Appendix B-1: Modeling Outputs and Effects

B-1.1. Introduction

Essentially the same modeling and analysis systems used in the FEIS were used for the SEIS. Therefore, this appendix will only describe items that were different from those used to produce the Final EIS for SNFPA and the reader can find a more detail description of the techniques and assumptions in Appendix B of the FEIS. This analysis, like that used in FEIS, was based on a multi-scale and hierarchical modeling approach to analyze the various alternatives developed by the interdisciplinary team. This analysis differs from the FEIS, in that it was supplemented by 2 large-scale landscape analyses to test a number of assumptions at scales smaller than the National Forest.

The analysis was accomplished by using a suite of different GIS, optimization, visualization, and simulation models to project how the national forests within the Sierra Nevada Framework region would respond to different disturbances and management events. Due to the complexity and magnitude of this project, the use of multiple models and development of a decision support system was required to integrate these processes.

The analysis uses data from forest inventory plots, GIS-based resource inventories, vegetative simulation models, fire simulation and effect models, operations research decision analysis techniques, and mapping and data visualization tools to support decision-making. Vegetative prescriptions, management activities, and disturbances events are assigned to specific types of land areas (allocations), and the resulting effects on forest outputs and environmental consequences including vegetation structure, wildlife suitability, and fuel conditions are evaluated.

Results from the modeling effort are only approximations of the outcomes under any given alternative. The limitations inherent in mathematical approximations of reality must be considered when analyzing the outputs and effects projected by these models. Once the EIS models were formulated, a number of sensitivity tests were made to check for validity, “reasonableness,” and to make calibrations to coefficients whose development was not based on empirical data or where development of coefficients was not exactly straightforward. This was done through an iterative process involving all of the ID Team members, key management members, and those responsible for developing the component models. The models used were not intended by their developers to provide precise information, especially over the geographic scale and time frame encompassed by the SNFPA, but rather to provide indication of direction of change, estimates of the magnitude of change, and time frames surrounding such change.

The analysis process was based on close integration of GIS and forest inventory data with traditional vegetative growth and yield modeling which allowed users to:

- define spatially explicit management allocations, treatments, constraints (S&Gs), and priority units using GIS technology,
- link these management units to forest inventory information,
- simulate and evaluate hundreds of thousands of possible management activities, while tracking over 50 resource variables through time,
- provide insight on policy or management alternatives with different sets of desired future conditions and standards and guides,

- select an “optimal mix” of treatments to achieve a balance among a broad range of often conflicting management goals and desired future conditions,
- evaluate alternative management strategies using sophisticated simulation, mapping, reporting, and data visualization or rendering tools,
- links various resource data and models into an integrated system, enabling analysis of both terrestrial and aquatic ecosystems, and
- declare spatially explicit delineation where land management activities and resource protection measures will be meaningful.

The purpose of these models is to provide insight and clarify knowledge. In many cases, these approximations are fully adequate to compare alternative strategies or reject those that are not feasible or reasonable. A choice between alternatives can be made even though the models may lack the precision to describe the behavior of specific attributes of a given alternative. In other words, the models reveal relative differences between alternatives more reliably than absolute differences.

B-1.2. Changes in Analysis, Assumptions, and Input Data

The modeling effort for the SEIS is slightly different than that used in the FEIS, primarily for two reasons. First, updated information is available for use in the SEIS. This includes the following:

- Three new forest inventories were used to update the Eldorado, Tahoe, and Plumas National Forests statistics. These updates included new vegetative type maps and new FIA inventory plots used to describe the mapping units.
- Each of the national forests within the bioregion updated the Great Gray Owl, Spotted Owl, and Goshawk Protected Activity Center [PAC’s] and home range core areas maps. These updates and refinement of boundaries are consistent with direction and definitions found in the ROD.
- Each of the national forests within the bioregion provided updated Wildland Urban Intermix [WUI] maps. These refinements are subject to further adjustment over time.
- Maps were updated to reflect that status of projects to be completed in the HFQLG Pilot Project Area.

Second, there have been changes in the way certain effects have been analyzed. This includes the following changes in assumptions used to model effects and consequences:

- The mapped representation of strategically placed area treatments was revised. In the FEIS, treatments were located in the upper 2/3 of slopes on south facing aspects. Treatment areas in the SEIS were modeled to more closely represent the herringbone pattern that underlies the “Finney” effect described in chapter 2. Through intensive fire and watershed analysis on Consumnes Watershed of the Eldorado National Forests and Kings River on the Sierra National Forest, it was found that pattern define in FEIS did not produce the desired outcomes and that a more efficient approach was needed from a fire fuels perspective. A pattern more evenly distributed over the landscape was found to be more efficient when model with FARSITE and FLAMMAP fire simulation models.
- The detailed watershed analysis described above was also used to update the fire effects coefficients in the region-wide models. Watershed analysis shows that units can be designed to retain fidelity to Finney strategy and avoid intersection with California spotted owl protected activity centers (PACs), except in areas where PACs are highly concentrated. These and other findings were used to develop coefficients that describe the related effects and effectiveness of different layout strategies and treatment intensities.

- Cost and Values derived from fuel treatment such as treatment cost and values derived from timber and biomass were updated to reflect current conditions.

B-1.3. Modeling of Alternatives

Estimates of effects are based on modeling using two complementary processes. First, the land allocations were mapped and an allowable range of prescriptions for each land allocation was developed with input from the project interdisciplinary team. Second, outputs from the combined prescription data and vegetation inventory were simulated through vegetative growth models to project changes in vegetation over time in a non-spatial manner. Outputs and treatments cannot be directly tied to specific acres on the ground for two reasons. First, the analysis includes the effects from future projected disturbances such as wildfire which cannot be predicted to occur on a specific acre, and second, the Forest Service planning process reserves to the project level planning the decision where and when specific acres will be treated. As a proxy for implementation, the model assigns a given level of treatments to a representative area to test whether the treatment can be accomplished within the constraints imposed by the standards and guidelines of the management alternative. If the activity can occur, the associated costs, revenues and outputs can be estimated along with changes in some components of habitat.

Potential outputs were generated by the use of scheduling models such as SPECTRUM or FELDSPAR. The table below shows generic prescriptions that are permitted on different land allocations used in this analysis. The following modeling rules apply to the table below.

- For each alternative, each land allocation has an associated prescription.
- The prescriptions are listed by number and any **lower** number prescriptions are permitted with some specific exceptions, as noted.
- A particular land area may be overlapped by several land allocations. When overlapping allocations occur, the lowest numbered prescription in all prescriptions sets applies and prescriptions with lower numbers are allowed.
- There are exceptions to this general rule where specific allocations mandate a higher level of treatment. For example, the defense zone overrides almost all other land allocations.
- Overrides only apply to code of equal to higher than the lowest code in the intersection set. If the specific area intersects an allocation with lower code than in the exception set, then the lower code applies.

Spatial modeling of the alternatives was conducted with ARC-INFO GIS software, with seamless resource and administrative layers across the Sierra Nevada region. Most of the analysis was conducted with GRID layers at a 30-meter pixel resolution. The development and meta-data documentation of the individual layers used for alternative modeling and consequences analysis are provided in detail in digital form in the project file as part of the planning record. A more detailed, technical description of the automated analysis process can be found in the administrative record of the FEIS. Essentially the same process was used for the SEIS.

Table B-1.3a. Maximum Permissive Prescription Modeled by Land Allocation or Zone.

Note: The Table below reflect the allocation of Prescriptions that are "PERMISSIVE" on different land allocation based on S&G's and DFC's or Intents. The prescription are code in a hierarchly manner to represent the most intensive Rx permitted on given acre of lands. Prescription with codes which are less are also permitted. Therefore, Rx's can cascade down to less intensive but not up to more intensive for a give land allocation or condition.

Data Layers, Grids, Coverages, etc.		S2-PROPOSAL							S1-ROD						
		HFQLG GRP SEL	HFQLG DFPZ	DEFENSE ZONE	TREAT ZONE SPLAT	WILDLAND SPLAT	AREA TREAT	Others	HFQLG GRP SEL	HFQLG DFPZ	DEFENSE ZONE	TREAT ZONE SPLAT	WILDLAND SPLAT	AREA TREAT	Others
Basic Treatment Zones								99							99
Group Selection [HFQLG ONLY]	int	75							75						
DFPZ's	int		71							40					
Defense Zone -WUI	int			73							50				
SPLAT's															
Threat Zone	int				63							40			
Wildlands	int					63							40		
Area Treatments															
Area Treatments	int						51							N/A	
Vegetative Type-Condition															
Non-Forested Types	=	n/a	01	01	01	01	01	01	01	01	01	01	01	01	01
Grasses	=	n/a	01	01	01	01	01	01	01	01	01	01	01	01	01
Plantations	=	n/a	15	15	15	15	15	15	01	15	15	15	15	15	15
Brush-Shrubs & slopes <=35%	=	n/a	17	17	17	17	17	17	01	17	17	17	17	17	17
Brush-Shrubs & slopes >35%		n/a	16	16	16	16	16	16	01	16	16	16	16	16	16
Eastside Pine Type and CWHR 4m,4d,5m,5d, or 6	=				65	65	65	65							
CWHR's in other than Eastside Pine	=														
4m cc 40-50%	=									27		27	27	27	27
4m cc 50-60%	=				61	61	61	61		27		27	27	27	27
4d	=									40		40	40	40	40
5m cc 40-50%	=									27		27	27	27	27
5m cc 50-60%	=									27		27	27	27	27
5d, 6	=				61					30		30	30	30	30
Other cwhr [1,2,.3, all dennsity & 4,5 p & s]	=							41		50		50	50	50	50
Residual															
Already Treated Lands to Fuel Standards	=	n/a	09	09	09	09	09	09	01	09	09	09	09	09	09
Classified Areas [in preemptive order]															
Administrative - Ownership - Not FS	min	01	01	01	01	01	01	01	01	01	01	01	01	01	01
Withdrawn: existing and Proposed, SIA, RNA, etc	min	01	01	01	01	01	01	01	01	01	01	01	01	01	01
Off-Base and Deferred Lands -HFQLG	min	01	01				01	01	01	01				01	01
Northwest Forest Plan [Lassen-Modoc]	min	01	01	01	01	01	01	01	01	01	01	01	01	01	01
Urban Core Areas -related to Defense Zone	min	01	01	01	01	01	01	01	01	01	01	01	01	01	01
Wild and Scenic Rivers	min	25	25	25	25	25	25	25	25	25	25	25	25	25	25
PACs and HRCAs in preemptive order															
Great Gray Owl - 50-ac	min	n/a	01	33	33	25	25	25	01	01	40	25	25	25	25
Spotted Owls - 300-ac dense (>5 within HR)	min	n/a	01	33	33	25	25	25	01	01	40	25	25	25	25
Spotted Owls - 300-ac spead out	min	n/a	01	01	01	01	01	01	01	01	01	01	01	01	01
Goshawks- 200-ac	min	n/a	01	33	33	25	25	25	00	01	40	25	25	25	25
Spotted owl Nest site - 500ft/18ac	min	n/a	01	23	23	23	23	23	01	01	23	23	23	23	23
Home Range Core Area for Spotted Owls	min				61	61	61	61							
Southern Fisher Conservation Area	min												23	23	23
Willow Flycatchers - occupied	min	01	01	01	01	01	01	01	01	01	01	01	01	01	01
Amphibian	min	01	01	01	01	01	01	01	01	01	01	01	01	01	01
Old Forest Emphasis Areas	min				61		43	43					25	25	25
Riparian Area - Perennials-Intermediate only															
SAT- Buffers minus empherial - HFQLG ONLY	min	01	01				01	01	01	01				01	01
Slope Break															
Greater than 35-% slope &Insuff. Vol.	min	01	25	25	25	25	25	25	25	25	25	25	25	25	25
Cost-offset Area															
Upper 2/3 Slope-Sand W Aspect	min				51	51									
Unassigned forested lands *[default]*		99	99	99	99	99	99	99	99	99	99	99	99	99	99

int	initial assignment of Rx based on DFC for Treatment Unit without constraints
=	reassignment of Rx based on it vegetative condition rather than allocation, S&G, or DFC
min	reassignment based on the most restrictive Rx or lowest number

NOTE: Treatment Allocations or Units are in pre-emptive order to prevent double counting GS trumps DFPZ's which Trumps DF which trumps TS which Trumps WS which Trumps AT for both Altn S1 and S2

Table B-1.3b. Summary of Prescription used to Model S-1 Rod and S-2 Proposal.

Summary Specification of Prescription used to model the ROD and the PROPOSAL		
RxCode	RxName	Description
No Treatment		
Rx-01	LetGrw	Let Grow - No Treatments planned
Rx-02	Lethal	Disturbance Model by FVS - Lethal Burn over 2/3 BA removed
Rx-04	MixLth	Disturbance Model by FVS - MixedLethal Burn over 1/3 and less 2/3 BA removed
Rx-06	NonLth	Disturbance Model by FVS - Non-Lethal Burn less than 1/3 BA removed
Rx-07	Wildld	Wildfland Fire Use
Rx-09	PreTrt	Already treated - sent to Rx for removal of surface fuels only - follow-up
Specialized Rx's [not modeled]		
Rx-11	system	Incidental Removal including road construction
Rx-12	system	Restoration of Species [I.e. Aspen]
Rx-13	system	Reforestation
Specialized Rx for Unique Forest types and/or conditions -		
Rx-14	NonCom	Treat as Plantation to age 50/50ft ave height- Convert to fuels only treatments
Rx-15	ComThn	Thin in plantation and treated of non-stocked forest lands
Rx-16	Br-Fire	Fire-Brush and Shrubs
Rx-17	BrMech	Mech-Brush and Shrubs
Rx-18	HwFire	Fire-Woodland-Hardwood types [live oaks]
Rx-19	HwMech	Mech-Woodland-Hardwood types [live oaks]
Fuel Reduction by Rx Fire and Hand Treatments		
Rx-21	Unburn	Ecological purpose
Rx-23	HandTr	Hand Treatment Required - RxFire is Not option - for nesting and den site protection
Rx-25	RxFire	Prescribed Burning Only
Summary of Prescription unique to the ROD only		
Fuel Reduction and Thinning		
Rx-27	Hndtr2	6-inch Diameter Rule - No Mech - Rx Fire maybe subsituted
Rx-30	ltfuel	12-inch DBH, 10% Canopy reduction, 50% retention
Rx-40	ctfuel	20-inch DBH, 20% Canopy reduction, 50% retention
Rx-48	mltprd	30-inch DBH, no- Canopy reduction, no- Canopy retention
Rx-50	dfpzfb	30-inch DBH, no- Canopy reduction, no- Canopy retention
Salvage		
Rx-101	system	Limited Salvage - dead only
Summary of Prescriptions under the Proposal only		
Fuel Reduction and Thinning		
all start Rx's always done a basic MechT1 or MechT2 treatment before considering constraints or moving to other objectives		
Rx-31	MechT1	Mech. Treatment - Surface and Ladder Fuels only
Rx-33	MechT2	Mech. Treatment - Surface, Ladder, and Crown Fuels only
Rx-35	ForHlt	Mech. Treatment - Surface, Ladder, and Crown Fuels + Forest Health - Drought resistance
Rx-41	OthThn	Mech. Treatment - Meets Fuels and Health applies to other CWHR classes - non habitat
Rx-43	OldFor	Pre-Mech. Treatment followed by RxFire - Meets old forest structure obj. - Meets 50% canopy
Rx-51	MaTbr1	Mech. Treatment - Meets Fuels and Health + sufficient volume to meet operability thresholds
Rx-55	2Stord	Mech. Treatment - Meets Fuels and Health + sufficient volume & two storied stands
Rx-61	MaThn1	Mech. Treatment - up to S&G's - 40/50-Goals treated as standard
Rx-63	MaThn2	Mech. Treatment - up to S&G's - 40/40
Rx-65	MaThn3	Mech. Treatment - Meets fuels and Health - Eastside Pine [4m-6] & HFQLG DFPZ's
Rx-67	MaThn4	Mech. Treatment - Meets Fuels DFC's and HFQLG's desires -ALTERNATE
Rx-71	Caspo2	Modified CASPO for HFQLG [based in Interim Guidelines] - Select 40%, others 30% BA retention
Rx-73	DefZon	Defense Zone Fuels and Revenue
Rx-75	Gap-30	Thin up or remove to 30-inch - GAP Regen [includes HFQLG version of Group Selection]
Timber Products		
used only on lands declared suitable for timber management - e.g. BVFSYU- Modoc NF		
Rx-81	GrpSel	Group Selection in units less 2.5-acres - manage by units
Rx-83	MatxGS	Matrix Group Selection were unit are inclusions
Rx-85	GrnTre	Green Tree Retention
Rx-87	Shltwd	Standard Shelterwood Harvest [prep, seed,and removal stages]
Rx-88	Adv-CC	Clear cutting with advanced regeneration
Rx-89	CCType	Clearcutting and Type conversion.
Salvage		
Rx-103	system	Limited Salvage dead and dying
Rx-105	system	Salvage up limits defined by S&G's in units > 10-acres

B-1.4. Overview of Scheduling Model Process

After the land allocation maps were completed for each alternative, analysis areas were developed based on:

1. vegetative types,
2. management areas or zones which define where activities are permitted, modified, or restricted,
3. constraints and/or desired conditions that constrain activities, and
4. other terrain or management designations where the same activity under the same prescription can be expected to produce significantly different output or where the full range of biologically possible management actions may not be appropriate.

Acres in each unique analysis area are assumed to respond in the same way to management activities and produce the same outputs and effects regardless of their location on the forest. This process allows the user to formulate and re-formulate alternative sets of management goals and desired resource conditions by creating new Analysis Areas, new management objectives, and new standards and guidelines.

All of the alternatives have several management areas where different management direction applies. The *land allocation* defines which activities are allowed, need to be modified, or are prohibited. The *standards and guidelines* define the limits or requirements that must be met before any activities occur. The o*bjectives* are usually defined as the set of desired conditions to be attained from carrying out the activities. The objectives provide a means of selecting which treatments should occur from the suite of option allowed in a given land allocation. In addition, for some of the alternatives, management direction includes *prioritization* of treatments depending upon spatial patterns, existing conditions of wildlife habitat, vegetation, fuel hazard or fire risk. When conflicts occur, land allocations override standards and guidelines which override objectives which override priorities. A summary of the names of the individual layers used in modeling alternatives and analyzing consequences, and the sources of the data for them, is provided in the following table. For complete documentation of the individual layers, see the GIS data documentation CD used for FEIS.

Forest inventory data are then linked to each strata type. The Region 5 Forest Service Forest Inventory and Analysis (FIA) inventories and databases provided sampling data to describe the various map strata. Data associated with a stratum type includes a tree list of species, dbh, height, live-crown ratio, tree sampling weight, etc. and plot location information. This data is the input used in the GAMMA forest vegetative simulators based on coefficients from Forest Service Forest Vegetation Simulator (FVS) model (formerly known as PROGNOSIS). The growth simulators represent the growth of FIA plots and the effects on tree growth stemming from application of various management treatments and disturbance (fire, insects, disease, etc.) agents over time. Data output from these simulators include yield and habitat tables that show how various attributes of the stand change from the cumulative effects of growth, treatment, and disturbance. This data also can be classified into CWHR categories and different types of specialized habitat. Over 50 variables are tracked over time by prescription. Information on regeneration success in plantations (summarized by Silvicultural Accomplishment Report), estimates of insect and disease activities based on change detection, and analysis of the last 25 years of fire history were used to develop the mortality model used in GAMMA and SPECTRUM. The Forest Service Timber Sale Program Information Reporting System (TSPIRS) and State of California Board of Equalization timber value databases were used to estimate values and costs.

A realistic growth and yield model is essential to predicting change in forest condition and assessing impacts of vegetative manipulation. There are numerous growth and yield models used to project forest growth and mortality. For this planning effort, we used the GAMMA model developed by Wilson, (1999) which is a variation of Forest Service FVS model. GAMMA uses the FVS growth coefficients but

manages the data and prescription scripts, or key words, differently. The GAMMA simulator permits the user to track inventory, growth, mortality, and removal through time. The GAMMA visual basic programming language options also permits the tracking of derived variables such as habitat components, snags, dead and down, etc. GAMMA is an individual tree growth and yield model for Sierra Nevada. The simulator processes stands of trees plot-by-plot and then aggregates the results as strata averages at end of each time period. Prescription "scripts" are developed to simulate management through time. These strata-prescription regimes are written to simulate how vegetative manipulation could occur in these types. The simulator uses forest inventory [FIA] plots data as input. The tree lists from inventory plots for each vegetation strata are run separately to develop yield streams particular to each vegetation strata. The results are stored in relational database for used by other programs. The GAMMA model defines the range of biologically feasible activities that can be considered as management options throughout the planning process.

B-1.5. SPECTRUM Analysis

The linear programming (LP) model SPECTRUM (formerly known as FORPLAN) developed by K. Norman Johnson was selected as the primary analysis tool for National Forest scale planning. SPECTRUM is used to analyze different management alternatives. It optimizes the attainment of desired future conditions (DFCs) by scheduling activities that move existing conditions toward the desired future conditions. The scheduling process is influenced by standards and guidelines imposed disturbance regimes, and the projected outputs and effects of time as a result of implementing the alternative. The major strength of this model is its ability to model the effects of constraints on outputs over time. The major limitations of this model, as related to this project, are that activities and projected effects are not spatially explicit (activities area assigned to AA's and not specific acres) and that inputs and outputs are deterministic (do not consider variability and uncertainty in input data).

SPECTRUM was used to determine the most cost effective schedule of treatments that would produce desirable outputs and effects given the objectives (DFCs) and the constraints (standards and guidelines) for each alternative. The interdisciplinary team provided a range of management alternatives. A SPECTRUM analysis was then made for each alternative and each National Forest within the SNFP region. All the information needed for SPECTRUM analysis was entered into a set of data files. The SPECTRUM matrix generator then created a matrix of rows and columns that is then solved by linear programming software. A report is then generated that is used by the interdisciplinary team to analyze the environmental consequences of the alternatives. Reports can be made for the entire planning area or for individual attributes defining the analysis areas or management prescriptions.

The interdisciplinary team specified which set or suite of prescriptions would be allowed on each acre of land by alternative. The development of these specifications has been described above. This specification was used in SPECTRUM to limit the kind of activities that could occur within a specific land allocation within a specific alternative. Each numerical code was placed in a hierarchy wherein activities represented by lesser numbers were allowed, but activities with greater numbers were not. This assignment was mapped and overlaid with vegetative strata and other layers to form unique analysis areas within the SPECTRUM model for each alternative.

Constraints are parameters added to the linear programming model that limit the means of optimizing goals as represented by the objective function. An example of constraint would be to limit the total amount of initial treatment to less than 120,000 per year for all alternatives analyzed. In many cases these constraints are imbedded in the yield and wildlife habitat tables (such as limits on canopy cover reduction).

A number of different output reports can be generated from the SPECTRUM system. The bulk of the report contains information on scheduling of activities, the amount of outputs and effects produced by

these activities, and financial costs and values produced. Examples of items reported include: acres of mortality by different severity classes, volume of timber removed by various products, acres of the forest in various CWHR classes, costs of different management activities, and the inventory, growth/mortality, and removal of various stand attributes such as snags, dead and down material, and large trees.

B-1.6. The "CWHR" System

The University of California, Berkeley, and the California Department of Fish and Game developed the California Wildlife Habitat Relationships System (CWHR) (Airola 1988, Mayer and Laudenslayer 1988, Zeiner et al. 1990) CWHR system cooperatively. It contains information relating the habitat preferences of 643 terrestrial vertebrate species found in California. It allows a user to predict the occurrence and habitat quality for any of these species based upon the presence of specific habitat types and habitat elements. It includes species notes for each species including life history, range maps, legal status, habitat requirements, etc. In addition, it contains ARC/INFO GRID habitat suitability models for more than 30 species, a dBase compatible database and data-query system, and a series of books describing the system. The WHR habitat system, like many other vegetation classification systems, uses the combination of plant species, size, and density to classify habitats. The CWHR system then uses this habitat classification to identify habitat relationships between the vegetation found in an area and wildlife which is likely to be found in that area.

WHR habitat classification predictions are incorporated into GAMMA vegetative growth and yield model, allowing the prediction of habitat changes over time associated with different vegetative and silvicultural regimes. Tying these habitat predictions back to the wildlife species database provides one basis for determining how planned forest management activities are likely to influence wildlife populations in the future. This information can then be used to evaluate whether or not a given mix of management activities are likely to meet a specific set of desired conditions related to wildlife habitat.

Experience has shown that many critical or important wildlife habitats should be modeled with a specific habitat model rather than trying to crosswalk a generalized model, such as CWHR, to predict those habitats. Therefore, species such as California spotted owl, goshawk, key fur bearers, etc. uses models and classification systems based upon documented habitat use and local observations instead of trying to use CWHR to understand forest management implications. Where possible, a "chain of evidence" approach leads to better habitat models. This method uses several different ecosystem and vegetative characteristics to identify habitat.

Figure B-1.6a. Chart of CWHR Classes.

CWHR HABITAT STAGES			YOUNG				MATURE		
			size class 0	size class 1	size class 2	size class 3	size class 4	size class 5	size class 6
			non-stocked	seedling	sapling	poles	small tree	large tree	multi-canopy
				<1-in DBH	1-5.9"-DBH	6-10.9"-DBH	11"-23.9"-DBH	>23.9"-DBH	size 5 over understory
OPEN	no cover	<10% canopy cover	**non-stocked**	**stocked**					
	sparse cover (S)	10-24% canopy cover		1x	2S	3S	4S	5S	
	open cover (P)	25-39% canopy cover			2P	3P	4P	5P	
CLOSED	moderate cover (M)	40-59% canopy cover			2M	3P	4M	5M	
	dense cover (D)	60-100% canopy cover			2D	3D	4D	5D	6

B-1.7. Modeling Disturbance from Wildfire, Insects, and other Pests

The purpose of disturbance prescriptions is to model disturbance and recovery from wildfire. To simulate fire, the tree-killing algorithms in the First Order Fire Effects Model (FOFEM) are used. The factors that affect tree mortality in FOFEM include scorch height and bark thickness. Gamma calculates a scorch height based on user-supplied flame-length. Bark thickness is calculated using Region 5 species-specific equations found in the Wessin, Sornec, and Icasca variants of the Forest Vegetation Simulator source code. Three conditions of fire severity, with associated recovery options, are modeled in the internal disturbance prescriptions lethal fire, mixed lethal fire, and non-lethal fire. Each of these are described in appendix B of the FEIS.

B-1.8. Canopy Cover Modeling using Plot Data

Tree crown cover is the ground area covered by a tree crown, as delimited by the vertical projection of its outermost perimeter. The aggregate expression of crown cover is canopy density, or canopy cover.

Canopy cover (expressed as a percent of area) is being afforded ever-increasing importance in terms of evaluating and classifying forest stands and in defining or setting parameters for stand treatments. Values for percent cover come from many sources; from photo-interpretation using the Li-Strahler model, from densiometer measurements in conjunction with wildlife habitat studies, from inventory data processing. There has been some concern over a period of time that percent cover values from these sources are being used interchangeably, without considering that these 3 approaches may result in widely, even wildly divergent values for percent cover.

Analysis for this SEIS is based on a calculation method using field measurement of tree diameter called PcNetAvg, with one exception. If the standards and guidelines required that canopy cover be measured by Photo Interpretation [PI], then a regression equation based on related plot and PI collected over the last 10-years in the region was used to convert to that scale. Percent cover is a component of the CWHR and LSOG habitat classification systems and is used to constrain tree removal in various thinning prescriptions.

John B. Collins and Curtis E. Woodcock compared percent cover values developed from photo-interpretation with values determined by processing forest inventory data (Collins, J.B. and Woodcock, C.E. Revising Estimates of Canopy Cover Derived from the Li-Strahler Model. Tech. Pap. No. 12. Boston University Center for Remote Sensing). To obtain estimated percent cover from field data, they used techniques analogous to those found in "How to estimate canopy cover using maximum crown width/dbh relationships" by Ralph Warbington and Jack Levitan for "non-overlapping" cover. First, the proportion of land covered by tree crowns is calculated based on dbh-crown width relationships (call this "gross" cover). Then the gross cover values are adjusted for crown overlap, assuming trees are randomly located:

Random Cover = (1 - 1/EXP (Gross Cover)) * 100

Where Gross Cover is the sum of individual tree crown area's (or mean tree crown area times number of trees) divided by 43560. This formulation has the desirable property of limiting percent cover estimates to less than 100%. Gross Cover for stands quite often exceeds 100%. The correction equation is:

Adjusted Cover = -0.0319 + 1.151 * Random Cover

In other words, percent cover values derived from photo-interpretation are about 15% higher than corresponding estimates derived from inventory data processing, assuming random tree spacing.

Gamma, an application developed for the Sierra Nevada Framework growth & yield analysis, uses a procedure named pcNetAvg to adjust Gross Cover to percent cover values used for habitat classification and for stand treatments which are defined, in part, by residual percent cover requirements. It calculates a weighted average between Random Cover and Gross Cover, and then averages the intermediate value with Random Cover. pcNetAvg values do not exceed 100% for any feasible values of Gross Cover.

B-1.9. Outputs, Effects, and Products generated by the Analysis over the Planning Horizon

1. ***SWTB*** **- MBF** Scribner, for all commercial conifers >= 9.9" dbh to 6-inch top (that would exclude species like juniper, bristlecone pine, etc. ... Net volume (minus defect) is determined using Levitan average defect equations.
2. ***BIOM*** **- BDT's -** calculate total stem cuft volume for all live trees, convert to **BDT's**
3. ***FUEL*** **-** slash and ground fuels, including litterfall and limbs. under development... cuft of down material **< 3.0**" diam, converted to **BDT**... for the grid inventories I can initialize point-by-point from woody debris inventory, for other inventories (Tahoe and plantations), we'll have to make a estimate.... amount at any point in time is result of initial value minus decay plus input from treatment or snag/limb fall... I can borrow much of this from FFE.
4. ***D&DW*** **-** cu ft of all dead material (standing and down) > 3.0"; initialize from inventory, level based on interaction of decay rate and new mortality -- reduced during treatment or fire by specified percentage...Proposed methodology is: for trees with dbh > 3.0", for larger material calculate a cone segment from lg diam = dbh to sm diam = 10", assuming taper is 1" in 8 feet... this will be approximate wood volume (not including bark).. then convert to **BDT**.

5. ***%COV*** **- Percent canopy cover** using regressed value to represent PI crown cover consistent with the mapping and plot work described above.
6. ***SNAG*** **- number of standing snags** > 15" dbh and minimum height of 20-ft; initial levels from inventories, level at any period is balance of snag fall predicted by exponential decay model (with half-life specified by species and/or dbh classes) and new mortality.
7. ***HDWD*** **- number of hardwood trees** > 15" dbh
8. ***LGTR*** **- number of large trees** -- minimum dbh is 30" westside, 24" eastside, 21" in alpine types (A and L)
9. ***VLTR***v **number of very large trees** -- minimum dbh is 50" westside, 40" eastside, 32" alpine
10. **CWHR** - 15 categories in 3 age dependent tables, same as draft except calculation method slightly modified... still uses pcNetAvg for percent cover [same as in the draft]. Measured in **acres.**
11. ***RANK*** - SNEP Old growth ranks 1-5 [same as in the draft] Measured in **acres.**

B-1.10. Contrast between Alternative S1 and Alternative S2

The primary differences in the modeled prescriptions [series of activities over time designed to meet a desired condition or objective] for Alternative S1 and Alternative S2 are described below.

1. Absolute upper diameter limits in Alternative S1 [6-inch, 12-inch, and 20-inch limits] are replaced with variable diameters limits in Alternative S2. These limits are based on retaining either 30 or 40 percent of the existing basal area in the largest trees. The 30-inch DBH maximum rule is retained. In most cases, except for previously thinned stands, the basal area retention rule will lead to lower limits than the 30-inch maximum. The Gamma model is used to calculate these diameter limits.
2. Under Alternative S1, canopy cover limits are considered absolute and treatments cannot bring the stand below these values even if the stand existing condition is at the “cusp” and a minimum desired fuel treatment would bring the stand below this standard. Under Alternative S2, fuels treatments are allowed in all cases, even the removal of ladder fuels would technically bring a stand below the canopy standard. This difference is significant because a large number of the acres to be treated are at the 40-50-percent canopy class and under Alternative S1, have a high probability of not being able to receive an adequate fuel treatment because of the canopy standards and guides.
3. Alternative S1 does not allow trees greater than 6-inches to be removed if the stand has a canopy cover of 40 to 49.9 percent and if mechanical means are to be used. Trees with diameter less than 6-inches are allowed to be harvested. The reason for this exception is that stems less than 6-inch do not count in the determination of canopy closure.
4. Alternative S1 requires approximately 20 percent of a stand [it ranges from 10-25 percent, depending on land allocation] to be left untreated if mechanical treatment is to be used. The result is fewer effective acres of treatment.
5. Alternative S1 and Alternative S2 apply the standards to different scales. Alternative S1 applies its standard and guidelines to individual stands while the standards and guidelines of Alternative S2 usually apply to stand aggregates within a treatment unit.
6. Only Alternative S1 requires the identification 1-acre inclusions of CWHR 5M, 5D, and 6 and assigns them a more restrictive set of standards. .

Just as there are significant differences between the alternatives, there are key similarities between them including the following:

1. **Alternative S1 and S2 use the same land allocations including the same treatment units over the next 20-years with two minor exceptions.** This explains why the treatment schedules and many of the effects are quite close when comparing Alternative S1 to Alternative S2. There are two notable exceptions: First there is the difference in the acres of group selection expected to occur in the HFQLG Pilot Project Area. Second there is some difference in the way treatments in PACs are controlled and modeled (see chapter 4 for more details).
2. Both alternatives use the same logic to assign which acres will receive a prescribed burn and which are candidates for mechanical treatment.
3. Neither alternative pushes the its treatment units to the maximum amount of product that could be produced, instead incorporating the desired condition in the prescriptions assigned to the land allocations. This means for the purpose of this analysis, the defense zone prescriptions did not remove all stems up to 30-inches. Rather, the prescription was limited to only remove the stems needed to alter fuels to meet a desired fuel condition for the zone. Both alternatives optimize at landscape rather than at stand level as related to selection of prescription to be used.

In summary, what distinguishes the alternatives from each other is the intensity of the activities that can occur in each of the treatment units. This directly affects the economic efficiency of the overall program and the number of acres that can actually be accomplished for a given funding level. the location of the treatment units is modeled the same for both alternatives.

B-1.11. Modeling Assumptions [General]

1. The proposed action to be analyzed is approximate 2.2 to 2.3 million acres vegetative treatments on 14 National Forest Units within the next 20-years for the purpose of fuels reduction and forest health. Each unit was analyzed separately with its own schedules.
2. The maximum “average” effectiveness of treatment was assumed to be 20-years; thereby requiring maintenance treatment at that time to maintain these acres in a desired fuel condition.
3. For all non-QLG forest units, GSNM, and BVFSYU, equal number of acres of treatment are assumed to occur annual for each plan period. Of the treatments, 50% are assumed to occur in the WUI in the first period until all the acres are utilized or like the Modoc where there are insufficient WUI treatment acres to meet the 50% of the program. For each acre of defense zone treated, 2-4 acres of threat zone area treatments were required to occur. This assured that the WUI get the desired mix of defense and threat zone treatment needed to reduce fire effects on the landscape.
4. The HFQLG Pilot Project is assumed to be completed by the end of calendar year 2009. It is then given the first priority for any Region-wide standards and guidelines that may constrain overall program activity, such as the 5-10% PAC entry rule. DFPZs will be maintained. After 2009, activities in the HFQLG Pilot Project Area are modeled under the rules applicable to the rest of the national forest lands in the bioregion.
5. It is assumed that 80% of the initial treatments related to fuels will require a “follow-up” treatment to get surface fuels to desired treatments. This is planned to occur with 2-4 years after initial treatment. It is also assumed that 80% of the follow-up treatments will need addition work with about 10-years. A 20-year maintenance cycle is then assumed. It is recognized that there will be large variance depending on local condition and this rule is only set up for the convenience of modeling effects and projecting cost. The majority of this work is assumed to be by prescribed

fire. For the purpose of modeling, if the initial treatment was fire, the follow-up is fire. If the initial treatment was mechanical-hand, it is assumed that 40% would be mechanical and 60% fire.

6. Plantations are treated as separate unit or allocation. It is assumed that the required release and pre-commercial thin would occur to maintain them. They are only subject the 30-inch maximum trees size removal rule and the prescription assigned to them would be a function of their condition and whether there was sufficient volume to cover a commercial removal.

B-1.12. Qualifications of Planning Team Analysts

The planning analysts for this project included Klaus Barber, Bernie Bahro, Andy Taylor, and Ken Wright. Each has over 15-years experience in the field. Together they have presented over 50 technical papers related to the kind of analysis described below, and all are considered experts in their fields. All have experience with Forest Plans, the FEMAT report and Northwest Forest Plan, and the revised draft environmental impact statement (RDEIS) for Managing the California Spotted Owl. Allocation mapping was accomplished by a team led by Dr. Joanne Fites-Kaufman, a forest ecologist with more than 10 years experience. Dr. Fites-Kaufman was also a principal scientist for the Sierra Nevada Ecosystem Project. All the analysts were supported by the interdisciplinary team in the development, testing, and deployment of the models.

Appendix B-2: Summary of Prescriptions Used to Model the Alternatives

Vegetative Simulator or Model: Gamma3 [Wilson, 2003] based on Forest Service Forest Vegetative Simulator and Variants was used to model vegetative effects from treatments and disturbances. The rules defined here are for the purpose of modeling effects and are subject to changes based on local conditions. In modeling the modal or most likely condition [rather than maximum or minimum] was used when the standards and guides allow for a range of conditions.

Treatment: is an activity done to a stand or stratum at a single point in time, e.g., burn treatment, habitat thin, DFPZ thinning, and lethal mortality.

Prescription: A series of treatments, follow-up treatments, in growth, etc. over a period of time. The year of the first scheduled treatment is set in Gamma, and from then on the treatment schedule is embedded in the prescription logic. Many prescriptions branch to different treatment sequences depending on strata label or stand conditions.

No Treatment Prescriptions

Rx –01: LetGrw: No treatments planned, the stands are allowed to grow and only subject to natural disturbance events.

Disturbance Events Modeled as Treatments

DE-02: Lethal or Stand Replacement Fire-Mortality: Over 2/3 of the basal area has been killed.

DE-04: Mixed-Lethal Fire-Mortality: Between 1/3 and 2/3 of the basal area has been killed.

DE-06: Non-Lethal Fire-Mortality: Less than 1/3 of the basal area has been killed.

Logic: Fire kills trees per FOFEM predicted mortality, reduces crown due to scorch to midway between original crown base and point of scorch height.

Parameters:

- flame length: feet (converts internally to scorch height)
- mort multiplier: modify FOFEM predictions
- percent area: area reduction factor, percent of area treated, applied uniformly

Specialized Prescription for special circumstances and not limited by Standards and Guides. Evaluated at the project level

Rx –07: WldFir: Wildland Fire Use is model the same as 80% non-lethal and 20% mixed lethal wildfire. Can only be used if an approved Fire Plan exists for the area. This is an form of area treatment.

Rx –09: Treated: Land has already been treated to the desired condition and no treatment is need in the planned period or only a follow-up treatment is needed.

Rx –11: xxxxxx: Incidental removal including road construction and removal for facility development. Decision is deferred to the project.

Rx –12: xxxxxx: Restoration of tree species such as Aspen, Riparian Hardwood, etc. Not subject to basal area retention, diameter, or canopy cover requirements. Decision is deferred to the project.

Rx –13: xxxxxx: Reforestation

Specialized Prescription for unique forest types or conditions and not subject to the general standards and guides related to integrated vegetative treatments

Rx –15: ComThn: Plantations and non-stocked lands on commercial capable and available forested lands. Follows the Framework standards and provides for release, pre-commercial thin, and commercial thins based on basal area targets [thin down to 55% of normal and produce a yield of 2.5-mbf/acre to be considered commerical]. Only binding constrain is 30-inch diameter limit on maximum size tree that can be removed.

Rx –16 and 17: Br-Shr: Fuel treatment prescription for Shrubs and Brush types. A mosaic burn is usually assumed were about 70-80% of the areas get converted to a younger age. Not modeled by FVS-Gamma.

Rx –18 and 19: Hrdwod: Fuel treatment for woodland [mainly live oak] type. Most Black oak –conifer type is subject to the same treatments as mature conifers. When mechanical treatments are used, no blue oaks over 8-inch and no other hardwood over 12-inch can be removed. Prescribed fire is the most common method used here.

Rx-20's: Fuel Treatment with minimum impact on the landscape based on hand treatments and prescribed burning

Rx –21: Unburn: Light prescribed fire based on an underburn with 2-ft flame length. This Rx is not used for meeting fuel objectives but rather returning fire to the ecosystem. No follow-up burn is modeled.

Rx –23: HandTr: Hand Treatment of material less than 6-inch followed by an underburn based on a 2-ft flame length with 3-years were hand treatments are the only permissible choice.. In most dense stands, this Rx does not convert the stand to desired fuel conditions because insufficient ladder and/or crown fuels are removed. This is Hand Treatment only.

Rx –25: RxFire: Use of prescribed fire to meet surface, ladder, and canopy fuel requirement or conditions. This treatment is followed by an underburn of 2-ft flame length with 5-years.

Rx –27: HndTr2: Hand Treatment of material less than 6-inch followed by an underburn based on a 2-ft flame length with 3-years. In most dense stands, this Rx does not convert the stand to desired fuel conditions because insufficient ladder and/or crown fuels are removed. Rx Fire is defined as a default Rx.

Fuel treatments in the 30-60's series are all based on the concept of doing a basic surface, and ladder and in some case canopy fuel treatment defined by prescription MechT1 [Area treatments] and MechT2 [fuelbreaks, DFPZs, and Defense Zones] first and then doing additional removals to meet other objectives. The basic treatments are done independent of any canopy closure requirements.

Rx-30's: Mechanical Fuel Treatment that remove ladder and canopy fuel similar that which would occur if a burn were to occur:

Logic: Mechanical treatment are model similar to Fire kills trees per FOFEM predicted mortality except no crown reduction.

Parameters:

- flame length: feet (converts internally to scorch height)
- mort multipler: modify FOFEM predictions
- percent area: area reduction factor, percent of area treated, applied uniformly
- max diameter: Limits the maximum size of tree that can be thinned

Logic: Ladder Fuel removes trees with crown base below threshold to a target basal area, subject to general canopy closure and dbh constraints, and additional species specific constraints as follows:

1. no GS removed
2. no sugar pine > 6" removed
3. no blue oak > 8" removed
4. no hardwoods > 12" removed

Rx –31: MechT1: This is the basic mechanical fuel treatment that is a proxy for surface and ladder fuel removal only and is used when canopy reduction is to be minimized but still have an effective fuel treatment. All the Rx's in the 30-60 series use this or MechT2 as their starting point. This Rx is **always permitted** if fuel treatments are required on a given acre. Constraints are tested for after this basic treatment has occurred. The trees to be removed are similar to those that would be killed if a fire were to occur based on 5-ft flame length as a proxy for removing minimum trees needed to meet surface and ladder fuels. There is a 20-inch diameter limit. This treatment would be followed up with an underburn or mechanical treatment based on a 2-ft flame length on using a 50% effectiveness factor. This Rx was developed for use in the SPLATs where the treatments are to function only as a modification of fire behavior and not as a barrier to fire.

Rx –33: MechT2: This is the basic mechanical fuel treatment that is a proxy for surface, ladder fuel, and some canopy fuel and is used when canopy reduction is to be minimized but still have an effective fuel barrier. For these types of prescriptions, this is the starting point. This Rx is **always permitted** if fuel treatments are required on a given acre. Constraints are tested for after this basic treatment has occurred. The trees to be removed are similar to those that would be killed if a fire were to occur based on 6-ft flame length as a proxy for removing minimum trees needed to meet surface and ladder fuels. There is a 24-inch diameter limit. This treatment would be followed up with an under-burn or mechanical treatment based on a 2-ft flame length on using a 50% effectiveness factor. This Rx was developed for DFPZs and Defense Zones were the treatments are to function as a barrier.

Rx –35: ForHlt: This mechanical prescription meets the Surface, Ladder, and Canopy fuel requirements and if excessive stocking still exists as measured by SDI, it further reduces the stocking until the stand is considered pest and drought resistant. The trees to be removed are similar to those that would be killed if a fire were to occur based on 7-ft flame length as a proxy for removing minimum trees needed to meet surface and ladder fuels. There is a 30-inch diameter limit. This treatment would be followed up with an under-burn or mechanical treatment based on a 2-ft flame length on using a 50% effectiveness factor. This Rx was developed for stands with excessive SDI's for forest type and site class and reduction is stand density is deemed necessary.

Rx-40's: Mechanical Fuel Treatment that apply to non spotted owl Habitats [NOT CWHR types 4m,4d,5m,5d, or 6]

Rx –41: OthThn: Fuel Thinning designed for CWHR size classes 2 and 3, all canopy density and size class 4 and 5 with canopy classes of S or P only. These stands are considered non-habitat for spotted owl. This prescription starts with a MechT1 treatment. Additional trees may by removed by thinning proportionally stems greater than 9.9-inch-dbh until one binds on only of the following constraints.

1. 30-inch DBH maximum size tree removal limit
2. 50 sq. ft. of basal area or ½ of existing basal area, whichever is larger

Rx –43: OldFor: Fuel Thinning designed for Old Forest Emphasis. Use when a mechanical treatment [MechT1] is needed to pre treatment for a stand. Once sufficient fuels have been removed to make burn safe, RxBurn at 4-ft is then used and followed up by RxFire Rx at 2-ft every 20 years. This prescription starts with a MechT1 treatment. The intent is to return to a natural fire regime using fire as tool for fuel maintenance to the extent possible. This is Rx-31 + Rx-25 combination.

1. 24-inch DBH maximum size tree removal limit
2. 50% canopy closure if it exists

Rx-50's: Mechanical Fuel Treatment that meet fuel objectives and provide some opportunities for timber sales and development of multi-storied stands short of regeneration

Rx –51: MnTbr1: This fuel treatment attempts to produce timber products at a minimum amount necessary to allow for a timber sale to occur while meeting fuel objectives. There is not an attempt to push for additional yield once the requisite volume for a sale is obtained. This prescription starts with MechT1 treatment. If the canopy closure is greater than 40% [pcNet], the stand is thinned proportionally from stem 9.9 inch until you bind on one of the following constraints.

- **3,000** board feet per acre of sawlog removal
- **5%** minimum retention in post canopy cover in stems 6-24-inches DBH [ignored in modeling since near to impossible to violate given the other rules]
- **30-inch** DBH maximum size of tree that can be removed mechanically
- **30%** maximum canopy reduction in a single treatment
- **40%** minimum BA retention in the largest trees,
- **40%** canopy closure minimum retention

Rx –55: 2Stord: Fuel thinning Rx for generating two storied stands [CWHR-6] and generating some value to off-set cost. Treatment starts with MechT1. If canopy closure after MechT1 treatment is greater than 40%, thin from above until [from the upper most diameter permitted under BA retention rule or the 30-inch rule, whichever is smaller] until one binds on one or more of the following constraints.

- **5%** minimum retention in post canopy cover in stems 6-24-inches DBH [ignored in modeling since near to impossible to violate given the other rules]
- **30-inch** DBH maximum size of tree that can be removed mechanically
- **30%** maximum canopy reduction in a single treatment
- **40%** minimum BA retention in the largest trees,
- **40%** canopy closure minimum retention

Rx-60's: Mechanical Fuel Treatment that remove ladder and canopy fuel similar that which would occur if a burn were to occur

Rx –61: MaThn1: This is universal Rx for doing the 50/50 Rule were the 50% Canopy Closure goal is invoked. Treatment starts with MechT1. If canopy closure after MechT1 treatment is greater than 50%, then thin proportionally stems greater than 9.9-inches until you bind on one of the following constraints:

- **5%** minimum retention in post canopy cover in stems 6-24-inches DBH [ignored in modeling since near to impossible to violate given the other rules]
- **30-inch** DBH maximum size of tree that can be removed mechanically
- **30%** maximum canopy reduction in a single treatment
- **40%** minimum BA retention in the largest trees,
- **50%** canopy closure minimum retention

If Canopy closure after the MechT1 is less than 50%, then

STOP

If canopy closure after MechT1 treatment is less than 50%, but greater than 40%, then thin proportionally stems greater than 9.9-inches until you bind on one of the following constraints:

- **5%** minimum retention in post canopy cover in stems 6-24-inches DBH [ignored in modeling since near to impossible to violate given the other rules]
- **30-inch** DBH maximum size of tree that can be removed mechanically
- **40%** minimum BA retention in the largest trees,
- **40%** canopy closure minimum retention
- 40% maximum canopy reduction in a single treatment

If Canopy closure after the MechT1 is less than 40%, then

STOP

Rx –63: MaThn2: This is universal Rx for doing the 50/50 Rule where the 40% Canopy Closure goal is invoked. This Rx pushes to the lower limit related to canopy. Treatment starts with MechT1. If canopy closure after MechT1 treatment is greater than 40%, then thin proportionally stems greater than 9.9-inches until you bind on one of the following constraints:

- **5%** minimum retention in post canopy cover in stems 6-24-inches DBH [ignored in modeling since near to impossible to violate given the other rules]
- **30-inch** DBH maximum size of tree that can be removed mechanically
- **30%** maximum canopy reduction in a single treatment
- **40%** minimum BA retention in the largest trees,
- **40% canopy closure minimum retention**

If Canopy closure after the MechT1 is less than 50%, then

STOP

Rx –65: MaThn3: This is universal Rx for doing Eastside Pine type only which have lower canopy closures on the average [based on the 30/30 rule]. This Rx pushes to the lower limit related to canopy. Treatment starts with MechT1. Then thin proportionally stems greater than 9.9-inches until you bind on one of the following constraints:

- **30-inch** DBH maximum size of tree that can be removed mechanically
- **30%** minimum BA retention in the largest trees,

Note: there are NO canopy requirements under this Rx.

Rx –67: MaThn4: This is a revised DFPZ Rx for used on HFQLG based on Forest desires. This Rx pushes to the limit in order to generate product and value. Treatment starts with MechT2 [for barriers]. If canopy closure after MechT2 treatment is greater than 40%, then thin proportionally stems greater than 9.9-inches until you bind on one of the following constraints:

- **30-inch** DBH maximum size of tree that can be removed mechanically
- 30% **minimum BA retention in the largest trees,**
- **40% canopy closure minimum retention**

Rx-70's: Mechanical Fuel Treatment that remove sufficient volume to meet fuel objectives and have the capacity to generate timber products and revenue to off-set the costs of total fuels package

Rx –71: Caspo2: Mechanical Fuel Treatment based on the California Spotted Owl Interim Guide Lines for defining level of treatment that can occur. Basal area retention standards depend on Timber Strata. Selected strata are bound by three major constraints:

- **30-inch** DBH maximum size of tree that can be removed mechanically
- **40%** minimum BA retention in the largest trees,
- **40% canopy closure minimum retention**

Non selected strata are bound by only these constraints:

- **30-inch** DBH maximum size of tree that can be removed mechanically
- **30%** minimum BA retention in the largest trees,

Rx –73: DefZon: This Prescription thin to 60% of normal basal area. This is a revised Defense Zone Rx that provides some addition limits on tree removal than just limiting to 30-inch trees. This Rx pushes to the limit in order to generate product and value. Treatment starts with MechT2 [for barriers]. This is followed by thinning proportionally stems greater than 9.9-inches until you bind on one of the following constraints:

- **30-inch** DBH maximum size of tree that can be removed mechanically
- **60%** of normal basal for the type and site**.**

If the basal area is below this standard after the MechT2 removal, then

STOP

Rx –75: Gap-30: This Prescription thin all stem less than 30-inches DBH. It is used for extreme cases in defense zone and to simulate GAP regeneration that is group selection with only tree over 30-inches left standing. This Rx pushes to the limit in order to generate product and value. In essence, this a shelterwood where all trees greater than 30 are seed trees and there is NO removal cut.

Rx-80's: Mechanical Treatment that permit Regeneration Harvest and harvest of trees over 30-inches for purposes other than Fuel

Rx –81: GrpSel: Group Selection were the treatment units up to 2.5-ac in size are treated like small regeneration or clear cut units.

Rx –83: Mtx-GS: Matrix Group Selection based on large stand basis were treatments are seen as inclusions within the stand but stand classification is based on the total stand, both treated and untreated.

Rx –85: GrnTre: Green Tree Retention [shelterwood with removal harvest] was on leaving 8 trees greater than QMD proportionally assigned.

Rx –87: ShltWd: Tradition Shelterwood based on 2 or 3 cycles (prep, seed, and removal harvest).

Rx –88: Adv-CC: Clear cutting or type conversion with advance regeneration maintained.

Rx –89: CC-TC-: Clear cutting or type conversion without advance regeneration.