)

CWHR types (Mayer and Laudenslayer 1988) are computed and tracked for each stand and each period by FORSEE and CONIFERS. The FORSEE CWHR calculations are based on the program developed by Greenwood and Eng (Greenwood and Eng 1993). All Ponderosa Pine cover types are changed to Eastside Pine (EPN) if the stand average precipitation is less than 35 inches or if the area is clearly within the geographic boundaries for EPN. All mixed conifer cover types are Sierra Mixed Conifer (SMC).

I.C. Harvest Scheduling

I.C.1. Woodstock

The Woodstock program from Remsoft Spatial Planning System (version 2022.01. Copyright Remsoft Inc. 1993-2015, www.Remsoft.com) is used to keep track of how and when to harvest stands or portions of stands in each period. An optimizing linear programming model is designed within Woodstock with the objective of maximizing harvest volume in all periods. There are limits to the model's ability to optimize, however, due to the limited silvicultural options for each stand and the various constraints specified in the model.

At the start of execution, Woodstock will schedule all pre-planned activities that are loaded into the "LpSchedule" file. This file contains a list of stands with the first period planned action (treatment). To schedule clearcuts within current THPs and other areas that have a higher likelihood of being clearcut, several stands are pre-selected for

clearcut in period one. The LpSchedule file also contains listings for 20-year selection entry stands in geographic proximity to each other, scheduled to start in either the first or second period, so that the resulting schedule is grouped into operational areas.

Next the model will continue scheduling harvesting actions in each period subject to the constraints, such as operability limits. Operability limits use landscape themes, which are codes that give each stand an identity and provide control for several functions within Woodstock. The four themes are as follows:

- Theme 1: a code for the yield set containing the silvicultural treatment projection.
- Theme 2: the operability code holding the type of stand and its treatment options.
- Theme 3: the future plantation type
- Theme 4: the stand number

Operability limits use Theme 2 to control the treatment options that are available to each stand or portion of a stand. Another operability constraint is that stands must have at least 5 MBF per acre to be clearcut. Theme 3 directs Woodstock to transition acres to a new plantation type after clearcut. After a clearcut 95% of the acres are transitioned to one of the three possible new plantation yield sets as described in Section I.B.6. Five percent of the acres remains as the current type and no harvest is allowed for five periods.

Model constraints are ownership-wide, model-wide limits, and include a non-declining inventory, even flow (with a given variance allowed) of total harvest volume, and even flow (with variance) and maximum limit on clearcut acres. Table 8 shows the number of stands and acres associated with wildlife constrained stands.

Table 8. The number of stand polygons and acres with minimum post-harvest retention requirements.

Harvest Constraint	Num. Stands	Acres
Maintain a minimum of 80 sq. ft. BA/acre	26	967
Maintain a minimum of 100 sq. ft. BA/acre	2	149
Maintain a minimum of 120 sq. ft. BA/acre	7	1,325
Maintain a minimum of 150 sq. ft. BA/acre	4	421
No harvest - High Conservation Value	4	217

I.D. Timber Assessment Results

As shown in Figures 2, 3, and 4, harvest scheduling results indicate a forest with increasing density over time as indicated by average BA, QMD, and volume. While foresters are aggressively trying to lower densities through the harvests of stocked timberland in anticipation of warmer and dryer conditions in the future, the overall conditions show increasing density due to the growth of the many plantations. The values in Figure 4 are based on the before harvest condition at the period midpoint.

Figure 2. Average ownership-wide basal area per acre over time.

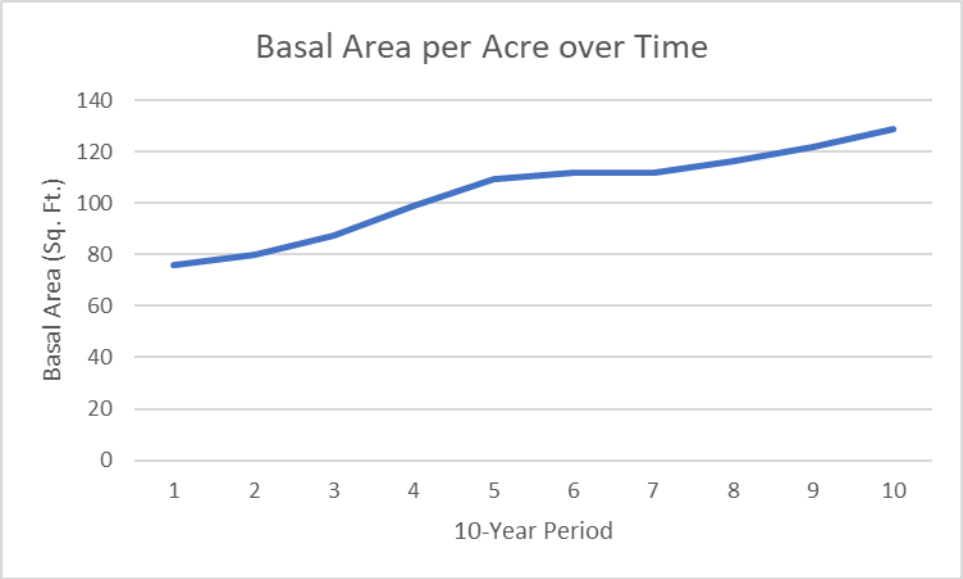


Figure 3. Average ownership-wide quadratic mean diameter over time.

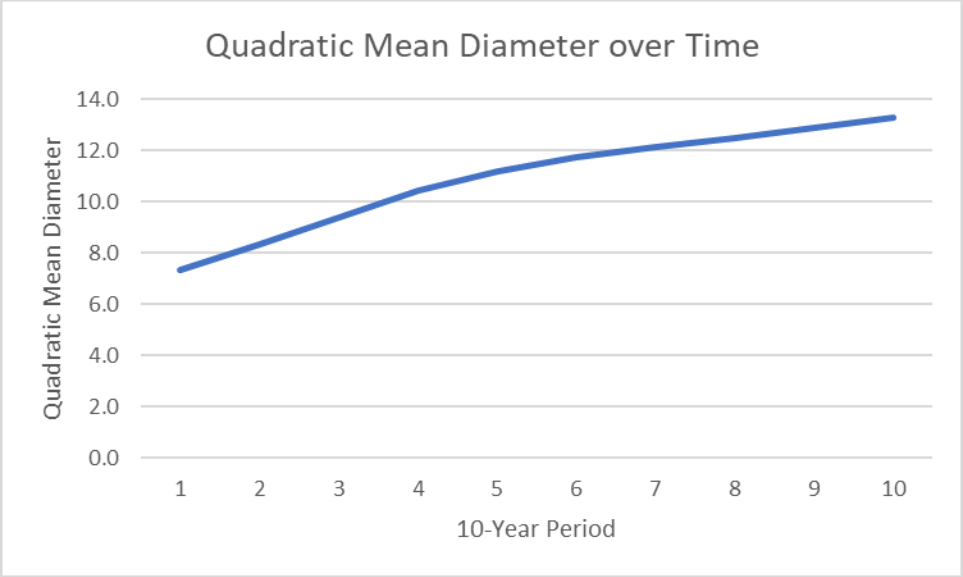
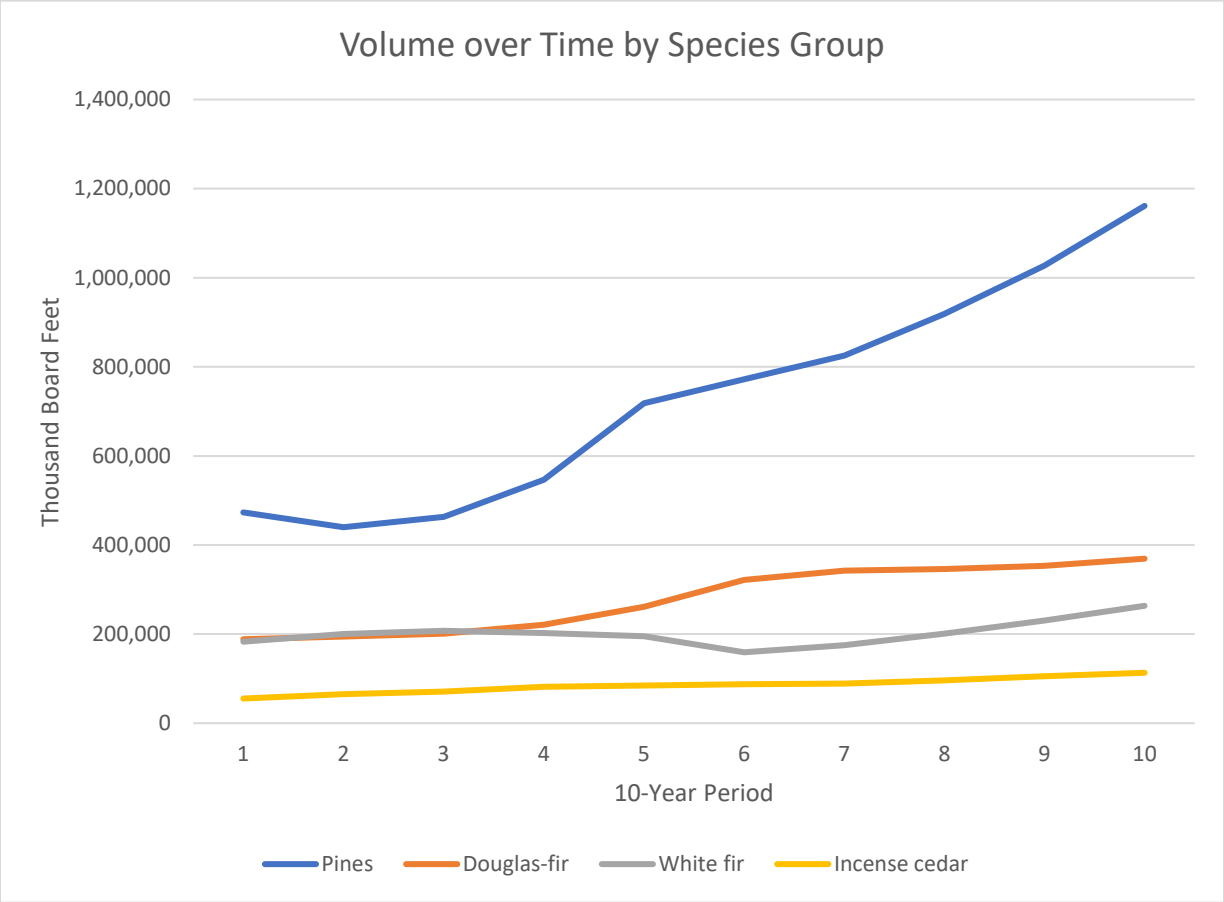


Figure 4. Standing inventory levels for pine species, Douglas-fir, white fir, and incense cedar over time.



Tables 9 and 10 show volume and acres by silvicultural group and period for the ownership. Total inventory is 900,372 MBF prior to activities at the midpoint of the first period, is relatively stable for the first 3 10-year periods and increases steadily thereafter as the plantations mature. The long-term sustained yield will be achieved by implementing the spirit of this model. Foresters will proceed in a workmanlike manner to meet or exceed the harvest and growth, forest health, and regeneration levels that are assumed in this model.

Table 9. Thousand board foot harvest volume by silvicultural treatment category and 10-year period.

Silviculture	1	2	3	4	5	6	7	8	9	10
Selection	227,934	228,706	223,524	197,406	299,276	330,118	337,602	330,517	334,204	333,132
Clearcut	40,137	39,364	44,546	71,771	83,681	52,839	45,356	52,440	48,754	49,825
Total Harvest	268,070	268,070	268,070	269,177	382,957	382,957	382,957	382,957	382,957	382,957

Table 10. Acres treated by silvicultural category and 10-year period.

Silviculture	1	2	3	4	5	6	7	8	9	10
Selection	39,755	34,682	41,880	39,137	56,071	68,494	55,605	51,074	52,525	48,765
Clearcut	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Reforestation	20,595	0	0	0	0	0	0	0	0	0

II. Consideration of Other Forest Values

Foresters shall select silvicultural systems, operating methods, and procedures which substantially lessen significant adverse impacts on the environment, and which best achieve long-term, maximum sustained production of forest products. This shall be done while protecting soil, air, fish and wildlife, and water resources from unreasonable degradation, and which evaluate and make allowance for values relating to range and forage resources, recreation and aesthetics, and regional economic vitality and employment.

II.A. Habitat Types and Elements

A wide variety of California Wildlife Habitat Relationship System (CWHR) diameter and crown closure classes are present creating a mosaic of habitat types within the RRF ownership. Because the ownership has been previously harvested under both uneven-aged and even-aged silviculture and subject to several large stand replacing wildfires, the variability of tree sizes within individual habitat types and across the landscape is high. However, the variability between habitat types across the ownership is lower than it would be in a fully regulated even-aged forest. Most of the habitat types are CWHR size class 3 and 4 with open to moderate crown closure. Although the average DBH in most types is between 10 and 26 inches, there is a wide range (from sapling to ≥40-inch DBH) of individual tree sizes within most types.

In addition to retaining a mosaic of habitat types across the ownership, specific measures are implemented as part of THPs to retain important wildlife habitat elements within habitat types. Specifically, wildlife habitat elements are retained through: Species-Specific Habitat Types (Section III.B.), Watercourse and Lake Protection Zones (Section III.C.), Limited or No Harvest Areas (Section III.D.), Large and Wildlife Trees (Section III.F.), Snags and Large Woody Debris (Section III.G.) and Hardwoods (Section III.H.).

II.B. Species Specific Habitat Types

Several federal or state listed, Board of Forestry sensitive, Fish and Game Code fully protected, rare or non-listed species occur within the RRF ownership. Due to their status under federal or state laws or regulations, retention of species-specific habitat has been retained in previous RRF THPs and will be retained in future RRF THPs. Projections in the model have been constrained for the entire inventory stand where the species is represented to take into consideration these species-specific habitat types that are retained within THPs. To-date, a total of 43 inventory stands comprised of 3,079 acres have been identified by RPFs or WBA wildlife biologist(s). The post-harvest species-specific habitat retention in THPs is tailored as follows:

(1) Legal status as either as federal or state listed, state candidate, sensitive, fully protected, rare or non-listed (FGC 3503.5) and,
(2) Suitable habitat associations or tolerance to disturbance from forest management activities and,
(3) Suitable habitat conditions and species occurrence at the specific site.

II.B.1 Federal or state listed, state candidate, sensitive or fully protected

Active Wildlife Site

These wildlife sites have been determined to be active based on direct observation of the RPF, the RPF designee, a wildlife biologist or detected using a remote camera or acoustic station. Also, at a minimum, a site may be determined to be active as defined under 14 CCR 895.1, Active Nest or continue to be active based on recommendations by either California Department of Fish and Wildlife (CDFW) or U.S. Fish and Wildlife Service (USFWS). Post-harvest habitat retention and disturbance measures for these species typically includes a: (1) No harvest site zone, (2) Limited harvest core area and (3) Critical period area (14 CCR 939.2, 939.3). The size of each of these zones or areas can vary by species, suitable habitat associations, site-specific habitat and tract level habitat conditions. These zones or areas are developed in consultation with either CDFW or USFWS and either proposed in the initial THP or amended into the THP. At a minimum, the den or nest site and all screening trees,

perch trees, and replacement trees shall be left standing (14 CCR 939.2(d)) and all snags within these sites shall be left standing (14 CCR § 939.1).

Species-specific suitable habitat has been previously retained in RRF THPs for these federal or state listed, candidate, sensitive and fully protected species including: Northern spotted owl, Northern goshawk, bald eagle, Cascades frog, Sierra Nevada yellow-legged frog and foothill yellow-legged frog. Each site or habitat zone has been assigned a minimum basal area (BA) retention that provides either suitable denning, nesting or foraging habitat for the species that may not be otherwise retained within a mosaic of habitats at the tract scale. Previously, these values ranged from 80 BA up to 150 BA. Since future species-specific habitat stands are unknown and predicting new sensitive species is speculative, future species-specific habitat stands will be described in individual THPs. For the purposes of estimating projections in the model, these inventory stands are treated in the model with a less aggressive selection harvest, retaining larger trees, and are not harvested to less than the preferred BA post-harvest retention described in this Section.

Historical or Currently Inactive Wildlife Site

These wildlife sites have been determined to be historical or inactive based on either lack of direct observations, a significant change in habitat has occurred since original use (e.g. nest tree has been blown down), or the site may be determined to be inactive as defined under 14 CCR 895.1, Active Nest or based on recommendations by either California Department of Fish and Wildlife (CDFW) or U.S. Fish and Wildlife Service (USFWS). Even if the site is determined to be historical or inactive, at no time shall the original den or nest site or any trees containing raptor nests be harvested.

II.B.2 Rare or Non-listed species

Active Wildlife Site

These wildlife sites have been determined to be active based on direct observation of the RPF, the RPF designee, a wildlife biologist or detected using a remote camera or acoustic station. Non-listed species den or nest sites shall be tailored to suitable habitat associations, tolerance to disturbance from forest management activities and species occurrence at the site. The species-specific habitat retention shall be designed by the RPF or a designee in consultation with a wildlife biologist to avoid or minimize potential effects of timber operations on the den or nest site. At a minimum, the den or nest site and all screening trees, perch trees, and replacement trees shall be left standing (14 CCR 939.2(d)) and all snags within these sites shall be left standing (14 CCR § 939.1). Additional post-harvest habitat retention and disturbance measures for these species may also include, depending on the species habitat associations, tolerance to disturbance and occurrence at the site; (1) No harvest site zone, (2) Limited harvest core area and (3) Critical period area. These retention areas are either proposed in the initial THP or amended into the THP.

Species-specific suitable habitat has been previously retained in RRF THPs for these rare or non-listed species including California spotted owl, barred owl, great horned owl, Cooper's hawk, sharp-shinned hawk, and red-tailed hawk. Each site or habitat area has been assigned a minimum basal area (BA) retention that provides either suitable denning, nesting or foraging habitat for the species that may not be otherwise retained within a mosaic of habitats at the tract scale. Previously these values ranged from 80 BA up to 120 BA.

Due to the wide range of suitable habitat conditions and relatively small spatial areas of rare or sensitive plant sites, these sites will be addressed in individual THPs. Typically, rare or native plant sites are conserved following one of the following measures: (1) The site boundary shall be flagged as an Equipment Limitation Zone where operations shall occur following the blooming period or, (2) The site boundary shall be flagged as an Equipment Exclusion Zone or, (3) The site boundary shall be flagged and no operations shall occur within the boundary and a 50 foot Equipment Limitation Zone outside the boundary where operation shall occur following the blooming

period. Due to the ability to work around these site boundaries and seasonal restrictions, there are no significant limits on productivity.

Historical or Currently Inactive Wildlife Site

These wildlife sites have been determined to be historical or inactive based on either lack of direct observations or a significant change in habitat has occurred since original use (e.g. nest tree has been blown down). Even if the site is determined to be historical or inactive, at no time shall the original den or nest site or any trees containing raptor nests be harvested.

II.C. Watercourse and Lake Protection Zones

Projections in this model have been constrained to estimate productivity losses for the protection of Class I and II watercourse and lake protection zones (WLPZ). This is primarily achieved by reducing the acres within GIS buffer zones along these WLPZs as specified in Section I.A.1. This is a straight acreage reduction to those affected stands and amounts to additional acreage outside of HCVF stands mentioned in the following Section II.D. This area reduction is an estimate for inventory and modeling purposes and is not intended for THP development or proposed THP measures. Specific WLPZ locations and protection measures will be detailed in individual THPs.

II.D. Limited or No Harvests within Forested Areas

Projections in this model have also been constrained for 52 High Conservation Value Forests (HCVF) stands with 1,870 acres of RRF ownership that will not be logged or will have limited individual tree removals. HCVF's are stands identified to meet requirements in the Forest Stewardship Council's (FSC) Pacific Coast Standards. HCVF stands are defined by the FSC standard as forests that contain environmental and social values of outstanding significance or critical importance at either a local or national level. Shasta Forests Timberlands LLC. has been annually third-party audited by Scientific Certification Services (SCS) to ensure that the RRF ownership is meeting the FSC standards including identification and conservation of HCVF stands.

HCVFs are generally within and along some of the Class I watercourse zones, in seasonally wet areas, are economically infeasible to harvest, and/or are in areas that are incompatible with harvesting operations. In the model, these stands are included in the inventory and growth projection, but they are not harvested. Any limited harvesting that may occur in HCVF stands will not significantly change the projections. This harvesting is likely balanced to some degree by areas within regularly harvested stands that have small site-specific, no-harvest areas.

II.E. Non-Forest Areas

As described in Section I, there are 13,737 acres that have been typed as non-forest. These acres are not included in the model. They include rock or barren outcrops, wet meadows, lakes or large ponds, grassland, brush, hardwood or non-commercial conifer areas, and industrial areas. These non-forest areas are important habitat types to many mammals, birds, amphibians, fish, and native plants. Some of these areas may be included in individual THPs for skid or haul roads, operational areas, or for small areas of harvesting such as aspen, meadow, or wet area restoration. When these important habitat types are included within the boundary of individual THPs, site-specific measures are proposed in the THP to ensure that no potential significant adverse impacts occur to species using these habitats.

II.F. Large and Wildlife Trees

Large and wildlife trees are important habitat structural elements within forested stands. Large trees are retained within the RRF ownership through five primary methods: (1) FSC certification legacy trees, (2) Large trees developed in WLPZ's (Section II.C), (3) HCVF's (Section II.D.), (4) Retention of non-merchantable trees greater than 16 inch DBH and less than 25% sound merchantable wood and, (5) Species-specific habitat types (Section II.B). The FSC certification requires retention of legacy trees which are defined in the FSC standard as a mature or old growth tree that provides a biological legacy. Legacy trees are painted, flagged and metal tagged for retention and entered into a GIS geodatabase. Large trees that are found within WLPZ's, HCVF's and species-specific habitat

types may be painted with a "W" or identified using metal tree signs. In addition, wildlife trees that may display habitat structural elements important to wildlife, like but not limited to, existing or alternate nest structures, cavities, basal hollows, large horizontal branches, or mistletoe platforms are retained with a painted "W" or identified using a metal tree sign.

Criteria used for selecting large or wildlife trees is discussed during annual field training conducted by and with foresters and wildlife biologists. Both large trees and wildlife trees have been and are tracked in the inventory when they occur within inventory plots. These trees are not included in the data sets used in this analysis.

II.G. Snags and Large Woody Debris

Complex forest structures like snags, green culls and large woody debris (LWD) (e.g. fallen logs, stumps, root wads) serve a variety of important forest ecosystem functions. Functions include nutrient cycling, substrate for fungal, mycorrhiza populations, use as breeding and foraging habitat for many species of vertebrate wildlife, and habitat for many invertebrates, which serve as prey for wildlife species. Criteria or methods used for retaining complex forest structures are discussed during annual field training conducted by and with foresters and wildlife biologists. To continue to maintain and enhance snags and green cull trees on RRF ownership a series of guidelines are followed using site-specific information during THP preparation:

(1) Tract level data collected within inventory plots is used to evaluate current snag and green culls. Snags and green culls will continue to be sampled in the on-going inventory cruises.

(2) All green cull trees or snags that do not contain at least 25% sound wood volume and do not pose a safety risk or a potential hindrance to future access for initial attack of wildfire will be retained.

(3) The tract level goal is to maintain 3.0 snags per acre on CWHR types with size class 3 and larger, and of these 0.5 snags per acre should be greater than or equal to 20-inch DBH, 0.25 snags per acre from greater than or equal to 24-inch DBH, and 0.1 snags per acre greater than or equal to 30-inch DBH.

(4) For tracts falling below these goals, specific measures will include:

(a) A reduction in the intensity of sanitation/salvage operations and,

(b) Specific retention of appropriately sized trees that are likely to become snags within the next 10 years, with an emphasis on retaining and recruiting snags in the largest diameters and,

(c) Prohibition of falling snags under firewood permits.

To continue to maintain and enhance large woody debris on RRF ownership a series of guidelines are followed using site-specific information during THP preparation:

(1) Tract level data collected within inventory plots is used to evaluate current LWD. Large woody debris will continue to be sampled in the on-going inventory cruises.

(2) All LWD that do not contain at least 25% sound wood volume and do not pose a safety risk or a potential hindrance to future access for initial attack of wildfire will be retained.

(3) Based on site-specific evaluation, LTO may be instructed to leave all LWD in place during all harvesting and site-preparation operations.

(4) The tract level goal is to maintain 1 to 2 pieces of LWD per acre at least 10 inches in diameter and 10 feet long. This retention should focus within CWHR types with size class 3 and larger.

II.H. Hardwoods

Native hardwoods occur as a minor component of forested stands within many of the lower and middle elevations of the ownership. Since these hardwoods occur within forested stands, projections in this model have also been constrained by the retention of hardwoods within forested stands. Hardwoods consist of a few primary species including black oak, canyon live oak, big leaf maple, various willows, quaking aspen, alder, and cottonwood. Mature hardwoods provide valuable wildlife habitat elements for many species of wildlife. These hardwoods

provide structures, broken top trees, cavities and basal hollows that serve as breeding and denning site. Also, hardwoods provide important forage for wildlife in the form of mast or acorns.

Currently, there is a limited amount of hardwood removal by commercial and non-commercial firewood cutters. Other than firewood there have been no markets for hardwoods for the past 25 years, and none are anticipated in the future. Due to the importance of hardwoods diameter, height, and crown data on all hardwoods is collected during the on-going cruises and is maintained in the inventory. The growth of hardwood trees is projected along with conifers in both the FORSEE and CONIFERS growth models. However, there is no volume assigned to hardwoods. In the timber assessment model harvesting of hardwood occurs at a lower intensity than conifers, as detailed in Section I.B.4. The relative composition of hardwoods to conifers does not significantly change during the planning horizon, as evidenced by predicted CWHR types. To continue to maintain and enhance hardwoods on RRF ownership a series of guidelines are followed using site-specific information during THP preparation:

(1) Landscape level data collected within inventory plots is used to evaluate current hardwoods. Hardwoods will continue to be sampled in the on-going inventory cruises.
(2) Hardwoods are generally not harvested during uneven-aged harvests. In forested stands with significant amounts of hardwoods, the RPF and wildlife biologist will review the hardwood distribution and density and propose a more aggressive site-specific treatment of hardwoods in the THP, if necessary. As an example, if hardwoods occur in densities high enough to preclude forest conifer management, a representative sample (usually around 10-20% of the original hardwoods) are individually marked for retention and would be proposed in the THP.
(3) In THPs that are harvested using even-aged methods, mature oaks are specifically retained for wildlife habitat. These oaks will be retained as part of variable retention methods (Section I.B.4.a.1).
(4) Hardwoods specifically retained within both uneven-aged and even-aged harvests will also be retained during post-harvest site preparation and vegetation control management activities.

II.I. Regional Economic Vitality

As demonstrated in this assessment, timber yields are consistent and sustainable. The supply of timber resources provides the raw materials for sustaining the health of the local and regional economies that are dependent on the timber industry. These raw materials provide for employment in the logging, trucking, milling, retail sales, and other associated industries that provide the commercial infrastructure and economic stability for the local and regional communities. Economic vitality in these rural communities also provides incentives for investment from other sources. In addition, federal, state and local tax receipts generated from income tax revenues, payroll taxes, State Board of Equalization timber yield taxes, property taxes, and retail sales taxes are enhanced.

WBA employs approximately 30 permanent and seasonal employees. In the performance of their management duties, equipment, supplies, vehicles, and services are purchased locally. WBA supports local communities through annual financial contributions to many organizations and associations. Many employees are involved and dedicate both time and finances to professional and community-related projects and organizations.

II.J. Other Forest Values

The protection of other forest values such as range, forage, aesthetics, recreational enjoyment, and archaeological resources is an important objective of RRF. These values have existed along with selection harvesting on RRF for many years. There are no limits to productivity beyond the existing constraints in the model.

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Appendix A. 2020 Growth Study Results

Table A1 is a list of permanent growth plot clusters that were used to assess tree growth. The plot clusters are also shown on the map Figure A1. The table shows the cluster name, tract, site quality, number of trees measured, the year of the previous measurement, the year of the re-measurement, and the total growth years.

For each tree in the growth plot database that was alive at both the original measurement and the re-measurement, several attributes are tracked, and a comparison is made for diameter and height between actual growth and modeled growth in FORSEE. A calculated ratio of means is used as a way of estimating calibration factors. This process is considered non-biased for growth model calibration (Dr. Bruce Krumland, personal communication and private write-up with statistical results and graphs. The write-up is available upon request.). The ratio of means is calculated as: sum (GD2)/sum (GFD2) for diameter and sum (GH)/sum (GFH) for height, where:

- GD2 = Annualized difference between the actual (measured) squared diameter and the initial squared diameter.
- GFD2 = Annualized difference between the modeled (FORSEE) squared diameter and the initial squared diameter.
- GH = Annualized difference between the actual total height and the initial total height.
- GFH = Annualized difference between the modeled total height and the initial total height.

The ratio of means is observed across tracts, species, and site quality, as shown in tables A2 through A4. Not enough data was available to make comparisons beyond tract or species or site quality. Many of the calculated values show poor growth results. However, there are several reasons for 'tempering' these results, including:

- Relatively small sample size. The total number of growth plot trees is less than 1% of the trees in the inventory database. Some forest types are not sampled at all.
- These results are lower than several previous calibration and growth analyses.
- The drought conditions in the years 2012 through 2015, and in many of the last two decades is in these results compared to different conditions for CACTOS data. Drought is expected in future years (AghaKouchak 2014, Diffenbaugh 2015), but the magnitude and duration are not yet clearly known, and some have suggested improved growth with increased carbon in the air, longer growing season, and rainfall.
- The future use of group openings is expected to increase to meet regeneration goals, and growth within and on the edge of group openings is increased (Blodgett studies).

As a result of this study, the calibration factors were lowered to 90% of actual diameter growth and 90% of actual height growth for all stands in all growth runs. In addition, stand site index was lowered for all areas for SP and DF, and site index was reduced by a value of 3 for low site areas including the Cheney Creek Tract, the Harvey Tract, and northeast portion (units 29 through 32) of the Jimmerson Tract (39% of the tract).

Table A1. List of plot clusters used in this growth study.

Cluster	Tract	Site	Trees	From	To	Years
1011076	Shasta	High	27	2004	2019	15
1011079	Shasta	Med/low	14	2004	2019	15
1021149	Shasta	Med/low	25	2004	2019	15
1021297	Shasta	Med/low	89	2004	2019	15
1111058	Pondosa	Med/low	100	2001	2015	14
1111212	Pondosa	Med/low	29	2004	2019	15
1111299	Pondosa	Med/high	12	2004	2019	15
1121028	Pondosa	High	11	2004	2019	15
1311006	Jimmerson	Med/low	11	2004	2019	15
1311027	Jimmerson	Med/low	21	2004	2019	15
1311183	Jimmerson	Low	28	1998	2015	17
1651047	Susanville	Low	82	1999	2015	16
1711016	Brush Hill	Med/low	44	2009	2019	10
1711106	Brush Hill	Med/high	41	2009	2019	10
1911133	Cheney Creek	Low	58	2010	2019	9
1911210	Cheney Creek	Low	73	2011	2019	8
2011006	Moonlight	Med/low	149	2011	2019	8

Table A2. Calculated ratio of means (Brm) for diameter and height by Tract.

Tract	Trees	DBH Cal	Ht Cal
Brush Hill	85	0.99	0.66
Cheney Creek	275	0.62	0.76
Jimmerson	58	0.71	0.76
Moonlight	149	0.92	0.88
Pondosa	147	0.88	0.85
Shasta	151	1.02	0.79

Table A3. Calculated ratio of means (Brm) for diameter and height by species.

Species	Trees	DBH Cal	Ht Cal
DF	113	0.80	0.65
IC	87	0.82	0.90
JP	124	0.73	0.70
PP	340	0.82	0.88
SP	42	0.90	0.71
WF	159	1.03	0.74

Table A4. Calculated ratio of means (Brm) for diameter and height by site class.

Site Class	Trees	DBH Cal	Ht Cal
High	38	1.23	1.07
Med/high	52	0.93	0.61
Med/low	473	0.93	0.79
Low	302	0.63	0.77

Mortality was also tracked. As expected, and largely driven by the drought years, actual mortality tracked in the growth plots (approximately 7.5% of trees) outpaced FORSEE modeled mortality (5.5% of trees). The sample size for mortality is small and variable. There was no recognizable pattern of difference among species, tracts, or tree size.

Plantation growth was also studied. This was a much easier task as each plantation age was known, and sampling has occurred on all plantations after the age of 15. These results can be seen by looking at the statistical attributes (BA, volume, etc) versus the stand age. However, great variation is observed in situations where residual trees were left from the previous stand, or in situations where brush and/or natural seeding of hardwood and conifer trees has occurred.

Plantations grow much faster than natural stands in general. FORSEE's underestimated growth of plantations is well known. With the increased site index of these stands (section II.A.6) these underestimates are less significant.

Figure A1. Map showing growth plot cluster locations.