Appendix B. Description of the Analysis Process

This appendix shares important features of the analysis that compared alternatives and provided information for the programmatic draft environmental impact statement (DEIS).

In order to understand the ability of the Apache-Sitgreaves NFs to be managed in different ways to address resource issues, a series of analyses were performed. Much of the analysis relied on the forests' Geographic Information System (GIS) database and existing inventories. A number of analysis tools and computer models were used to help specialists understand the potential effect of management actions.

This appendix highlights some of the main analyses processes that were used in the development of this DEIS. For each resource area that is described in the DEIS, the relative specialist report contains methodology and analysis descriptions. These specialist reports are available in the "Plan Set of Documents." Other key documents and evaluations (including, but not limited to, wilderness, RNA, and wild and scenic river evaluations) that served as references and laid the foundation for DEIS analyses are listed in appendix E and are available in the "Plan Set of Documents."

The appendix is organized by the following sections:

- Vegetation Modeling
- Timber Suitability Analysis and Timber Calculations
- Livestock Grazing Suitability Analysis
- Species Viability Analysis
- Socioeconomic Resources Analysis
- Research Needs

Vegetation Modeling

The vegetation analysis modeled the potential vegetation conditions resulting from natural disturbances and succession in conjunction with proposed management (mechanical, planting, and burning treatments) for each of the alternatives. Analyses were conducted on vegetation using potential natural vegetation types (PNVTs), existing mid-scale vegetation types[1], and soil types

[1] Mid-scale vegetation types were determined using satellite data and are mapped at the scale of 1:100,000. The mid-scale vegetation inventory for all Apache-Sitgreaves NFs' vegetation types analyzed in this report was conducted in 2005 and 2006. As a result of the 2011 Wallow Fire, the Apache-Sitgreaves NFs' midscale mapping product was updated to reflect changed conditions. This product represents a rapid assessment done to help identify changed vegetation condition within the perimeter of the Wallow Fire. The assessment utilized mid-scale existing vegetation data products for vegetation dominance type, tree size, and overstory canopy cover map units as well as RAVG (Rapid Assessment of Vegetation Condition after Wildfire) data produced by the Remote Sensing Applications Center (RSAC) representing overstory canopy cover mortality classes. The datasets were combined using a standard rule-set, developed by the U.S. Forest Service Southwestern Regional Office, to determine where mid-scale map units had changed according to fire severity. This outcome is intended as a rapid assessment of changed condition and does not represent an update of the official mid-scale map products.

from the Terrestrial Ecosystem Survey[2].

For each PNVT, model projections were used to show the departure from desired conditions for each alternative, and to estimate trends and future conditions.

Modeling projected trends in state and transitions were derived through the use of the Vegetation Dynamics Development Tool (VDDT), Version 6.0.25 (ESSA Technologies, 2006). VDDT software is a non-spatial model that allows the user to model vegetation change over time as a series of vegetation states that differ in structure, composition, and cover and to specify the amount of time it takes to move from one vegetation state to another in the absence of disturbance[3].

Various disturbance agents affecting the movement of vegetation between states (or transitions) are incorporated (e.g., mechanical vegetation treatments, surface fires, mixed-severity fires, stand-replacing fires, grazing, insect outbreaks, and drought events). By varying the types and rates of disturbance across the landscape, the effects of different disturbance regimes, such as historic and current fire regimes, or different management treatments, such as planned and unplanned fire ignitions, fire suppression, grazing practices, and mechanical fuel treatments, on vegetation can be investigated (Schussman and Smith, 2006). Input data used in modeling came directly from forest management activities and fire data over the last 25 years.

State destinations and transition probabilities for vegetation treatments were derived from Forest Vegetation Simulator (FVS), modeling, Version 6.31. FVS is a distance-independent; individual-tree forest growth model widely used in the United States and is used to compare alternatives. State destinations for natural fires and fire treatments were derived from FVS, modeling, Version 2.02 and Fire and Fuel Extension (FFE) (Rebain, 2010).

Forest Inventory and Analysis (FIA) plot data were used to calibrate the VDDT model to estimate relative proportions of even- and uneven-aged conditions on the forests (Weisz et al., 2012).

Some of the drawbacks and limitations of VDDT modeling are:

- Many of the VDDT inputs used were derived from other modeling outputs, e.g., FVS timber harvest treatment state transition destinations and the probability of those outcomes
- Many of the VDDT inputs used were derived from incomplete data sources such as the Forest Service Activity Tracking (FACTS[4]) database

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[2] The terrestrial ecosystem survey referenced in this document is specific to the Apache-Sitgreaves NFs and is a classification of ecological types. It maps terrestrial ecological units based on soil types and existing vegetation (Laing et al., 1987).

[3] State and transition models are simple box-and arrow diagrams in which boxes represent observed or theoretical ecosystem states and arrows represent the observed or theoretical transitions among these states. These models are commonly used to conceptualize either formal mathematical models or the complex behavior of dynamic systems. They are essentially a means of mapping system behavior in the absence of adequate predictive models (Westoby et al., 1989).

[4] FACTS is an activity tracking system for all levels of the Forest Service. It supports timber sales in conjunction with TIM Contracts and Permits; tracks and monitors NEPA decisions; tracks KV trust fund plans at the timber sale level, reporting at the national level; and, it generates national, regional, forest, and/or district reports. FACTS is a nationally supported application that tracks land based activities through the NEPA, Layout, and Accomplished stages of a

- VDDT is a non-spatial model intended mainly for broad scale analysis
- VDDT projects changes in vegetative conditions in response to succession, disturbances, and management treatments; however, the VDDT model divides vegetation conditions within each PNVT into a small number of discrete states, and it is acknowledged that there is more variability within each state and within nature than has been modeled for plan revision.
- A small number of states were selected because the VDDT model is driven by the data available; the amount of available data was limited
- VDDT modeled the distribution of landscape states over time, and does not model the more detailed physical (soil, temperature, precipitation, aspect, elevation, productivity) chemical and biological dynamics of what is happening at each scale of spatial resolution
- VDDT is a long-range, broad scale, strategic model, and does not describe what is happening at a site-specific level of detail to individual trees, groups of trees, etc.
- VDDT does not model detailed mechanisms of landscape change, but by calibrating the VDDT models with FVS model outputs (Weisz et al., 2012), VDDT modeling takes advantage of some of the detailed mechanisms (mortality, regeneration, background dwarf mistletoe presence, natural growth, succession, etc.) that FVS considers
- VDDT models overstory structure, composition, and cover as defined by mid-scale vegetation mapping in great detail, but does not model the understory vegetation (for example, the species composition of grasses and forbs)
- VDDT models the probability and timing of events (such as fire behavior, management activities, insect and disease occurrences, etc.) based on empirical observations, but our current information on historical behavior and evidence cannot accurately predict future behavior due to climate change and other phenomena which may not have occurred within the realm of the statistical evidence which is available to us today

It is assumed the disturbances (e.g., management activities) selected for the VDDT model represent the majority of disturbances the Apache-Sitgreaves NFs experience. There could be many variations to these disturbances; however these were not modeled in detail for this analysis. According to Lauenroth and Laycock (1989), and others, succession may follow multiple pathways and reach different end-points depending on the effects of disturbance on the life history characteristics of the vegetation; causing predictability to be limited by the importance of chance or infrequent events.

The following PNVTs were modeled using VDDT software: ponderosa pine, wet mixed conifer, dry mixed conifer, and spruce-fir forests; Madrean pine-oak, and piñon-juniper woodlands; Great Basin and semi-desert grasslands. State and transition modeling was not conducted for interior chaparral, montane/subalpine grasslands, and the four riparian PNVTs. Separate, regionally consistent VDDTs models were not developed for the montane/subalpine and riparian PNVTs.

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project. The features in GIS represent the activity unit on which these activities occur and are depicted in GIS as polygons, lines or points. FACTS version 2.0 uses a total of three feature classes for each feature type - polygon, line, point. Within each feature class, there exists three “subtypes” to identify the stage an activity is in - NEPA, Layout, Accomplished. The appropriate stage of an activity unit is determined by the status of the project.

Various spreadsheets for calculating the relative differences between alternatives for similarity to desired and reference conditions, interspersion of states, acres of aspen, and understory production as a function of overstory tree density were used for processing the output results.

- Assumption: The population and calibration of VDDT using FIA plots and FVS modeling of growth and disturbances generally represents the response of forested PNVTs well enough to compare the potential responses of alternatives in a relative way.

Goals or desired conditions used to evaluate contributions to sustainability come from the desired conditions in the proposed plan. These desired conditions are a combination of:

- Forest Service Southwestern Region consistent desired conditions, which were developed using an interdisciplinary process and various scientific references.
- Apache-Sitgreaves NFs specific desired conditions that supplement the Region 3 consistent desired conditions. The Apache-Sitgreaves NFs also developed desired conditions for PNVTs not addressed in the regionally-consistent process.

Additional information about the analysis process can be found in the “Vegetation,” “Forest Products,” and “Fire Specialist” reports in the “Plan Set of Documents.”

Vegetation Treatments

The following tables provide the variables that were input into individual VDDT models to determine the resulting movement toward or away from desired condition and vegetation state makeup. The input variables represent potential management activities by alternative including the acres treated mechanically, by planting, or by fire. Table 178 provides a summary by PNVT and alternative. Table 179 displays more detail, including the treatment types, for the modeled PNVTs.

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Table 1. Summary of modeled annual treatment objectives (acres) by PNVT and alternative for the high, average, and low levels

	Alternative A			Alternative B			Alternative C			Alternative D		
	High	Avg	Low	High	Avg	Low	High	Avg	Low	High	Avg	Low
Ponderosa Pine Forest (602,206 acres on NFS Land)												
Acres treated Mechanically	NA	7,119	NA	11,025	6,289	1,552	24,255	13,341	2,426	9,450	5,434	1,417
Acres treated by Planting	NA	450	NA	1,200	875	550	1,400	1,100	800	400	263	125
Acres treated by Fire	NA	3,150	NA	11,025	6,300	1,575	10,187	5,614	1,040	22,050	12,679	3,308
Total Acres Treated	NA	10,719	NA	23,250	13,464	3,677	35,842	20,055	4,266	31,900	18,376	4,850
Dry Mixed Conifer Forest (147,885 acres on NFS Land)												
Acres treated Mechanically	NA	1,808	NA	2,772	1,584	396	6,160	3,388	616	2,400	1,380	360
Acres treated by Planting	NA	100	NA	450	338	225	500	383	265	200	150	100
Acres treated by Fire	NA	800	NA	2,910	1,663	416	2,772	1,525	277	5,880	3,381	881
Total Acres Treated	NA	2,708	NA	6,132	3,585	1,037	9,432	5,296	1,158	8,480	4,911	1,341
Wet Mixed Conifer Forest (177, 995acres on NFS Land)												
Acres treated Mechanically	NA	2,147	NA	3,325	1,900	475	7,315	4,023	731	2,851	1,640	428
Acres treated by Planting	NA	325	NA	500	375	250	700	575	450	0	0	0
Acres treated by Fire	NA	950	NA	3,325	1,900	475	3,135	1,725	314	6,650	3,824	998
Total Acres Treated	NA	3,422	NA	7,150	4,175	1,200	11,150	6,323	1,495	9,501	5,464	1,426

	Alternative A			Alternative B			Alternative C			Alternative D		
	High	Avg	Low	High	Avg	Low	High	Avg	Low	High	Avg	Low
Spruce-Fir Forest (17,667 acres on NFS Land)												
Acres treated Mechanically	NA	108	NA	95	55	14	208	112	16	36	21	6
Acres treated by Planting	NA	5	NA	50	35	20	10	8	5	0	0	0
Acres treated by Fire	NA	100	NA	606	347	87	892	493	93	964	555	145
Total Acres Treated	NA	213	NA	751	437	121	1,110	613	114	1,000	576	151
Madrean Pine-Oak Woodland (397,927 acres on NFS Land)												
Acres treated Mechanically	NA	0	NA	0	0	0	0	0	0	0	0	0
Acres treated by Fire	NA	1,063	NA	11,143	7,429	3,714	5,000	3,125	1,250	22,335	13,029	3,722
Total Acres Treated	NA	1,063	NA	11,143	7,429	3,714	5,000	3,125	1,250	22,335	13,029	3,722
Piñon-Juniper Woodland (222,166 acres on NFS Land)												
Acres treated Mechanically	NA	500	NA	2,341	1,561	780	4,213	2,633	1,053	4,042	2,358	673
Acres treated by Fire	NA	713	NA	1,412	941	470	600	375	150	3,443	2,009	575
Total Acres Treated	NA	1213	NA	3,753	2,502	1250	4,813	3,008	1,203	7,485	4,367	1248
Great Basin Grassland (185,523 acres on NFS Land)												
Acres treated Mechanically	NA	500	NA	10,269	7,702	5,135	0	0	0	6,161	4,621	3,081
Acres treated by Fire	NA	41	NA	10,000	7,500	5,000	0	0	0	14,000	10,500	7,000
Total Acres Treated	NA	541	NA	20,269	15,202	10,135	0	0	0	20,161	15,121	10,081

	Alternative A			Alternative B			Alternative C			Alternative D		
	High	Avg	Low	High	Avg	Low	High	Avg	Low	High	Avg	Low
Semi-Desert Grassland (106,952 acres on NFS Land)												
Acres treated Mechanically	NA	0	NA	0	0	0	0	0	0	0	0	0
Acres treated by Fire	NA	27	NA	3,000	2,500	2,000	0	0	0	3,000	2,500	2,000
Total Acres Treated	NA	27	NA	3,000	2,500	2,000	0	0	0	3,000	2,500	2,000
Montane/Subalpine Grassland (51,559 acres on NFS Land) - Not Modeled in VDDT												
Acres treated Mechanically	NA	0	NA	500	500	500	500	500	500	500	500	500
Acres treated by Fire	NA	0	NA	0	0	0	0	0	0	0	0	0
Total Acres Treated	NA	0	NA	500	500	500	500	500	500	500	500	500
Riparian Forests and Areas (48,241 acres on NFS Land) - Not Modeled in VDDT												
Acres treated Mechanically	NA	0	NA	0	0	0	0	0	0	0	0	0
Acres treated by Fire	NA	0	NA	350	350	350	0	0	0	450	450	450
Total Acres Treated	NA	0	NA	350	350	350	0	0	0	450	450	450

Table 2. Acres by treatment type used to model the low and high annual treatment objectives

PNVT	Alternative A	Alternative B		Alternative C		Alternative D	
Ponderosa Pine	**Average**	**Low**	**High**	**Low**	**High**	**Low**	**High**
B Free thin all sizes to target BA	1,240	396	2,814	683	6,826	11	77
C Thin from below to target BA	2,090	287	2,042	243	2,426	0	0
D Thin under 16-inch diameter to BA	1,999	0	0	0	0	1,348	8,987
E GroupSelect with matrix thin	1,370	677	4,807	1,071	10,706	50	331
F Shelterwood seed cut to target BA	420	192	1,362	429	4,297	8	55
G Clearcut with legacy trees	0	0	0	0	0	0	0
H Clearcut-Coppice	0	0	0	0	0	0	0
I Plant Seedlings	450	550	1,200	800	1,400	125	400
J RX FIRE ONLY low conditions	2,836	551	3,858	364	3,565	1,158	7,718
K RX FIRE ONLY moderate conditions	316	866	6,064	571	5,602	1,820	12,128
L RX FIRE ONLY high conditions	0	157	1,102	104	1,020	330	2,205
M Thin under 9-inch diameter to BA	0	0	0	0	0	0	0
Dry Mixed Conifer	**Average**	**Low**	**High**	**Low**	**High**	**Low**	**High**
B Free thin all sizes to target BA	221	19	110	20	192	0	0
C Thin from below to target BA	372	9	70	14	140	0	0
D Thin under 16-inch diameter to BA	355	0	0	0	0	0	1,193
E GroupSelect with matrix thin	244	227	1,585	380	3,961	0	0
F Shelterwood seed cut to target BA	74	23	175	60	660	0	0

PNVT	Alternative A	Alternative B		Alternative C		Alternative D	
G Clearcut with legacy trees	0	0	0	0	0	0	0
H Clearcut-Coppice	0	0	0	0	0	0	0
I Plant Seedlings	100	225	450	265	500	100	200
J RX FIRE ONLY low conditions	720	99	693	66	660	210	1,400
K RX FIRE ONLY moderate conditions	80	277	1,940	185	1,848	588	3,920
L RX FIRE ONLY high conditions	0	40	277	26	264	83	560
M Thin under 9-inch diameter to BA	542	118	832	142	1,207	360	1,207
Wet Mixed Conifer	**Average**	**Low**	**High**	**Low**	**High**	**Low**	**High**
B Free thin all sizes to target BA	150	14	94	26	254	0	0
C Thin from below to target BA	258	13	94	64	635	0	0
D Thin under 16-inch diameter to BA	600	0	0	0	0	0	1,973
E GroupSelect with matrix thin	450	286	2,000	346	3,423	0	80
F Shelterwood seed cut to target BA	20	3	20	21	211	0	0
G Clearcut with legacy trees	34	13	93	86	846	0	0
H Clearcut-Coppice	34	13	93	86	846	0	0
I Plant Seedlings	325	250	500	450	700	0	0
J RX FIRE ONLY low conditions	855	159	1,107	105	1,044	332	2,214
K RX FIRE ONLY moderate conditions	96	317	2,218	208	2,091	665	4,436
L RX FIRE ONLY high conditions	951	0	0	0	0	0	0
M Thin under 9-inch diameter to BA	601	133	931	102	1,100	428	798

PNVT	Alternative A	Alternative B		Alternative C		Alternative D	
Spruce-Fir	**Average**	**Low**	**High**	**Low**	**High**	**Low**	**High**
B Free thin all sizes to target BA	3	0	3	1	7	0	0
C Thin from below to target BA	17	0	2	0	7	0	0
D Thin under 16-inch diameter to BA	18	0	0	0	0	5	31
E GroupSelect with matrix thin	27	10	70	11	137	0	0
F Shelterwood seed cut to target BA	0	0	0	0	0	0	0
G Clearcut with legacy trees	10	1	3	1	13	0	0
H Clearcut-Coppice	17	1	3	1	13	0	0
I Plant Seedlings	5	20	50	5	10	0	0
J RX FIRE ONLY low conditions	90	28	201	31	297	48	321
K RX FIRE ONLY moderate conditions	10	58	404	62	596	97	643
L RX FIRE ONLY high conditions	0	0	0	0	0	0	0
M Thin under 9-inch diameter to BA	16	2	14	2	31	1	5
Piñon-Juniper	**Average**	**Low**	**High**	**Low**	**High**	**Low**	**High**
B Free thin all sizes to target BA	180	0	0	96	383	0	0
C Thin from below to target BA	0	0	0	0	0	0	0
D Thin under 16-inch diameter to BA	150	0	0	0	0	647	3,884
E GroupSelect with matrix thin	40	780	2,341	957	3,830	26	158
F Shelterwood seed cut to target BA	0	0	0	0	0	0	0
G Clearcut with legacy trees	130	0	0	0	0	0	0

PNVT	Alternative A	Alternative B		Alternative C		Alternative D	
H Clearcut-Coppice	0	0	0	0	0	0	0
I Plant Seedlings	0	0	0	0	0	0	0
J RX FIRE ONLY low conditions	81	0	0	0	0	0	0
K RX FIRE ONLY moderate conditions	9	470	1,412	150	600	575	3,443
L RX FIRE ONLY high conditions	0	0	0	0	0	0	0
M Thin under 9-inch diameter to BA	0	0	0	0	0	0	0
Madrean Pine-Oak	**Average**	**Low**	**High**	**Low**	**High**	**Low**	**High**
B Free thin all sizes to target BA	0	0	0	0	0	0	0
C Thin from below to target BA	0	0	0	0	0	0	0
D Thin under 16-inch diameter to BA	0	0	0	0	0	0	0
E GroupSelect with matrix thin	0	0	0	0	0	0	0
F Shelterwood seed cut to target BA	0	0	0	0	0	0	0
G Clearcut with legacy trees	0	0	0	0	0	0	0
H Clearcut-Coppice	0	0	0	0	0	0	0
I Plant Seedlings	0	0	0	0	0	0	0
J RX FIRE ONLY low conditions	797	0	0	0	0	0	0
K RX FIRE ONLY moderate conditions	266	3,714	11,143	1,250	5,000	3,722	22,335
L RX FIRE ONLY high conditions	0	0	0	0	0	0	0
M Thin under 9-inch diameter to BA	0	0	0	0	0	0	0

PNVT	Alternative A	Alternative B		Alternative C		Alternative D	
Great Basin Grassland	**Average**	**Low**	**High**	**Low**	**High**	**Low**	**High**
B Free thin all sizes to target BA	0	0	0	0	0	0	0
C Thin from below to target BA	0	0	0	0	0	0	0
D Thin under 16-inch diameter to BA	0	0	0	0	0	0	0
E GroupSelect with matrix thin	0	0	0	0	0	0	0
F Shelterwood seed cut to target BA	0	0	0	0	0	0	0
G Clearcut with legacy trees	250	5,135	10,269	0	0	3,081	6,161
H Clearcut-Coppice	250	0	0	0	0	0	0
I Plant Seedlings	0	0	0	0	0	0	0
J RX FIRE ONLY low conditions	0	0	0	0	0	0	0
K RX FIRE ONLY moderate conditions	41	5,000	10,000	0	0	7,000	14,000
L RX FIRE ONLY high conditions	0	0	0	0	0	0	0
M Thin under 9-inch diameter to BA	0	0	0	0	0	0	0
Semi-Desert Grassland	**Average**	**Low**	**High**	**Low**	**High**	**Low**	**High**
B Free thin all sizes to target BA	0	0	0	0	0	0	0
C Thin from below to target BA	0	0	0	0	0	0	0
D Thin under 16-inch diameter to BA	0	0	0	0	0	0	0
E GroupSelect with matrix thin	0	0	0	0	0	0	0
F Shelterwood seed cut to target BA	0	0	0	0	0	0	0
G Clearcut with legacy trees	0	0	0	0	0	0	0

PNVT	Alternative A	Alternative B		Alternative C		Alternative D	
H Clearcut-Coppice	0	0	0	0	0	0	0
I Plant Seedlings	0	0	0	0	0	0	0
J RX FIRE ONLY low conditions	0	0	0	0	0	0	0
K RX FIRE ONLY moderate conditions	27	1,333	2,000	0	0	1,333	2,000
L RX FIRE ONLY high conditions	0	667	1,000	0	0	667	1,000
M Thin under 9-inch diameter to BA	0	0	0	0	0	0	0

Timber Suitability Analysis

The provisions of the 1982 Planning Rule require lands which are not suited for timber production to be identified. Timber production is the purposeful growing, tending, harvesting, and regeneration of regulated crops of trees to be cut into logs, bolts, or other round sections for industrial or consumer use. The term timber production does not include production of firewood.

An analysis was completed to determine the acres suitable and not suitable for timber production on the Apache-Sitgreaves NFs. This analysis was completed in three main steps to determine: (1) the lands tentatively suitable for timber production; (2) the cost efficiency of meeting forest objectives, including timber production; and (3) the lands suitable for timber production by alternative. The analysis process and results are summarized and displayed below.

The forests followed guidance set forth by the Southwestern Region guidance (Forest Service, 2009), National Forest Management Act, and provisions of the 1982 Planning Rule for determining suitability. Further descriptions of the analysis process can be found in the “Forest Products” section of this DEIS and the “Forest Products Specialist Report” in the “Plan Set of Documents.”

Step 1: Lands Tentatively Suitable for Timber Production

Tentatively suitable acres were based on the following criteria (table 180). Starting with the entire Apache-Sitgreaves NFs, GIS data was used to overlay and subtract the features listed below. The analysis resulted in 808,368 acres that were carried forward into the next step of the suitability process. Alternative A resulted in a slightly different tentatively suitable acreage (807,289 acres) because more lands were in the research natural area category (1,882 acres).

Table 3. Criteria and acres used to identify lands as tentatively suitable for timber production

Tentatively Suitability Lands	Acres	Total Acres
Total Apache-Sitgreaves NFs		2,110,196
Non-NFS Land	94,844	
Total NFS Lands		2,015,352
Non-forest Lands		
Areas not defined as forest land (>10% at maturity)	4,250	
quarry, urban/agriculture, water		
Grasslands	344,033	
Great Basin, montane/subalpine, semi-desert		
Woodlands	617,094	
Madrean pine-oak, piñon-Juniper		
Interior chaparral	55,981	

Tentatively Suitability Lands	Acres	Total Acres
Wetland/cienega	17,900	
Lands withdrawn from timber production		
Designated Wilderness	20,628	
Bear Wallow, Escudilla, Mount Baldy		
Blue Range Primitive Area	43,258	
Research Natural Area	219	
Eligible or suitable wild and scenic river segments classified as wild	23,085	
Irreversible resource damage likely		
Unsuited/unstable soils (sensitive and unstable)	23,952	
Inadequate restocking		
Low reforestation potential based on soil properties	56,584	
Lands Tentatively Suitable for Timber Production		808,368

The above table reflects the same step 1 common to all action alternatives.

Acres of “unsuited/unstable soils” and “low reforestation potential” were derived from the “Apache-Sitgreaves NFs Terrestrial Ecosystem Survey” (Laing et al., 1987). They were not modified after the 2011 Wallow Fire, because the forest soil scientist believes it is too early (in 2012) to determine accurate estimates of soil productivity losses due to fire consumption of the organic layers and/or subsequent erosion of topsoil. The fire area soils, watersheds, and ground cover have not yet stabilized post-burn. This is a site-specific determination that will need to be made at the project level and based on soils monitoring over time. Any estimates made of possible site conversion from forested PNVTs to grass/rock/shrubland in the “Forest Products Specialist Report” for this analysis are purely estimates based on a search of relevant literature, which will also require onsite monitoring for validation.

Adjustments to the suitable timberland acreage within the Wallow Fire and other high-severity fires may be appropriate in the next 10 years during the scheduled review and update of the forest suitability classification process.

Step 2: Cost Efficiency Analysis

Alternative D was not analyzed for timber harvest economic efficiency because of the alternative theme and its incompatibility with regulated timber production.

The tentatively suitable land for Alternatives A, B, and C was categorized into four strata using GIS:

1. Roaded tractor operable (slopes under 40 percent with an existing road system in place);

2. Unroaded tractor operable (slopes under 40 percent but with no roads existing, thus requiring new construction);
3. Cable/helicopter operable (steep slopes over 40 percent with roads close enough to serve for cable yarding and/or short-turn helicopter yarding);
4. Too isolated or too small to log (areas of otherwise operable ground, but in isolated locations such that logging is impractical).

Stratum 4 was removed from further considerations because logging would be impractical. Alternative A (1987 plan) did not account for these same strata.

Acres of spruce-fir forest were not analyzed in this step because they are located inside lands withdrawn for timber production, are on sensitive/unstable soils, and/or are included in strata 4 above.

Economic efficiency spreadsheets developed by the U.S. Forest Service Washington Office were used to generate the cost efficiency outputs. All economic efficiency analysis spreadsheets are on file in the Plan Set of Documents. The operability costs associated with ponderosa pine, dry mixed conifer, and wet mixed conifer including market revenue values and associated costs, of strata 1 through 3 were input to determine present net values and benefit:cost ratios. Table 181 displays the financial results:

Table 4. Net revenue, present net value, and benefit:cost ratio for ponderosa pine and dry mixed conifer for strata 1 to 3

Stratum	PNVT	Undiscounted Net Revenue	Present Net Value at 3% Discount	Benefit:Cost Ratio at 3% Discount
1	Ponderosa Pine	-$6,558/acre	-$1,473/acre	0.0190
1	Dry Mixed Conifer	-$6,666/acre	-$1,509/acre	0.0185
1	Wet Mixed Conifer	-$7,264/acre	-$1,687/acre	0.0141
2	Ponderosa Pine	-$6,770/acre	-$1,637/acre	0.0171
2	Dry Mixed Conifer	-$7,304/acre	-$1,785/acre	0.0157
2	Wet Mixed Conifer	-$7,834/acre	-$1,970/acre	0.0121
3	Ponderosa Pine	-$19,912/acre	-$4,580/acre	-0.0479
3	Dry Mixed Conifer	Not modeled	NA	negative
3	Wet Mixed Conifer	Not modeled	NA	negative

Benefit:cost ratios for strata 1 and 2 in all three PNVTs are low but positive, while the value for stratum 3 is negative. There was no need to model dry and wet mixed conifer in stratum 3, because they have benefit:cost ratios more negative than the ponderosa pine result, are on steep slopes, and are MSO protected habitat that has management requirements which conflict with timber harvest. Any species mix harvested in the dry and wet mixed conifer brings lower market sale value than ponderosa pine, while the costs of operating in these two PNVTs are higher than the ponderosa pine costs. The excessively high costs to manage a regulated timber production program associated with stratum 3 (cable/helicopter operable lands) on all PNVTs were considered cost-prohibitive and were removed from further consideration.

Forest Service roads budgets have been declining dramatically. Less than 10 miles of new NFS road construction has been done in the past 5 years, and this trend is expected to continue. Additive costs of deferred maintenance roads in stratum 1, combined with new construction roads and future maintenance for stratum 2 under current budget trends, would also make stratum 2 cost-inefficient for this planning period.

Although there are short-term costs associated with stratum 1, long-term benefits of treatments include fewer acres of trees/timber and wildlife habitat lost to uncharacteristic fire, better tree growth rates and overall forest health, and greater resiliency to climate change. There are also benefits associated with contributions to the local economy through a steady flow of timber products.

It was determined that 0 (zero) acres in alternative A, 69,590 acres in alternative B, and 85,234 acres in alternative C are not economically cost efficient. These acres were subtracted from the tentatively suitable land base and not carried forward to the next step.

Step 3: Lands Suitable for Timber Production

The final step in the suitability evaluation was to apply any remaining criteria identified in chapter 4 Suitability of the proposed plan. These criteria (table 182) include lands where management objectives limit timber harvest (e.g., Recommended Wilderness Management Area, Mexican spotted owl (MSO) protected lands). GIS was used to identify the not suitable areas. Accessible and operable acres in alternative D are not available for commercial timber production, due to this alternative’s emphasis on using one single cutting entry, with maintenance by natural processes (e.g., fire) thereafter. Therefore, due to the intentional design of alternative D, all 808,368 acres of tentatively suitable lands are not appropriate for timber production and no economic or further suitability analysis was needed.

Table 5. Lands suitable or not suitable for timber production

Area	Suitable	Not Suitable
General Forest Management Area	X	
Community-Forest Intermix Management Area	X	
High Use Developed Recreation Area Management Area		X
Energy Corridor Management Area		X
Wild Horse Territory Management Area	X	
Wildlife Quiet Area Management Area	X	
Natural Landscape Management Area		X
Recommended Research Natural Area Management Area		X
Research Natural Area Management Area		X

Area	Suitable	Not Suitable
Primitive Area Management Area		X
Recommended Wilderness Management Area		X
Wilderness Management Area		X
Communications sites		X
Developed recreation and administrative sites		X
Eligible or suitable wild and scenic river		X
MSO protected lands		X

Since management areas change by alternative, the resultant acres identified as suitable for timber production vary. These are identified in the results section below.

Results

The following tables (tables 183, 184, and 185) display the criteria and resulting acres considered to be suitable for timber production by alternative. Differences in final acres of suitable timberlands between the alternatives are a result of different reductions shown from the tentatively suitable lands due to the differing theme of each alternative.

Table 6. Alternative A timber production suitability determination

	PNVT Acres	Acres	Subtotal Acres	Total Acres
Total Apache-Sitgreaves NFS Land				**2,015,352**
Lands Tentatively Suitable for Timber Production				**807,289**
Lands where Management Area Prescriptions Precludes Timber Production			**12,258**	
Special Management Areas, Energy Corridor, and Water		12,258		
Lands where Management Objective Limit Timber Harvest			**30,159**	
Riparian		19,407		
Eligible or suitable wild and scenic river corridors classified as recreational or scenic		10,752		
Lands not economically cost efficient			**0**	
The 1987 plan did not limit suitable acres to cost efficient lands		0		
Lands Not Appropriate for Timber Production				**42,417**

	PNVT Acres	Acres	Subtotal Acres	Total Acres
Lands Suitable for Timber Production (38 percent of NFS land)		**764,872**		**764,872**
Dry mixed conifer	108,208			
Ponderosa pine	503,412			
Spruce-fir	5,180			
Wet mixed conifer	148,072			
Lands Not Suitable for Timber Production (62 percent of NFS land)				**1,250,480**

Table 7. Alternative B timber production suitability determination

	PNVT Acres	Acres	Subtotal Acres	Total Acres
Apache-Sitgreaves NFS Land				**2,015,352**
Lands Tentatively Suitable for Timber Production				**808,368**
Lands where Management Area Prescriptions Precludes Timber Production			**65,497**	
High Use Developed Recreation Area, Energy Corridor, Natural Landscape, Recommended Research Natural Area, and Recommended Wilderness Management Areas		65,497		
Lands where Management Objective Limit Timber Harvest			**76,537**	
Riparian		15,696		
Communications sites		91		
Developed recreation sites and administrative sites		5,862		
Eligible or suitable wild and scenic river corridors classified as recreational or scenic		8,258		
Mexican spotted owl protected lands (PACs)		46,630		
Lands not economically cost efficient			**69,590**	
Steep slope but loggable		54,466		
Dry mixed conifer	18,631			
Ponderosa pine	6,327			
Spruce-fir	2,548			
Wet mixed conifer	26,960			
Unroaded areas		12,511		
Dry mixed conifer	1,292			
Ponderosa pine	9,589			
Spruce-fir	32			

	PNVT Acres	Acres	Subtotal Acres	Total Acres
Wet mixed conifer	1,598			
Too isolated or too small to log		2,613		
Lands Not Appropriate for Timber Production				**211,624**
Lands Suitable for Timber Production (29.6 percent of NFS land)		**596,743**		**596,7441***
Dry mixed conifer	65,086			
Ponderosa pine	445,440			
Wet mixed conifer	86,217			
Lands Not Suitable for Timber Production (70.4 percent of NFS land)				**1,418,608**

* Difference from subtotal due to rounding

Table 8. Alternative C timber production suitability determination

	PNVT Acres	Acres	Subtotal Acres	Total Acres
Apache-Sitgreaves NFS Land				**2,015,352**
Lands Tentatively Suitable for Timber Production				**808,368**
Lands where Management Area Prescriptions Precludes Timber Production			**27,321**	
High Use Developed Recreation Area, Energy Corridor, Natural Landscape, Recommended Research Natural Area, and Recommended Wilderness Management Areas		27,321		
Lands where Management Objective Limit Timber Harvest			**91,067**	
Riparian		19,927		
Communications sites (buffer to 5 acres)		94		
Developed recreation sites and administrative sites		6,341		
Eligible or suitable wild and scenic river corridors classified as recreational or scenic		12,174		
Mexican spotted owl protected lands (PACs)		52,531		
Lands not economically cost efficient			**85,234**	
Steep slope but loggable		62,261		
Dry mixed conifer	21,415			
Ponderosa pine	8,731			
Spruce-fir	3,086			
Wet mixed conifer	29,029			

	PNVT Acres	Acres	Subtotal Acres	Total Acres
Unroaded areas		13,637		
Dry mixed conifer	1,295			
Ponderosa pine	10,381			
Spruce-fir	82			
Wet mixed conifer	1,879			
Too isolated or too small to log		9,336		
Lands Not Appropriate for Timber Production				**203,622**
Lands Suitable for Timber Production (30.0 percent of NFS lands)		**604,746**		**604,746**
Dry mixed conifer	65,778			
Ponderosa pine	451,179			
Wet mixed conifer	87,789			
Lands Not Suitable for Timber Production (70.0 percent of NFS lands)				**1,410,606**

For alternatives B and C all acres of spruce-fir forest were classified as nonsuitable because they are located inside withdrawn lands, are too isolated or small to log, and/or are in MSO protected habitat. Some acres of spruce-fir forest were classified as suitable timberlands in the 1987 plan.

MSO protected activity centers (PACs) were eliminated as “lands where management objectives limit timber harvest” due to a 9-inch diameter cutting cap limitation required by the current “MSO Recovery Plan.” Additional MSO protected habitat on steep slopes outside of PACs was further eliminated as not cost-efficient to harvest. Care was taken to avoid double-counting these acreage deductions when more than one reason exists for the deduction. Should the “MSO Recovery Plan” be revised during this planning period, changes in timberland suitability classification may need to be reviewed and adjusted accordingly.

Timber Calculations

The “Forest Products Specialist Report” and report appendices (Forest Service, 2012) in the “Plan Set of Documents” provides complete records of all assumptions, rationale, data sources, methodologies, and references used to estimate timber volumes by alternative. The following is a brief summary of how the ASQ, LTSYC, and nonindustrial wood volumes were derived.

All wood volumes cut under each alternative are considered as byproducts of vegetation restoration treatments that maintain or move toward desired conditions. The PNVTs from which wood could be cut that were modeled in VDDT include ponderosa pine forest, dry and wet mixed conifer forests, spruce-fir forest, piñon-juniper woodland, and Great Basin grassland.

Two models were used to estimate volumes of wood cut under each alternative: (1) Forest Vegetation Simulator (FVS) and (2) Vegetation Dynamics Development Tool (VDDT). Various cutting simulations modeled in the FVS were used by the U.S. Forest Service Southwestern

Region to produce estimates of three product categories: cubic feet per acre of industrial timber, and nonindustrial firewood cut, as well as tons of biomass per acre resulting from proposed restoration treatments (Weisz et.al., 2012). The per-acre estimates from FVS were then incorporated into the VDDT model as another outcome attribute for the first 5 decades of treatments simulated for each PNVT, and expanded for multiple acres cut in each alternative.

The resulting VDDT wood volumes were entered into MS Excel spreadsheets for further summation of the three different wood product categories, as estimates for treated acres of both suitable timberlands and nonsuitable timberlands. Those volumes only represent green trees expected to be cut and offered to markets under plausible cutting methods to implement each alternative. The same average volume estimate of green and dead poles, posts, firewood, powerline corridor/roadside hazard tree salvage small sales, and other wood products sold annually under personal and commercial use permits to meet local public demand (not modeled in VDDT) was also included in the total volume estimated for each alternative.

ASQ Volume Calculations

Only volumes of industrial conifer timber species and commercial sizes cut from suitable timberlands, and used as logs, bolts, or roundwood (excluding firewood) are included in the ASQ calculation. See the “Forest Products Specialist Repor” (Forest Service, 2012) for industrial definitions and tree species included. Because the modeling only represents one possible green-tree cutting scenario under each alternative, the resulting volume outputs are too precise for a forestwide programmatic assessment. Therefore, all ASQ values have been rounded to the nearest thousand CCF.

According to the National Forest Management Act (NFMA), dead salvage volume of wildfire-killed and insect/disease-killed trees from suitable timberlands does not contribute to the ASQ. Because such volume may be unpredictable and highly variable, it is an additional volume that can be offered above the ASQ.

LTSYC Calculations

When a forest has achieved the desired regulated condition, the basic concept of long-term sustained yield is that annual harvest levels should cut no more than the net annual growth. Net growth is gross growth less natural mortality. In cases when net growth volume exceeds total cut volume, an excess of overgrowth poses an imbalance in the ecosystem that eventually is not sustainable. Such an imbalance can contribute to higher risks of severe stand-replacement wildfire, and outbreaks of insect or disease species which capitalize on trees weakened by over-crowding. Figure 82 below illustrates this concept.

Long term sustained yield capacity (sustainable harvest) for suitable timberlands was determined for each alternative using the following formula:

> **LTSYC = (24 cubic feet /acre/year of net growth) x (number of suitable timberland acres in the alternative)**

The net growth volume per acre per year is based on an average 30-year re-entry cutting cycle modeled in FVS for each forested PNVT by the USFS Southwestern Region as the ideal timeframe to maintain desired forest conditions stated in the proposed plan and for implementing an uneven-aged cutting system to reach forest regulation for sustained harvest yields (Youtz and Vandendriesche, 2012).

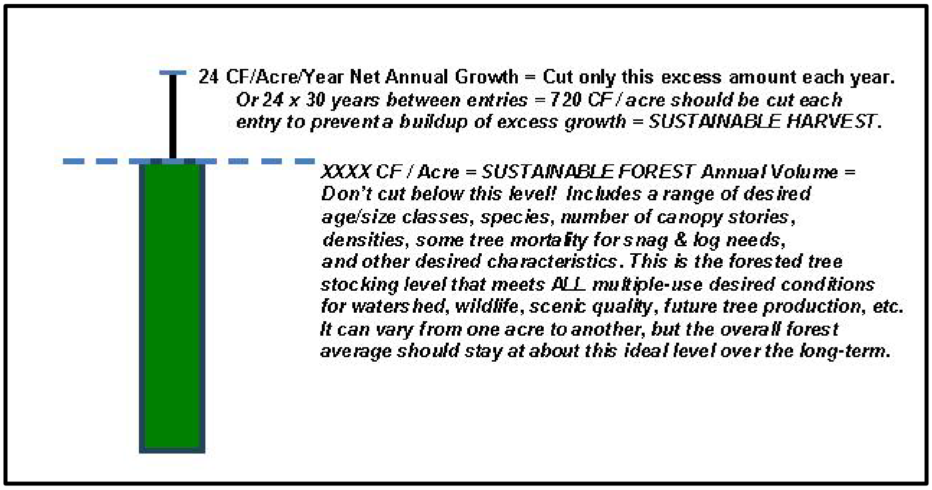

Figure 82. Conceptual diagram of ideal cutting level for a sustainable forest and sustainable harvest

For simplification of analysis, the long-term sustained yield of 24 cubic feet per acre per year used is a rounded, weighted average value for all suitable timberlands, using the regional model run results for each PNVT, based on the proportional acres of each forested PNVT present on the Apache–Sitgreaves NFs suitable land base. Only the Southwestern Region's high-site model run for the ponderosa pine/grass type was used in this calculation, because soils not capable of producing at least 20 cubic feet/acre/year (approximately site index of 70 or greater) were eliminated from the tentatively suitable land base with the Apache-Sitgreaves NFs' soils assessment (see the "Forest Products Specialist Report" (Forest Service, 2012)). Because acres of suitable timberland vary by PNVT, a weighted average was used to verify the correct average to be used for all analyses of all PNVTs combined. Table 186 below shows how this average was derived mathematically.

Table 9. Average LTSY calculation for all suitable timberland PNVTs on the Apache-Sitgreaves NFs by alternative

PNVT	Suitable Acres[1]	LTSY in cubic feet/acre/year[2]	Multiplication Product
Alternative A			
Ponderosa Pine[3]	503,412	23.6	11,880,523
Dry Mixed Conifer	108,208	22.9	2,477,963
Wet Mixed Conifer	148,072	24.7	3,657,378
Spruce-Fir	5,180	0	0
Totals	764,872	71.2	18,015,864
Weighted Average: 18,015,864 / 764,872 = 23.6, rounded to 24 cubic feet/acre/year			

PNVT	Suitable Acres[1]	LTSY in cubic feet/acre/year[2]	Multiplication Product
Alternative B			
Ponderosa pine[3]	445,440	23.6	10,512,384
Dry Mixed Conifer	65,086	22.9	1,490,469
Wet Mixed Conifer	86,217	24.7	2,129,560
Spruce-Fir	0	0	0
Totals	596,743	71.2	14,132,413
Weighted Average: 14,132,413 / 596,743 = 23.7, rounded to 24 cubic feet/acre/year			
Alternative C			
Ponderosa pine[3]	451,179	23.6	10,647,824
Dry Mixed Conifer	65,778	22.9	1,506,316
Wet Mixed Conifer	87,789	24.7	2,168,388
Spruce-Fir	0	0	0
Totals	604,746	71.2	14,322,528
Weighted Average: 14,322,528 / 604,746 = 23.7, rounded to 24 cubic feet/acre/year			

[1] See the “Forest Products Specialist Report,” appendix A-2 for additional information.

[2] From Youtz and Vandendriesche, 2012.

[3] Only the regional ponderosa pine/grass type high site index LTSY model result was used.

Because this net growth average of 24 cubic feet per acre per year does not vary by alternative, it was used in all LTSYC calculations for all alternatives in DEIS chapter 3, table 149.

To comply with legal requirements of the National Forest Management Act (NFMA) and Multiple Use-Sustained Yield Act (MUSYA), long-term sustained yield also means that ASQ volumes harvested from suitable timberlands cannot decline from one decade to the next. Ideally, harvest volumes below the LTSYC should continue increasing to eventually reach the LTSYC and then level off at or near that regulated value. The only exception to this rule is if the cutting volumes are departed above the LTSYC, in which case they would be expected to decline toward the LTSYC over time.

Alternative A’s ASQ volumes for decades 1 through 5 are all within 1 to 2 percent of each other, which indicates a flat line of sustained yield harvests. VDDT methodology used in this analysis did not permit the ability to model the most logical changes in cutting methods for subsequent re-entries on acres previously treated with the model inputs. By decade three, less intermediate thinning treatments to cut smaller sized trees would be used; instead more uneven-aged group selection cuts which require cutting bigger trees would be used, thus producing greater harvest volumes than those shown here for decades 3 through 5.

Alternatives A and B comply with legal requirements by cutting at levels which do not decline and are below the LTSYC. The first 5 decades of VDDT modeling do not produce substantially increasing harvest volumes that ramp up closer to the LTSYC, due to predicted cutting levels on suitable timberlands according to budget and workforce estimates for these alternatives in this planning period.

ASQ cutting departures above the LTSYC can be temporarily justified to correct the imbalance of excess net growth, provided the volumes cut decline over time to eventually level out at or below the LTSYC. This is the case for Alternative C. This declining volume trend came from the VDDT model runs for decades 1 through 5 and is based on treatment inputs for each alternative that are documented in the "Forest Products Specialist Report" (Forest Service, 2012). A declining trend is logical when heavy restoration cuts are needed early to prevent excessive tree mortality from severe wildfires, competition, and insect/disease outbreaks. Once overgrowth levels have been reduced, then subsequent decades should produce volumes which taper down toward reaching desired conditions that are intended to promote a more sustainable forest. Because VDDT modeling was not done beyond 50 years, it is assumed that continued aggressive cutting levels beyond decade five would be needed to bring forested conditions closer to desired conditions and the LTSYC.

Alternatives A and C were found to comply with the nondeclining even flow legal requirement by continuing the same treatment strategy each decade in the initial level of VDDT modeling. In the case of alternative B, however, the initial VDDT model runs which repeated the same treatment strategy in subsequent decades after this planning period produced ASQ volumes that consistently declined each decade, while staying below the LTSYC. Therefore, additional analysis at a more refined level of modeling revealed that treatment strategy would need to change after the 15-year planning period for alternative B.

In order to sustain a nondeclining even flow of ASQ volumes on suitable timberlands in alternative B, additional modeling revealed that the restoration strategy for decades 2 through 5 would need to do the following: increase treatment acreages in closed canopy transition vegetation states in the ponderosa pine and dry mixed conifer PNVTs; and shift to using low-severity prescribed fire as a maintenance tool for thinning just the seedling/sapling sizes.

These modeling shifts represent adaptive management that is predictable because as more acres are restored to desired open-canopy in these two PNVTs, cuts in each transition state would produce less volume per acre; thus the need to cut more acres overall to sustain the same total volume yields. Likewise, using moderate-high-severity fire as a thinning tool would predictably reduce measurable volume available for ASQ harvest. Thinning only seedlings/saplings that have very little measurable wood volume by using only low-severity fire would not impact available ASQ volume.

These shifts in management methodology could begin after the planning period. It is assumed that continued restoration treatments toward desired conditions beyond decade five would eventually bring alternative B ASQ levels up closer to the LTSYC, provided uncharacteristic disturbances don't occur first to drastically alter the trends shown in this analysis.

Base Sale Schedule

The provisions of the 1982 Planning Rule call for a base sale schedule, or timber sale schedule. This planning effort emphasizes proposed management outcomes rather than outputs. The desired outcome is to restore the forested PNVTs toward desired ecological conditions, while also providing wood products to the economy as a byproduct of the restoration activities. Therefore, listing site-specific volume outputs tied to individual sales for each of ten years is not appropriate to provide here as a forest program target. The action alternatives offer a flexible range of annual cutting volumes, based on the realistic objective levels that help to frame the alternative. Annual volume levels offered for sale will vary as budgets, market demand, and opportunities occur.

For example, the annual cutting level for alternative B may vary from one year to the next between the high and low range of ASQ volumes shown in the DEIS chapter 3 table 148 (ASQ volume from suitable timberlands for the first decade), provided the decade total does not exceed the annual average times ten. Therefore, forestwide ASQ cutting volumes could fluctuate between 122,000 CCF and 26,000 CCF each year, provided that the total maximum volume of all cuts in the decade would not exceed 736,000 CCF for the 10-year total ASQ.

ASQ volumes from suitable timberlands only constitute a fraction of the total wood products that would result from cutting treatments implemented to restore forested acres toward the ecological desired conditions. In reality, a majority of industrial tree species in the traditional sawtimber, pulp, and pole size classes are no longer sold as these products. Many are currently sold as firewood, and/or extracted from the forest and scaled as tons of biomass, which are not included in the definition of ASQ volume. This trend is expected to increase, as the nation continues to emphasize alternative energy (heat and electricity) generation from green biomass fuel. The 4FRI contract identifies traditional sawtimber, roundwood products, and biomass offerings which all can be provided from a mix of suitable and nonsuitable timberlands on the Apache-Sitgreaves NFs.

Non-ASQ Volume Calculations

All sizes of industrial conifer species cut on lands classified as nonsuitable timberlands were also estimated from VDDT model runs, and tabulated as cubic feet of non-ASQ wood volume. Non-commercial sizes of industrial species cut from both suitable and nonsuitable timberlands were tabulated as tons of biomass. Woodland species cut from both suitable timberlands and nonsuitable lands were tabulated as cubic feet of firewood. These non-ASQ volumes would be available for market and public offerings.

Total Wood Products

The total of all wood products of all categories potentially available to offer markets in the first decade was tabulated for each alternative, by high and low treatment objective levels in table 187.

Table 10. Estimated ranges of annual wood product volumes potentially available to offer in decade 1, by alternative from all NFS lands (suitable and nonsuitable timberlands)

Product Class	Alt. A	Alt. B		Alt. C		Alt. D	
	Average	High	Low	High	Low	High	Low
Cuts on Suitable Lands							
ASQ Industrial Species1 (Timber 9+" and Pulp 5-9") in CCF	74,392	121,591	25,585	268,353	38,522	0	0
Firewood (5+" non-industrial conifer and hardwood species) in CCF, Non-ASQ	14,606	17,530	8,533	33,615	10,019	0	0
Biomass (0+" non-industrial sizes and species) in Tons, Non-ASQ	323,302	400,667	59,336	1,202,219	128,463	0	0
Cuts on Nonsuitable Lands							
Non-ASQ Industrial Species (Timber 9+" and Pulp 5-9") in CCF	5,780	17,804	2,959	31,192	3,402	48,403	6,065
Firewood[2] (5+"non-industrial conifer and hardwood species) in CCF , Non-ASQ	10,976	76,528	46,633	18,413	8,699	59,438	32,203
Biomass (0+"non-industrial sizes and species) in Tons, Non-ASQ	24,822	185,132	82,848	122,548	13,418	246,798	66,026
Summary of Total Cuts on All Treated Lands (ASQ and Non-ASQ Combined)							
Industrial Species[1] (Timber 9+" and Pulp 5-9") in CCF	80,172	139,395	28,544	299,545	41,924	48,403	6,065
Firewood[2] (non-timber conifer and hardwood species) in CCF	25,582	94,058	55,166	52,028	18,718	59,438	32,203
Biomass (non-industrial sizes and species) in Tons: Or Converted to CCF[3]	348,124 or 99,464	585,799 or 167,371	142,184 or 40,624	1,324,767 or 378,505	141,881 or 40,537	246,798 or 70,514	66,026 or 18,865
Grand Total of All Wood Products, All in CCF	**205,218**	**400,824**	**124,334**	**730,078**	**101,179**	**178,355**	**57,133**
Averaged Grand Total of All Wood Products, All in CCF	**205,218**	**262,579**		**415,629**		**117,744**	

[1] Industrial species for all alternatives include different live trees modeled in VDDT for restoration cutting, plus additional constant volume sold in small sales and on TIM permits (miscellaneous live and dead small salvage sales, road and recreation site hazard trees, pulp and poles).

[2] Firewood for all alternatives is different live trees modeled for restoration cutting plus additional constant TIM permit sales for dead/down firewood sales, plus posts sold in TIM.

[3] Conversion factor used: 3.5 tons = 1 CCF. Source: R3 Measurements Specialist, based on R3 weight scale study conducted locally.

The table above is the source for table 150 in the DEIS chapter 3, and shows how those volumes were further summarized for DEIS display. The same alternative averaged grand total volumes in the table above are shown in figure 83.

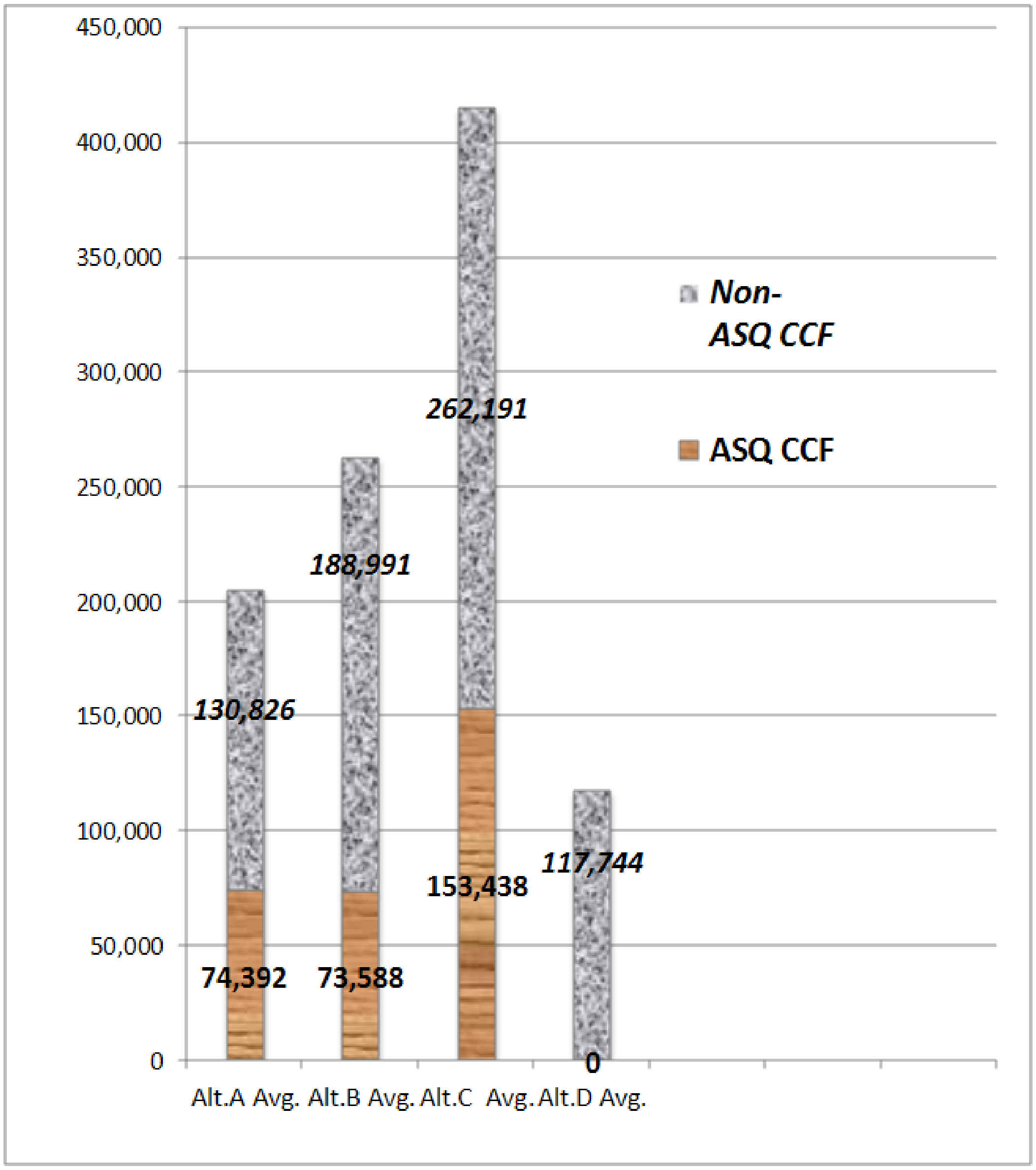

Figure 83. Total annual wood product volume estimates for decade 1 (from both suitable and nonsuitable timberlands)

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Livestock Grazing Suitability Analysis

Provisions of the 1982 Planning Rule require that the capability and suitability for producing forage for grazing animals on NFS lands be determined. The analysis process and results are discussed in the following sections.

Capability is the potential of an area of land to produce resources, supply goods and services, and allow resource uses under an assumed set of management practices and at a given level of management intensity. Capability depends upon current conditions and site conditions such as climate, slope, landform, soils, and geology, as well as the application of management practices, such as silviculture, burning, or insect and disease treatments.

Suitability is the appropriateness of applying certain resource management practices to a particular area of land, in consideration of relevant social, economic, and ecological factors. A unit of land may be suitable for a variety of individual or combined management practices.

Capability and suitability are required to be analyzed on a forestwide basis by the provisions of the 1982 Planning Rule. The identification of lands suitable for livestock grazing is not a decision to authorize grazing. Decisions to authorize grazing are made at the project (allotment) level of analysis consistent with direction in the land management plan utilizing procedures for project-level analysis and decisionmaking. National Forest System grazing allotments have long histories of monitoring resource conditions and monitoring actual livestock grazing use, which can be correlated on the site-specific basis. Livestock numbers are based on monitoring of resource conditions, including riparian and other critical and key areas, and then taking actions to adjust management (e.g., timing, frequency, duration of use) to control livestock impacts affecting progress toward a wide range of resource goals and desired conditions.

Step 1: Capability

Capability to produce forage for grazing animals was originally determined in the 1980s during the development of the 1987 plan and was based on individual allotment data. Landscape scale conditions that determine capability have not changed since the first evaluation. The Analysis of the Management Situation (1983) and the Environmental Impact Statement (1987) document the analysis of grazing capability and suitability for the 1987 plan.

Step 2: Suitability

Suitable rangeland is that which is appropriate for the activity of livestock grazing in consideration of relevant social, economic, and ecological factors. To identify the lands suitable for livestock grazing, additional criteria (table 188) from chapter 4 Suitability of the proposed plan were used.

Table 11. Lands suitable or not suitable for livestock grazing

Management Area	Suitable for Livestock Grazing	Not Suitable for Livestock Grazing
General Forest	X	
Community-Forest Intermix	X	
High Use Developed Recreation Area	X	
Energy Corridor	X	
Wild Horse Territory	X	
Wildlife Quiet Area	X	
Natural Landscape	X	
Recommended Research Natural Area		X
Research Natural Area		X
Primitive Area	X	
Recommended Wilderness	X	
Wilderness	X	
Other Areas		
Active and vacant grazing allotments	X	
Current National Forest System land not in a grazing allotment		X
Black River Conservation Area		X

Results

Table 189 displays the acres of land that are suitable for livestock grazing in alternative A and table 190 displays the action alternatives. To calculate the acres suitable for livestock grazing in the action alternatives, GIS was used to subtract areas not in an allotment, the Black River

Conservation Area, and the designated and recommended research natural areas. The 1987 plan was used as the baseline to identify lands suitable for livestock grazing in alternative A.

Table 12. Alternative A acres suitable for livestock grazing as identified in the 1987 plan

Management Area	Acres	Management Area	Acres
1: Forest Land	836,288	11: Water	0
2: Woodland	611,025	12: Bear Wallow Wilderness	11,080
3: Riparian	6,870	13: Escudilla Wilderness	5,200
4: Grasslands	243,126	14: Black River	7,176
5: Developed Recreation Site	0	15: West Fork Black River	3,465
7: Mount Baldy Wilderness	7,079	16: Chevelon Canyon	0
8: Blue Range Primitive Area and Additions	187,410	17: East and West Forks Little Colorado River	2,360
9: Escudilla Demonstration Area	10,872	18: Sandrock	0
10: Research Natural Area	0		
Total Acres Suitable for Livestock Grazing = 1,931,951			

Table 13. Acres suitable for livestock grazing by action alternative

	Alternative B	Alternative C	Alternative D
Total Acres of NFS Land	2,015,352		
Acres of NFS Land in the Black River Conservation Area	-28,430		
Acres of NFS Land outside grazing allotments	-77,270		
Acres of NFS Land in Research Natural Area and Recommended Research Natural Area Management Area	-8,140		-6,536
Total Acres Suitable for Livestock Grazing	**1,901,512**		**1,903,116**

References

U.S. Forest Service. (1983). Analysis of the Management Situation. Southwestern Region. Apache-Sitgreaves National Forests.

U.S. Forest Service. (1987). Environmental Impact Statement for the Apache-Sitgreaves National Forests Plan. Southwestern Region. Apache-Sitgreaves National Forests.

Species Viability Analysis Process

The process of analyzing all the forest planning species (FPS), potential natural vegetation types (PNVTs), habitat elements, and four plan alternatives is complex. It therefore relies heavily on an approach that categorizes species, habitats, and management and compares plan alternatives. The viability process involved a series of steps for analyzing the 95 non-fish FPS, consisting of 30 mammals, 22 birds, 6 amphibians/reptiles, 12 invertebrates, and 25 plants. The same process was followed, but in a more generalized manner, for the remaining fourteen FPS, consisting solely of fish species. A description of the species viability analysis process follows.

Step 1: Characterize Species

The first part of the process characterizes the existing condition of FPS relative to their current abundance and distribution. Species most subject to risk for viability are generally those that are rare or uncommon or those whose habitat is most likely to be substantially affected by forest management and activities.

FPS were evaluated using information from earlier wildlife assessment reports which reflected input from Apache-Sitgreaves NFs and other biologists, species specialists, a collaborative wildlife group, knowledgeable publics, and Arizona Game and Fish Department. Each FPS was given a forest or F ranking described in table 191.

Table 14. Forest (F) rankings for forest planning species (FPS) on the Apache-Sitgreaves NFs

F Ranking	Description of species abundance and distribution relative to reference or desired habitat conditions
F?[1]	Unknown abundance and distribution
F1	Extremely rare
F2	Rare
F3	Uncommon (including locally common but in rare locations)
F4[2]	Widespread
F5	Secure

[1] Because of insufficient information to determine abundance and distribution, F? species are analyzed as F1 species.

[2] Populations of some F4 species could be affected by extensive landscape scale management and activities depending on timing, both spatial and temporal.

Some of the rarer or uncommon species are designated threatened, endangered, or sensitive species. In addition, some of the FPS are noted as being “highly interactive” species. These are species that play an important ecological role by impacting their habitat or populations of other species, and/or species needing large landscapes and habitat connectivity.

Step 2: Characterize Habitat

The second part of the viability process entails identifying important habitat that is most likely to influence viability. Habitat can be the broad vegetation type or certain habitat features. For the wildlife (non-fish) viability analysis, habitat is characterized by the PNVTs and specific "habitat elements" (e.g., snags, dense cover, down woody debris).

Next, future habitat abundance and future habitat distribution are determined for each PNVT and habitat element based on plan implementation. An underlying assumption is that habitat abundance and distribution within the range of conditions that species have experienced over evolutionary time is likely to maintain them into the future (Haufler 1999)[5]. As such, the historic or reference condition is the desired condition for habitat in order to sustain FPS viability into the future[6].

Future habitat abundance is qualitatively classified as rare, occasional, or common, Future habitat distribution is qualitatively classified as poor, fair, or good. Tables 192 and 193 provide a description of these classifications. Note that future habitat distribution is classified in terms of desired conditions; hence, while a PNVT or habitat element's abundance may be common across the planning area in the future, if it is still mostly departed from desired conditions based on VDDT modeling states (ESSA, 2006), it would be considered "poorly" distributed. See the Vegetation Specialist Report (Forest Service, 2012d) for more information.

Table 15. Values used to classify future habitat abundance

Future Habitat Abundance Value	Description
rare	The habitat (PNVT or habitat element) is rare, with limited occurrences, or habitat consists of patches generally occurring over a very minor portion of the planning area.
occasional	The habitat (PNVT or habitat element) is encountered occasionally, generally occurring over a small portion of the planning area.
common	The habitat (PNVT or habitat element) is abundant and frequently encountered, generally occurring over much of the planning area.

[5] Note that the scale of abundance and distribution differs among species (Holthausen, 2002) and was so considered for this analysis.

[6] Historic, called reference, condition for PNVTs was provided by The Nature Conservancy. Desired conditions are essentially the same as reference conditions for most PNVTs; however, the desired conditions for three PNVTs were adjusted based on three FPS' needs (see the "Vegetation Specialist Report" for more information). Historic conditions for habitat elements are less well understood but are generally described in other plan desired conditions.

Table 16. Values used to classify future habitat distribution

Future Habitat Distribution Value	Description
poor	The habitat (PNVT or habitat element) is poorly distributed within the planning area relative to historic or desired conditions. Number and size of habitat patches and/or their evenness in distribution over the landscape is greatly reduced.
fair	The habitat (PNVT or habitat element) is fairly well distributed within the planning area relative to historic or desired conditions. Number and size of habitat patches and/or their evenness in distribution over the landscape is somewhat reduced.
good	The habitat (PNVT or habitat element) is well distributed within the planning area relative to historic or desired conditions. Number and size of habitat patches and/or their evenness in distribution over the landscape is similar to those conditions.

Combined into table 194, the above classes express the likelihood that a particular PNVT or habitat element would affect viability of the associated species FPS with plan implementation. This is referred to as the likelihood of limitation. Table 195 defines the categories of likelihood of limitation to viability used to compare plan alternatives.

Table 17. Likelihood of limitation to FPS viability based on future habitat abundance and future habitat distribution

Future Habitat Abundance	Future Habitat Distribution		
	Poor	Fair	Good
rare	High limitation	High limitation	Moderate limitation
occasional	High limitation	Moderate limitation	Low limitation
common	Moderate limitation	Low limitation	Low limitation

Table 18. Definitions for likelihood of limitation to viability based on future habitat abundance and distribution

Likelihood of Limitation	Description
High limitation	High probability that the habitat (PNVT or habitat element) will be limiting for a species' viability
Moderate limitation	The habitat (PNVT or habitat element) has a likelihood of some limitation for a species' viability
Low limitation	The habitat (PNVT or habitat element) will likely not be limiting to a species' viability

Step 3: Characterize the Species-Habitat Relationship

The third part of the process characterizes the relationship between species and associated habitat in order to make comparisons between alternatives. The viability risk rating (VRR) value, is created by combining F rankings for individual FPS with the likelihood of limitation for its associated PNVT(s) and habitat element(s). This linkage of species ranking and habitat elements is referred to as the species-habitat relationship.

Table 19. Viability risk rating (VRR) values reflecting species' F rank and likelihood of limitation

Likelihood of Habitat Limitation	FPS F ranking			
	F? or F1	F2	F3	F4/F5[1]
high	very-high	high	moderately-high	moderate/low[2]
moderate	high	moderately-high	moderate[2]	low/low[2]
low	moderately-high	moderate[2]	low[2]	low/low[2]

[1] F4 and F5 species are not species of viability concern but a few are considered FPS as highly interactive species.

[2] Moderate and low level risk ratings are not considered viability risk ratings of consequence, see assumptions.

Step 4: Characterize Management Effects

All alternatives include actions to restore or maintain habitat and species viability, but their relative effectiveness varies. Hence, the fourth part of the process characterizes management by alternative in an overall general manner. The management effect (ME) value describes the alternative's relative consequence to each PNVT or habitat element in terms of minimizing risk and contributing to associated species viability as shown in the following table.

Table 20. Description of relative management effect (ME) rating for alternatives

Rating	Management Effect
1	Greatest relative improvement or maintenance of habitat abundance and distribution through management and activities.
2	Intermediate relative improvement or maintenance of habitat abundance and distribution through management and activities.
3	Least to no relative improvement or maintenance of habitat abundance and distribution as a result of management/activities or lack of thereof (or by factors outside of Forest Service control).

Step 5: Viability Consequences

The viability risk rating outcomes and the management effect rating outcomes form the basis for the determination of environmental consequences to FPS as a result of plan implementation. These consequences are expressed as the relative "viability effectiveness" for each alternative for the 15-year plan period, with consideration of trend to 50 years.

This step entails summarizing likelihood of limitation and management effect for each PNVT and habitat element by alternative (figure 84, box 1). The viability risk ratings for each species-habitat relationship by alternative is also summarized (figure 84, box 2).

Next, the number of species-habitat risk ratings of consequence (moderately-high, high, very-high) is tallied for both PVNTs and habitat elements by alternative (figure 84, box 3). The number of viability risk ratings is summarized by alternative for each of the management effects (figure

84, box 4). The viability analysis uses the information generated in the above steps to show how effectively plan implementation would contribute to species viability by alternative.

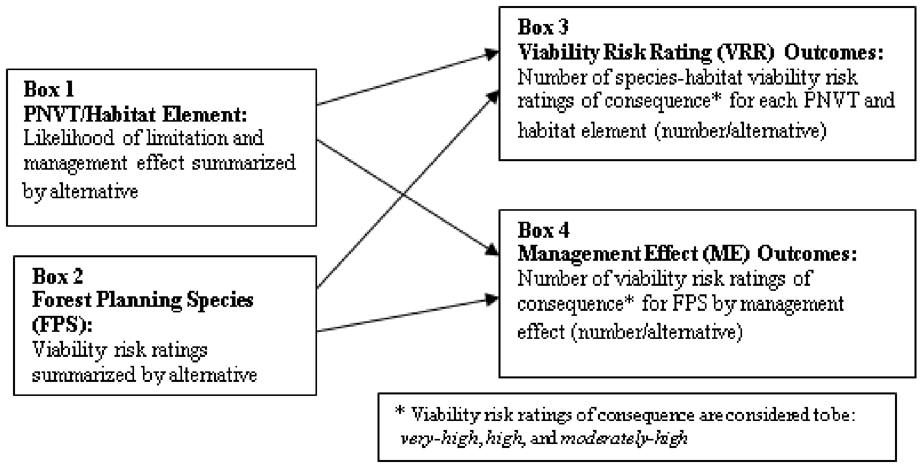

Figure 84. Viability Risk Rating outcomes and Management Effect outcomes that form the basis for environmental consequences

Information used in the species viability analysis as described above include forest plan decisions such as desired conditions, standards and guidelines, different alternative management area allocations, different alternative treatment objectives, and different alternative vegetation states provided by the VDDT modeling (ESSA, 2006).

Results

The viability risk rating outcomes and the management effect rating outcomes form the basis for the determination of environmental consequences to FPS, expressed as the relative “viability effectiveness” for each alternative. These species viability results are presented in chapter 3 (“Wildlife and Rare Plants” and “Fisheries” sections) of this DEIS. Complete details of the species viability analysis can be found in the wildlife and fisheries specialist reports (Forest Service 2012a, 2012b, and 2012c) available in the “Plan Set of Documents.”

References

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Socioeconomic Resources Analysis

Section 219.12(h) of the 1982 Planning Rule directs the planning team to "evaluate the significant physical, biological, economic, and social effects of each management alternative that is considered in detail. The evaluation shall include a comparative analysis of the aggregate effects of the management alternatives and shall compare present net value, social and economic impacts, outputs of goods and services, and overall protection and enhancement of environmental resources." The economic analysis helps to fulfill these evaluation requirements.

Data Sources

Economic impacts were modeled using IMPLAN Professional Version 3.0 (IMpact analysis for PLANning, Minnesota IMPLAN Group, Inc.) with 2009 data. IMPLAN is an input-output model, which estimates the economic impacts of projects, programs, policies, and economic changes on a region. IMPLAN analyzes the direct, indirect, and induced economic impacts. Direct economic impacts are generated by the activity itself, such as the value of cattle grazed on the Apache-Sitgreaves NFs. Indirect employment and labor income contributions occur when a sector purchases supplies and services from other industries in order to produce their product. Induced contributions are the employment and labor income generated as a result of spending new household income generated by direct and indirect employment. The employment estimated is defined as any part-time, seasonal, or full-time job. In the economic impact tables, direct, indirect, and induced contributions are included in the estimated impacts. The IMPLAN database describes the economy in 440 sectors using Federal data from 2009.

Data on use levels under each alternative were collected from the Apache-Sitgreaves NFs' resource specialists. In most instances, the precise change is unknown. Therefore, the changes are based on the professional expertise of the forests' resource specialists (provisions of the 1982 Planning Rule, 219.12(g)).

Regional economic impacts of the alternatives are estimated based on the assumption of full implementation of each alternative. The actual changes in the economy would depend on individuals taking advantage of the resource-related opportunities that would be supported by each alternative. If market conditions or trends in resource use were not conducive to developing some opportunities, the economic impact would be different than estimated here.

Financial efficiency analysis was conducted with QuickSilver Version 6. The financial efficiency analysis compares the anticipated Forest Service expenditures and revenues, by alternative over the life of the plan. Data on program revenues and program expenditures were provided by the Apache-Sitgreaves NFs budget staff and resource specialists (provisions of the1982 Planning

Rule, 219.12(e)). A 4 percent discount rate is commonly used for evaluations of long-term investments and operation in land and resource management by the Forest Service (Forest Service Manual 1971.21). This discount rate was used in the calculation of present net value (PNV). PNV is the difference between program revenues (benefits) and program expenditures (costs) over a 15-year period, using a 4 percent discount rate. The annual expenditures were summed over 15 years using a 4 percent discount rate (so that one dollar today is valued higher that one dollar in 10 years). The sum of the discounted annual expenditures represents the present value of costs. The same exercise was conducted using the annual program revenues for key resource areas. The sum of the discounted annual revenues represents the present value of benefits. The difference between the present value of costs and the present value of benefits is PNV. The higher the PNV, the more financially efficient the alternative. Inflation can affect PNV; however, due to the uncertainty of future inflation, OMB Circular A-94 recommends avoiding assumptions about the inflation rate whenever possible. Thus for the purposes of this analysis, inflation is left at zero.

Social impacts use the baseline social conditions presented in the socioeconomic resources affected environment section of the DEIS and visitor profiles from the NVUM results for the Apache-Sitgreaves NFs (Forest Service, 2001) to discern the primary values that the forests provide to area residents and visitors. Social effects are based on the interaction of the identified values with estimated changes to resource availability and uses.

Assumptions

- Information on the timing of costs and benefits was not available for the economic efficiency analysis. Furthermore, the analysis does not provide a full accounting of all costs and benefits. The only benefits considered are program revenues (i.e., forest receipts) and the only costs considered are direct forest expenditures. Therefore, the estimates of net present value are limited to the available data, which was sufficient to conduct a thorough economic efficiency analysis.
- The economic impact of grazing was estimated using authorized levels. However, actual use is permitted annually based on various factors, such as current forage conditions. Therefore, the estimated economic impact of grazing is likely to overstate the jobs and income provided.
- Changes in use levels were estimated using professional judgment. However, actual changes in use are difficult to predict and frequently depend on factors outside the control of the Forest Service.
- The framework for the social analysis employs generalities. Area residents and Apache-Sitgreaves NFs forest visitors have diverse preferences and values that may not be fully captured in the description of social consequences. Nevertheless, the general categories are useful for assessing social impacts based on particular forest-related interests.

References

U.S. Forest Service. (2001). National Visitor Use Monitoring Program (NVUM). Accessed 21 March 2011. http://fsweb.nris.fs.fed.us/products/NVUM_Results/index.shtml

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Research Needs

As a result of extensive environmental analysis related to plan revision, several research needs have been identified related to the resource topics under review. Future data and information provided by research in these areas would help better manage the Apache-Sitgreaves NFs.

- **Aspen**
  - How can the distinction between elk and livestock impacts be made?
  - How can the age of aspen clonal root systems be determined?
  - What is the best indicator of a healthy aspen stand? Is it an even-aged or multi-storied stand?
- **Recreation Use**
  - Are there other monitoring systems, besides the National Visitor Use Monitoring program, that can provide more accurate and timely visitor use information?
- **Grazing**
  - At the project level, how can range readiness be determined based on growing degree days?
- **Species Habitat**
  - What is a reasonable allocation of forage between livestock and wildlife across all ownerships?
- **Wildlife Quiet Areas**
  - What is the effectiveness of wildlife quiet areas?
  - What are the effects of nonmotorized activities, human presence, and level of noise on wildlife?
- **Minor species (sensitive species)**
  - What are the locations, abundance, genetic exchange, and condition of species where this knowledge is lacking?
- **White pine blister rust resistance**
  - What is the genetic diversity of white pine across the forests to counter the impact of white pine blister rust?
- **Priority watersheds**
  - What indicators should be monitored to show actual improvement of watershed condition?
- **Fire**
  - Are planned and unplanned ignitions an effective tool for moving toward desired conditions?
- **Research Natural Areas (RNA)**
  - What potential research can the recommended RNAs facilitate?