Appendix B - Description of the Analysis Process

This appendix describes the analysis process and techniques used by the interdisciplinary team during the Forest Plan Revision. It contains a framework of the planning process and a discussion of the various analytical tools used and analyses performed.

Framework of the Planning Process

The revision of a Forest Plan is guided by the general planning process described in 36 CFR 219.12. This section describes ten steps, which lead from the completion of a Forest Plan to the completion of a revised Forest Plan.

Step 10. Monitoring and Evaluation (Step 10 of the Initial Planning Process)

The last step of the initial forest plan process is the first step in revising a forest plan. Annual monitoring and evaluation has been done since the Forest Plan was released in 1983. The monitoring report has helped the Forest Supervisor identify several reasons to revise the Forest Plan.

Step 1. Identification of Purpose and Need

After the Forest Supervisor determined that a revision was needed, a series of public meetings were organized. At these meetings, the public was encouraged to comment on areas in the Forest Plan which needed revision. Local government officials were also involved at this stage. The feedback was screened into five possible categories of action:

- Topics that require a plan revision.
- Other revision items that would not require a significant amendment but need to be addressed in the Revised Plan.
- Topics that could be addressed through an amendment to the 1983 Plan.
- Topics that are related to implementation of the Plan.
- Topics outside the scope of a plan revision.

As a result of this planning action, the Regional Forester determined in September 1992 that there were five topics for the Forest Plan Revision. These topics are described in Chapter 1 of the EIS.

1. Biological Diversity
2. Roadless Areas/Wilderness
3. Timber Suitability and Timber Management
4. Recreation Opportunities/Travel Management
5. Wild and Scenic Rivers

As the planning process continued, other changes not specifically related to the five major topics were also considered. However, the revision topics have become the primary focus of the Forest Plan Revision effort.

Step 2. Planning Criteria

During this step, the remainder of the process is outlined. As the Revised Plan was being prepared, several mid-course corrections were necessary, as models were not available or working properly, computer resources or assistance was not available, or public suggestions added additional considerations. For these reasons, completion of the Revised Plan has taken longer than originally estimated.

Step 3. Inventory Data and Information Collection

A Geographic Information System (GIS) was used to build the data base used in the plan revision. The type of data and information needed for the revision process was based on the revision topics. The data was collected and assembled in a manner meaningful for answering planning problems, as discussed later in this appendix.

Step 4. Analysis of the Management Situation (AMS)

This step determines the ability of the planning area to supply goods and services in response to society's demands. It provides background information for formulating a broad range of reasonable alternatives. The June 1993 AMS document focused on the revision topics, and several of the models described in this appendix were initially developed during this step. Much of the work originally completed for the AMS has been redone and is incorporated into this EIS.

Step 5. Formulation of Alternatives

Some initial ideas for alternatives were developed and discussed in the AMS. These were further formulated by the interdisciplinary team following NEPA procedures. Broad themes were developed in response to the revision topics. An in-depth review of the goals, objectives, standards, and guidelines of the 1983 Plan was made, and possible changes were identified. Additional changes were identified by the Rocky Mountain Regional Office to provide consistency across the Region. These changes were packaged together into compatible sets. The alternatives were presented to the public at a series of open houses during the fall of 1993. Comments from the public and local government officials were solicited. After reviewing the comments, the alternatives were further refined into the set that appears in the DEIS. Based on public comment, these were further refined into the set of alternatives found in the FEIS.

Step 6. Estimated Effects of Alternatives

The physical, biological, economic, and social effects of implementing each alternative considered in detail were estimated and compared according to NEPA procedures.

Step 7. Evaluation of Alternatives

Significant physical, biological, economic, and social effects of implementing alternatives were evaluated.

Step 8. Preferred Alternative Recommendation

The Forest Supervisor, along with the entire Forest Leadership Team, reviewed the interdisciplinary team's evaluation and recommended a preferred alternative to the Regional Forester. The Regional Forester selected the preferred alternative, Alternative C, which was presented in the DEIS.

Step 9. Plan Approval and Implementation

After public comment on the DEIS, changes were made to the Plan and EIS. The Regional Forester reviewed the documents and made a final decision, selecting Alternative C as the Revised Forest Plan.

Inventory Data and Information Collection

A Geographic Information System (GIS) was used to develop the Forest Plan Revision data base. The resulting data base was used to analyze suitable timber lands, build Forest Planning Model (FORPLAN) analysis areas, and perform other analyses for the revision. To develop the data base, the following layers were overlaid in GIS:

- Rocky Mountain Resource Information System (RMRIS) - This layer contains the RMRIS locations and sites (identifiers that link to the RMRIS data base). RMRIS is an integrated resource data base that was adopted by the Region in 1983. It is used daily by district offices for project implementation. The RMRIS data that was incorporated in the revision data base was the location and site, cover type, size class, density, percent crown cover, elevation, plant association, habitat structural stage, and aspect. A copy of this RMRIS data was made in April of 1997 when the revision data base was built.
- Land Status - This layer contains information on Forest ownership, administering districts, and wilderness status.
- Slopes - This layer was derived from Digital Elevation Models (DEM) provided by the Geometronics Service Center in Salt Lake City. The slope maps were generated with the following classes: 0-20%, 20-30%, 30-40%, 40-60%, and 60%.
- Soil - This layer contains the soil type from a level 3 soil inventory. The soil inventory was completed from 1980 to 1993.
- Geologic Hazard - This layer gives the geologic composition of an area. Potential geologic hazards are identified.
- Watershed - This layer contains the boundaries for the 6th-level watersheds on the Forest.
- Riparian - This layer contains riparian polygons on the Forest. It includes the vegetation type and location inside or outside of a stream channel. Riparian areas too small to be delineated as a polygon were stored as line data. These lines were buffered by 100 feet and combined with the riparian polygon layer. Lakes or ponds are also included in this layer.
- Management Area Prescription by Alternative - These layers contain the management area prescriptions allocated for each alternative. There is one layer for each alternative. The information in this layer is shown on the management area prescription maps accompanying this document.
- Inventoried Roadless Areas - This layer contains the inventoried roadless areas.
- Recreation Areas and Cultural Sites - This layer contains developed recreation sites, such as picnic grounds, campgrounds, summer home sites,

and ski areas. The layer also contains areas that are known to be highly sensitive to cultural resources over large areas.

The revision data base was rebuilt for the final EIS in April of 1997. Therefore, all information incorporated in the data base is from April, 1997 or earlier. Paradox, a data base system that runs on a personal computer (PC), was used for storing the data. Paradox and FORTRAN (a computer programming language) were then used for generating reports and analysis.

Timber Suitability Analysis

To use the most current data, timber suitability was reanalyzed for the final EIS. The steps were the same as for the draft, with the exception of riparian areas. For information on changes to riparian areas, see the discussion on the following page regarding resource uses that preclude timber production.

The first step in determining timber suitability was to identify forested lands available for timber harvest. From the overlay of GIS layers described above, the RMRIS layer was used to identify National Forest System forested and nonforested lands. Designated wilderness (from the land status layer) was used to identify lands not available.

The next step in determining suitability was to identify the following:

- Areas incapable of producing industrial wood - These areas were identified using cover type from RMRIS.
- Areas where irreversible soil or watershed damage may occur - These areas were identified using slopes and geologic hazard.
- Areas where regeneration in 5 years was not assured - These areas were identified using elevation, aspect, and plant association from RMRIS.
- Areas where adequate response information was not available - There is inadequate information regarding the growth and regeneration of lands producing less than 20 cubic feet per acre per year. Soils were used to identify these lands. Maps of the unproductive sites were generated and reviewed by districts for verification or correction.

The above steps result in the identification of land that is tentatively suitable for timber production. Timber suitability is further refined before entering the FORPLAN model. The next four steps are common to all alternatives and benchmarks:

- Areas that are administratively withdrawn -- These areas were identified in the recreation layer.
- Areas that have significant cultural resources -- These areas were identified in the cultural site layer.
- Areas allocated to resource uses that preclude timber production - Riparian areas (from the riparian layer) and Douglas-fir, ponderosa pine, or limber pine stands (identified in the RMRIS layer) were excluded from suitable timber lands. The Forest has very little Douglas-fir, ponderosa pine, or limber pine, and these stands tend to have unique habitat that is important for wildlife. Riparian areas also provide unique habitat for wildlife. In the draft EIS, only riparian polygons (areas large enough to be delineated as a polygon for GIS) were included in the suitability analysis. For the final EIS, riparian areas that

were delineated as a line were buffered by 100 feet to account for the management and protection of these areas. This buffered area was added to the riparian polygons for inclusion in the suitability analysis.

Maps were generated to reflect the above criteria. These maps were reviewed by the districts. Additional nonsuitable lands were identified based on the following:

- Any additional areas that may have irreversible soil or watershed damage or where regeneration cannot be assured in five years.
- Areas that are inoperable - rocky or wet soils. These lands would be uneconomical to harvest.

Districts also identified areas that had different economics (higher costs) due to accessibility problems. These areas remain in the tentatively suitable land base but are identified in the FORPLAN model as requiring helicopter logging to access:

- Areas where there was no right-of-way and where, in order to acquire a right-of-way, condemnation was the only solution.
- Areas that were inaccessible - small islands or inclusions in incapable or nonforested lands.

The district updates to suitability were linked to RMRIS locations and sites and then stored in an optional field in the RMRIS data base. This information was included in the plan revision data base.

Table B-1 displays new estimates of acres tentatively suitable and common to all alternatives for timber harvest and compares them with the estimates made in 1983.

Figure B-1 shows the distribution of conifer that is tentatively suitable and common to all alternatives. Aspen (on less than 40% slopes) is included in the tentatively suitable base. However, because of the small market for aspen and its low revenue value, most of these lands are uneconomical and will not be scheduled for timber harvest.

To verify the timber suitability and the FORPLAN model, a prototype model was built and run, and the solution was mapped. When attempting to map the FORPLAN solution, it was apparent that operability was a problem in many areas. Soils were then used to identify areas that had wet or rocky soils and where operability would be a problem. These acres were then taken out of the tentatively suitable base.

The next step in suitability determination is the management area prescription allocation for each alternative. The only management area prescriptions that are suitable for timber harvest and contribute towards the ASQ are 5.11, 5.13, and 5.21. Under these prescriptions, timber management is a goal, and timber would be managed on a rotation or scheduled basis. Timber harvest may occur on other management area prescriptions, but it is not the goal and would not be managed on a rotation basis.

The final step in timber suitability was to identify areas that would be uneconomical to manage for timber. Areas with aspen on greater than 40% slopes or roadless areas comprised of mostly aspen are highly uneconomical and were subtracted from the suitable land base.

Table B-1. Summary of Lands Suited for Timber Production in M Acres		
Classification	**1983 Forest Plan**	**Alt A (1997 Analysis)**
Net National Forest	1,356.3	1,356.7
Water (Lakes and Reservoirs)	-2.5	-3.5
Non-Forest Land	-302.6	-254.5
Forest Land	1,051.2	1,098.7
Not Available (forested)		
Wilderness	-126.0	-191.6
Wilderness Study (1983)	-45.3	
Not suitable due to		
Nonindustrial Wood	0.0	-0.1
Irreversible Soil/Watershed Damage	0.0	-9.5
Five Year Regeneration Not Assured	0.0	-17.9
Inadequate Response Info (growth <20 cu.ft./ac/yr)	-24.0	-33.3
Tentatively Suitable	855.6	846.3
Not Suitable due to Management that Precludes Timber		
Recreation, Administrative, and Ski Area Sites	-2.2	-7.3
Areas with large Cultural Resource Sites	0.0	-3.1
Riparian Areas	0.0	-26.7
Areas with unique habitat*	0.0	-3.1
Inoperable Areas	0.0	-51.5
Tentatively Suitable and Common to All Alternatives	853.4	754.6

*Douglas-fir, Ponderosa Pine, or Limber Pine

Table B-2 displays the acres suitable (scheduled and unscheduled) by alternative. Figures B-2 through B-8 show the distribution of suitable conifer (scheduled and unscheduled) timber lands for each alternative.

Table B-2. Suitable Acres by Alternative	
Alternative	**Acres**
A	**421,335**
B	**244,397**
C	**357,821**
D	**296,009**
E	**421,008**
F	**154,493**
G	**418,732**

FORPLAN was then run on the suitable, scheduled and unscheduled, acres. Based on constraints and economics, the model determined the ASQ and the land base necessary to produce the ASQ. The acres used in generating ASQ are termed "suitable and scheduled".

Analytical Tools Used

Forest Vegetation Simulation (FVS) Model

The primary tool used for estimating growth and yield used in the FORPLAN model is the Forest Vegetation Simulation Model (FVS), formerly called Prognosis. FVS is an individual-tree, distance-independent, growth and yield model. It has its structural roots in the Stand Prognosis Model developed by Albert Stage from the Intermountain Research Station. Staff at the USFS Forest Management Service Center in Fort Collins have now calibrated sixteen additional variants of the model to specific geographic areas throughout the west, midwest, and northeastern United States.

FVS allows the user to calculate estimates of forest stand structure and species composition over time and quantify this information to (1) describe current and future forest stand conditions, (2) simplify complex concepts of forest vegetation into user-defined indices, attributes, etc., and (3) allow the manager to ask better questions about growth and yield of forested stands and complete analyses to answer those questions. FVS uses actual forest stand data selected from the Forest's RMRIS data base to project growth and yields for future outputs.

The FVS model structure contains modules for growing trees; predicting mortality; establishing regeneration; simulating growth reductions, damage, and mortality due to insects and disease; performing management activities; calculating tree volumes; and producing reports. One of the strengths of the FVS system is its ability to incorporate local growth rate data directly into the simulation results.

There are several steps in building the growth and yield tables. The first step was to stratify the Forest. Based on the issues and the availability of data, forested areas were stratified by major cover type, size class, and density. The major cover types used were lodgepole pine, spruce/fir, and aspen. Size classes were defined as nonstocked and seedlings, saplings, poletimber, and sawtimber. Density classes of low (40% average maximum density), medium (40-60% average maximum density), and high (60% average maximum density) were also used. Data for the forest stratification came from the RMRIS data base. Cover type and size class are defined fields in RMRIS. For density, the average maximum density percent was used where it was available (stands with actual inventory data). For those stands with no average maximum density percent, crown closure percent (from photo interpretation) was used to estimate density.

The next step was to generate a sample of forest stand data. To have a statistically sound sample, it was determined that 600 forested stands should be selected to represent the Forest. A minimum of five stands was set to represent any strata. Six hundred stands were then selected from across the Forest by a Sample Stand Selection computer program developed by Dan Greene. Additional stands were selected to complete the minimum stands per strata. There were additional stands selected to fully represent the nonstocked/seedling strata in various cover types.

The inventory data from these stands was then used in the FVS program to show present volumes and predict future growth and yield. Outputs of the FVS program were compared to the outputs of the RMSTAND program. FVS was then calibrated so that outputs were similar to the RMSTAND program. Large tree diameter scale factors were calculated from base FVS runs and inserted into the FVS program for future predictions. Utilization standards within FVS were adjusted to the current standards for the Forest. Mortality adjustments were made in FVS to reflect the actual growth patterns shown by the RMSTAND program. Finally the defect factors used in the RMSTAND program were converted to similar defect factors used in FVS.

Verifications were then made on the FVS outputs. Permanent plot data had previously been remeasured on the Forest. The difference in the original plot data and the remeasured plot data was compared to growth predictions of the FVS model. It was found that the FVS outputs were very accurate to the growth found in the remeasured plots. Average growth data from the original stand exam data was calculated showing +/- one standard deviation of the data around the mean and compared to averages of the same data from the FVS runs. It was found that the predicted values of the FVS runs were within one standard deviation of the actual data.

Standard reports such as summary tables of trees per acre, basal area, cubic foot volume, etc., as well as stand structure and species composition tables, were developed for all stands used in the predictions. Values from these tables were then used to build the yield tables used in the FORPLAN model.

Forest Planning Model (FORPLAN)

FORPLAN is a specialized matrix generator and report writer to a standard linear programming optimizer. The Forest used C-WHIZ as the linear programming optimizer. C-WHIZ is available for PCs and is a product of the Ketron Division of the Bionetics Corporation. Linear programming is a standard mathematical technique for solving simultaneous linear equations subject to constraints and an objective function. FORPLAN is used to build a linear program matrix that is then solved by C-WHIZ. The solution from C-WHIZ is then interpreted by FORPLAN, which generates a report and produces a Paradox data file containing the results. The Paradox data file can then be used for further analysis, including combination with the revision data base to generate additional reports.

The version of FORPLAN used for this FEIS was FORPLAN Version 2, Release 14. It was run on a Pentium PC. Although FORPLAN is a standardized model used by all National Forests in the development of forest plans, there is no standard way of using the model. The tool is flexible and can be adapted to the needs of each individual forest.

For the Routt, FORPLAN was used as a timber harvest scheduling tool, reporting timber outputs and timber costs and benefits, while tracking wildlife habitat structural stages and water yields. FORPLAN was not used to make land allocation decisions. Those decisions were made by the districts, based on knowledge of the land. Acres assigned to management area prescriptions were transferred to the model. Given the management emphasis and constraints to meet standards and guidelines, the model then determined whether or not to harvest timber on a particular area, when to harvest, and the type of timber harvest.

FORPLAN was used to schedule timber harvests by decade for the next 20 decades. This long planning horizon assures a sustainable yield into the future. Only the first five decades were carried forward into other analysis.

Land Stratification

Land stratification is the process of identifying a set of attributes, or strata, to use in defining the land base. This is done to organize the forest land base into logical subunits that respond similarly to management actions. In FORPLAN, each strata is called a "level" and combining these levels results in an "analysis area." FORPLAN level identifiers 1 through 6 are used to describe analysis areas. Analysis areas are usually homogenous, but not contiguous. The attributes used in developing analysis areas are based on the issues to be addressed by the model, differences in resource response, and the reliability of the data. Table B-3 shows the land stratification and analysis area composition.

Analysis areas are developed by combining the six level identifiers shown in Table B-3 and calculating the amount of acreage for each combination that is present. Activities and outputs that are associated with analysis areas are on a per acre basis.

Table B-3. FORPLAN Land Stratification

Level 1	Roading Economics	roading costs in roadless areas, zone definition for roadless areas
Level 2	Sensitive Watersheds	grouping of watersheds at or near threshold grouped by percent available to harvest by 0%, 6%, 15% or 25%; also break out of Williams Fork for separate reporting
Level 3	Allocation	management area prescription 33 = 5.11 management area prescription 35 = 5.13 or 5.21 management area prescription US = unsuitable (other management area prescription)
Level 4	Species	Tree Species -- lodgepole pine, spruce/fir, or aspen
Level 5	Size Class and Density	6 = nonstocked/seedling 7 = sapling 8A = pole stand 0-40% density 8B = pole stand 41-60% density 8C = pole stand 61-100% density 9A = mature stand 0-40% density 9B = mature stand 41-60% density 9C = mature stand 61-100% density
Level 6	Slope/Access	determines the logging method <40% slopes = tractor log >40% slopes = cable log no access or no right-of-way = helicopter log

The analysis areas were generated from the revision data base (see earlier discussion). The data base reflects conditions as they exist in April 1997. Without adjustment to the data base, FORPLAN could schedule stands for future harvest which have actually been cut between April 1997 and the implementation of the Revised Plan. To correct this, districts identified areas that were currently under a timber contract or would be sold by the end of fiscal year 1997. This information was added to the revision data base.

Another tool for stratifying land in FORPLAN is the use of zones. Zones are defined by groups of analysis areas that comprise a contiguous area. Zones are used to define activities and outputs on a per area basis. In the Routt FORPLAN model, zones were used for roadless areas that required construction of a collector system of roads to access the timber. The forest engineer completed an analysis for each roadless area to determine the miles of road construction and reconstruction needed to build a collector system. Based on this analysis, analysis areas within certain roadless areas were put in zones.

Timber Prescriptions

FORPLAN level identifiers 7 and 8 are used to define the analysis area management prescription. Several timing choices were applied to these options. Timing choices are defined by specifying in the model the range of ages in which an existing stand and a regenerated stand may be harvested. Based on constraints and the objective, the FORPLAN model determines the management prescription to apply to an analysis area and the timing of implementation.

Table B-4. FORPLAN Prescriptions

Level 7	**Management Emphasis**
	Commercial Timber Management
	Minimum Level of Management (no timber management)
Level 8	**Management Intensity**
	Minimum Level of Management (no timber management)
	Clear Cut
	2-step Shelterwood
	3-step Shelterwood
	Irregular Shelterwood
	Coppice
	Group Selection
	Individual Tree Selection

Table B-4 displays the management prescriptions defined in the FORPLAN model. All analysis areas were given the option of no management (level 7 of minimum level and level 8 of minimum level). For analysis areas that were suitable for timber management (level 3 identifier of 33 or 35), several timber prescriptions were available. The timber prescriptions that are available varies based on management area prescription allocation (5.11, 5.13, or 5.21), species, size class, and density. Table B-5 displays the timber prescription options based on these factors. No mature or pole size conifer stands have an option for pre-commercial thin in the existing stand. Lodgepole pine sapling stands have the option of having a pre-commercial thin in the existing stand. Nonstocked or seedling lodgepole pine stands are required to have a pre-commercial thin in the existing stand. All lodgepole pine regenerated stands require a pre-commercial thin. Spruce/fir regenerated stands have no pre-commercial thin.

For management area prescription 5.13, timing choices were based on culmination of mean annual increment (CMAI) with merchantability specifications of 8" DBH to a 5" top DIB. The age at which CMAI is reached was determined by FVS. For all species, mature and pole sized existing stands have already reached CMAI. For saplings, CMAI for the existing stand is at age 110 for lodgepole pine, 150 for spruce/fir, and 110 for aspen. For the regenerated stands and existing seedlings or nonstocked, CMAI is at age 120 for lodgepole pine, 100 for spruce/fir, and 100 for aspen.

For management area prescription 5.11, timing choices were based on a rotation age that is longer than CMAI and closer to a biological rotation. The rotation age is 200 years for lodgepole pine and spruce/fir and 150 years for aspen.

Revenues and Costs

FORPLAN was constructed as a timber harvest allocation model. Only revenues and costs pertaining to the timber program were included in the model. Thus, Present Net Value (PNV) calculations pertain only to timber

Table B-5. Timber Prescription Options

Mgmt Area Rx	Species	Size Class/ Stocking	FORPLAN Level 8	Timber Rx Description
5.13	Lodgepole Pine	All/All	CC S2	Clear Cut Existing Stand, Clear Cut Regen Stand 2-step Shelterwood Existing Stand, 2-step Shelterwood Regen
5.13	Spruce/Fir	All/All Mature/All or Pole/Good Pole/Medium Pole/Poor Mature/All or Pole/Good Pole/Medium	S2 S3 G1, G2, or G3 G2, G3, or G4 G3, G4, or G5 T1, T2, or T3 T2, T3, or T4	2-step Shelterwood Existing Stand, 2-step Shelterwood Regen Stand 3-step Shelterwood Existing Stand, 3-step Shelterwood Regen Stand Group Selection starting in Decade 1, 2, or 3 with 20 year cycle Group Selection starting in Decade 2, 3, or 4 with 20 year cycle Group Selection starting in Decade 3, 4, or 5 with 20 year cycle Individual Tree Selection starting Dec. 1, 2, or 3 with 20 year cycle Individual Tree Selection starting Dec. 2, 3, or 4 with 20 year cycle
5.11	Lodgepole Pine	All/All Mature/All or Pole/Good or Pole/Medium Pole/Poor	CC S2 IR G1, G2, or G3 G2, G3, or G4	Clear Cut Existing Stand, Clear Cut Regen Stand 2-step Shelterwood Existing Stand, 2-step Shelterwood Regen Irregular Shelterwood Existing Stand, Irregular Shelterwood Regen Stand Group Selection starting in Decade 1, 2, or 3 with 20 year cycle Group Selection starting in Decade 2, 3, or 4 with 20 year cycle
5.11	Spruce/Fir	All/All Mature/All or Pole/Good Pole/Medium Pole/Poor Mature/All or Pole/Good Pole/Medium Pole/Poor	S2 S3 IR G1, G2, or G3 G2, G3, or G4 G3, G4, or G5 T1, T2, or T3 T3, T4, or T5	2-step Shelterwood Existing Stand, 2-step Shelterwood Regen Stand 3-step Shelterwood Existing Stand, 3-step Shelterwood Regen Stand Irregular Shelterwood Existing Stand, Irregular Shelterwood Regen Stand Group Selection starting in Decade 1, 2, or 3 with 30 year cycle Group Selection starting in Decade 2, 3, or 4 with 30 year cycle Group Selection starting in Decade 3, 4, or 5 with 30 year cycle Individual Tree Selection starting Dec. 1, 2, or 3 with 30 year cycle Individual Tree Selection starting Dec. 2, 3, or 4 with 30 year cycle Individual Tree Selection starting with Dec. 3, 4, or 5 with 30 year cycle
5.11 or 5.13	Aspen	All/All	CP	Coppice Existing Stand, Coppice Regen Stand

Sawtimber revenue figures reflect a 4-year average of harvest values (revenues actually paid) for sawtimber on the Routt National Forest. The average conifer sawtimber harvest value is $153.16/thousand board-feet (MBF). The average value for sawtimber aspen is $65.30/MBF.

All harvest on the Routt has been tractor logged. To determine a value for cable logged timber, the additional cost of this harvest method was calculated. The additional cost of yarding, felling and bucking, and overhead in cable logging was determined to be $124/MBF. The additional cost was included in FORPLAN as an activity found only on steep slopes.

Helicopter logging was also considered for those areas that are difficult to access but have good stands of timber. To estimate the reduction to revenues over tractor logging, a PC-based program named Helipace (Helicopter Logging Production and Cost Estimation) was used to evaluate several areas on the Forest. Helipace was designed by Aerial Forest Management Foundation, USDA Forest Service, Pacific Northwest Research Station. The analysis indicated that helicopter logging costs are $166/MBF above tractor logging. The additional cost was included in FORPLAN as an activity found only for inaccessible areas.

All costs associated with timber and their production functions were developed by the interdisciplinary team and district timber staffs. The basis for the costs was a 3-year historic average, with changes based on the updated standards and guidelines. After the model was run, costs were reviewed to determine if they were realistic.

The production function for miles of road reconstruction and construction was developed based on the historic amount constructed/reconstructed for the amount of timber harvested. The production function for road construction and reconstruction was varied based on whether the area was already roaded, a roadless area not requiring a collector system, or a roadless area requiring a collector system.

Each roadless area was evaluated for the construction of a collector road system. Those roadless areas requiring a collector system were modeled in FORPLAN as individual zones. The miles required to build the collector system and the price of construction were determined by the Forest Engineer. Before a zone could be entered for timber harvest, the model required the construction of the collector system. One-third of the conifer timber volume for the zone could be accessed while the collector system is being built (over a decade time period). Once the collector system was built, the rest of the volume was accessible using only local roading costs.

A summary of all costs in the FORPLAN model is shown in Table B-6.

FORPLAN Economic Analysis (Stage II)

Stage II analysis was run to estimate the most profitable timber prescription for each analysis area and to determine which analysis areas had the highest returns for timber. The analysis consists of sorting through economic information that is generated for use in FORPLAN and finding the highest present net value for each part of the Forest. The analysis was done by taking data from the FORPLAN matrix and placing it in a Paradox database. Results from the Stage II analysis can be found in the planning record.

Table B-6. Summary of Costs in the FORPLAN Model

Activity	Cost/Unit	Production Relationship
Silvicultural Exams & Planning		
First Entry	$5	10 ac exam/1 ac harv
Second Entry	$5	1.5 ac exam/1 ac harv
Sale Prep		

Clear Cut	$29.99/mbf	1 mbf prep/1 mbf harv
Shelterwood, Group Selection	$40.44/mbf	1 mbf prep/1 mbf harv
Individual Tree Selection	$56.11/mbf	1 mbf prep/1 mbf harv
Clear Cut in Rdls Area	$35.99/mbf	1 mbf prep/1 mbf harv
Shltrwd, Group Sel in Rdls area	$46.44/mbf	1 mbf prep/1 mbf harv
Individual Tree Sel in Rdls area	$62.11/mbf	1 mbf prep/1 mbf harv
Heritage Resource Inventory		
First Entry	$15.21/ac	1.5 ac/1 ac harv
Second Entry	$2.00/ac	1.5 ac/1 ac harv
Sale Administration		
Clear Cut	$18.45/mbf	1 mbf admin/1 mbf harv
All others	$21.54/mbf	1 mbf admin/1 mbf harv
Site Prep for Natural Regen		
Clear Cut	$135.00/ac	0.25 ac prep/1 ac harv
Shelterwood (seed cut)	$135.00/ac	0.05 ac prep/1 ac harv
Litigation and Appeals	$2.00/mbf	1 mbf litigation/1 mbf harv
EIS prep and litigation for rdls area	$48,000/rdls area	1 EIS per rdls area
Planting - Clear Cut only	$500.00/ac	0.01 ac plant/1 ac harv
Seeding - Clear Cut only	$180.00/ac	0.13 ac plant/1 ac harv
Certification of Natural Regen		
Clear Cut	$9.50/ac	0.61 ac cert/1 ac harv
Shelterwood	$9.50/ac	0.95 ac cert/1 ac harv
Group or Individual Tree Sel.	$9.50/ac	1.0 ac cert/1 ac harv
Pre-commercial Thin		
Regen Stand	$150.00/ac	1 ac thin/1 ac regen age 20 LP
Exist Stand - CC, SW	$150.00/ac	1 ac thin/1 ac size 7 w/ PCT
Exist Stand - Group Sel 2nd Entry	$90.00/ac	1 ac thin/1 ac harv
Exist Stand - Individual Tree Sel	$90.00/ac	1 ac thin/1 ac harv
Common Services/Overhead	$22.50/mbf	1 $ overhead/1 mbf harv
Law Enforcement	$0.68/mbf	1 $ law/1 mbf harv
Rights-of-Way	$9,300/case	0.08 cases/1 mmbf harv
Local Roads - Purchaser Road Const		
First Entry	$17,000/mile	0.0096 mile/1 ac harv
Local Roads - Purchaser Road Reconst		
First Entry	$5,530/mile	0.0025 mile/1 ac harv
Local Road Const - Preconst Engineer.	$8,000/mile	1 mile preconst/1 mile const
Local Road Reconst-Preconst Engineer.	$5,150/mile	1 mile preconst/1 mile reconst
Local Road Const - Engineering	$5,070/mile	1 mile eng/1 mile const
Local Road Reconst - Engineering	$2,000/mile	1 mile eng/1 mile reconst
Local Road Maintenance Btwn Entries	$106.80/mile	1 mi maint/1 mi const each dec.
Pre-haul Maintenance - 2nd Entry	$2,000/mile	1 mile maint/1 mile const
Cable Logging - additional cost	$124.00/mbf	1 mbf cable log/1 mbf harv on >40% slopes
Helicopter Logging - additional cost	$166.00/mbf	1 mbf heli log/1 mbf harv on inaccessible area
Collector Roads - Construction	varies by rdls area	varies by rdls area
Collector Roads - Reconstruction	varies by rdls area	varies by rdls area

Benchmark Analysis

Benchmark analysis is specified in the NFMA regulations in 36 CFR 219.12(e) as part of the AMS. Selection of those benchmarks to develop is dependent upon the revision topics. Benchmarks assist in defining the range within which alternatives can be constructed. Three benchmarks are relevant to the timber revision topic. They are:

1. Maximizing the present net value of the timber program.
2. Maximizing timber production in the first decade.
3. Minimizing costs of the timber program.

The NFMA regulations in 36 CFR 217.27 list management requirements that must be considered in benchmarks. The following basic management requirements were included in the benchmark FORPLAN models:

- Timber harvest regulations.
- Nondeclining flow and long-term sustained yield.
- The ASQ only generated from tentatively suitable timber lands.
- Water quality and watershed protection.
- Riparian protection.
- Snag-dependent species protection.
- Base level of visual resource protection.

The maximum present net value benchmark for timber has a PNV (over the plan horizon of 200 years) of $38,231,465. The ASQ is 403 MMBF in decade 1, with harvest occurring on 23,273 acres. Very little spruce/fir is harvested in the first three decades, when the majority of harvest is clearcutting in lodgepole pine. For decades four and beyond, there is a mixture of clear cutting in lodgepole pine and shelterwood systems in spruce/fir. No group or individual tree selection is implemented over the planning horizon.

The maximum timber benchmark has an ASQ of 539 MMBF in decade 1, with harvest occurring on 55,318 acres. The PNV for timber is -$24,519,807 (over the plan horizon of 200 years). There is a reduction in ASQ for the maximum timber benchmark from that found in the draft EIS because timber suitability and timber yield tables were updated for the final EIS. Also, in the draft EIS, all regenerated stands were pre-commercial thin, increasing volumes in the future. This has been changed in the FEIS, with only lodgepole pine stands receiving a pre-commercial thin.

The minimum level benchmark for timber would show no commercial timber production or an ASQ of zero. The PNV for timber is zero, since there would be no costs incurred (for timber) and no revenues generated.

The range of natural variability described in Appendix D serves as a benchmark for the biological diversity revision topic. The roadless inventory and Alternatives F (retain all roadless areas in a roadless state) and G (open most roadless areas to development) serve as benchmarks for the roadless area revision topic. There are no benchmarks that are relevant to the recreation/travel management or the wild and scenic rivers revision topics.

FORPLAN Constraints

Several constraints were developed for the FORPLAN model in response to standards and guidelines and the management requirements in the NFMA regulations (36 CFR 219.27). Constraints were also developed in response to management goals and to improve the model's simulation of actual management of the Forest. The following FORPLAN constraints were applied to all alternatives, except where noted. The affect of each constraint on the model is discussed in the following section on "Sensitivity Analysis."

1. Long Term Sustained Yield (LTSY) and Nondeclining Yields

Ensures that the timber yield is sustainable and will not decline in any decade.

2. Snags

To allow for the retention of snags, the timber yields for regenerated stands were reduced in the yield tables. For clearcuts, shelterwood, and coppice, four trees per acre were retained for snags. For group or individual tree selection, two trees per acre greater than 17 inch DBH were retained in management area prescription 5.13 and four trees per acre greater than 20 inch DBH were retained in management area prescription 5.11.

3. Aspen Limit

Most alternatives (A, C, E, and G) have a constraint that requires the model to harvest 2 million board-feet (MMBF) of aspen per year for the planning horizon (200 years) at the full implementation level and 1 MMBF per year at the experienced budget level. Because aspen is uneconomical, the model would not choose to harvest any without the constraint. However, there is a small market for aspen, and the model was used to analyze the effects and costs of supplying this product. Because the market is unstable, aspen is being tracked separately from conifer and does not enter into the LTSY calculation.

The aspen constraint was changed to 1 MMBF per year for Alternatives B and D at both budget levels. Alternative F had no constraint to require the harvest of aspen.

4. Sensitive Watersheds

Watersheds that were at or near threshold were identified. The amount of the watershed that could be harvested before threshold was reached was identified. The watersheds were then grouped by the percent allowed to harvest. Grouping was by 0%, 6%, 15%, or 25%. The watersheds were then constrained to this percentage that could be cut in the first 5 decades of the plan.

5. Visuals

Two questions had to be answered to model the visual constraints. The first is "How long does it take for an opening to no longer affect the visuals of an area?" The second is "How much of an area may be in an opening and still meet the visual quality objective (VQO)?"

Analysis was performed to answer these two questions. Regeneration surveys and stand exam data were reviewed to determine the age when stands would be 25 feet tall and have 400 trees per acre. Wayne Shepard, a research scientist at the Rocky Mountain Research Station, was consulted as to the age. From this information, it was determined that it requires approximately 30 years for a regenerated lodgepole pine stand and 40 years for a regenerated spruce/fir stand on the Routt to achieve a 25 foot average height and 400 trees/acre. At this point, the opening would no longer have an affect from a visual standpoint.

Any stands that are lodgepole pine and size class 6 (nonstocked) at the beginning of the planning horizon will be considered to be openings for another 20 years. Stands that are spruce/fir and size class 6 at the beginning of the planning horizon will be considered to be openings for another 30 years.

Analysis was performed using viewpoints, stand data, and terrain data to determine the amount of the landscape that could be in an opening and still meet the VQO. The analysis indicated that, on the average, 25% of a landscape is unseen from viewpoints. To maintain a VQO of partial retention, 10-15% of the seen landscape could be in an opening. Because the FORPLAN model is not spatial and because only timber harvest resulting in an opening was included in the constraint, the threshold of 10% for the seen area was used. Although unseen areas are not constrained for visuals, they are still limited in the amount that can be in an opening at one time. Watershed, wildlife cover, and dispersion requirements limit the amount of openings in unseen areas to approximately 20%. The weighted average for the whole area is 12.5% in an opening (based on 0.75 of area multiplied by 0.10 plus 0.25 of area multiplied by 0.20).

To maintain a VQO of modification, analysis indicated that 20-25% of the seen landscape could be in an opening. Because only timber harvest resulting in an opening was included in the constraint and because there are other harvest limits (watershed, wildlife, and dispersion), the threshold of 20% for the entire area was used.

The 5.11 management area prescriptions were modeled as 75% partial retention and 25% modification. The 5.13 management area prescriptions were modeled as 25% partial retention and 75% modification. Two output codes were used to keep track of the openings. Existing openings were tracked with the code 0EFL. New openings were tracked with EFLT. The total of the two output codes were aggregated into output code AEFL. Complex time dependent yield composites were used to track an existing (size class 6) opening as an opening (20 years for lodgepole pine and 30 years for spruce/fir) at the beginning of the planning horizon. Sequence dependent yield composites were used to track any harvest opening as an opening (30 years for lodgepole pine and 40 years for spruce/fir). A General Relational Constraint was then used to limit the amount of conifer 5.11 or conifer 5.13 that could be an opening or, in other words, the amount of AEFL.

6. Pre-commercial Thinning (PCT)

Because of the upfront cost with delayed returns, the model does not choose on its own to PCT any existing stands. Because, in reality, the Forest would PCT these stands to improve forest health and increase productivity, a constraint was included that requires at least 5,000 acres (500 acres/yr) to be PCT in the first decade only. This PCT would occur in size class 7 (saplings).

Lodgepole pine stands that are currently nonstocked or seedlings (size class 6) are required to have a PCT within 2 decades. However, because of the cost of doing PCT in the second decade, the model does not choose on its own to put any of the size class 6 stands into timber production. In reality, the Forest would be doing PCT on these stands and managing them on a rotation basis. A constraint requiring at least 5,000 acres of size class 6 lodgepole pine to be PCT in decade 2 was built. This constraint put sthese lands into timber management.

These constraints were changed under Alternative F because the size of the timber program was greatly reduced from the other alternatives. In Alternative F, the constraint was changed to 2,000 acres in decades 1 and 2.

7. Cable Logging

The Forest has not used cable logging in the past, and it is unrealistic to assume we will begin to cable log many hundreds of acres in future years. In order to support a higher level of harvest in current decades, the model may choose to do a substantial amount of cable logging in future decades. Thus, a constraint was included that limits cable logging to 2,000 acres for any one decade.

8. Helicopter Logging

To limit the helicopter logging to a reasonable number of acres in any decade, a limit of 1,000 acres for any one decade was included. In addition, based on site-specific analysis of acres that may be viable for helicopter logging (due to economics, terrain, etc.), the model is limited to 5,000 acres of helicopter logging over the planning horizon.

9. Species Mix

Revenue value is not broken out by species. Therefore, the model would choose to harvest the species with the highest volume, while meeting all other constraints. In reality, the species harvested are mixed (historically about 60% lodgepole). To more accurately reflect plan implementation, the total timber harvested was constrained to be comprised of between 40 and 60% lodgepole pine.

Because of the limited amount of lands available to manage for timber, this constraint caused an infeasible solution for Alternative F. The constraint was changed under this alternative to require between 20 and 80% of the harvest to be lodgepole pine.

10. 5.11/5.13 Management Area Prescription Mix

This constraint was used in the model for the draft EIS. However, the constraint was dropped from the final EIS model because of public comment.

11. Low Density, Mature Conifer

Because of the low volumes per acre, the model chooses not to harvest any of the conifer in the 9A strata. In reality, the Forest would harvest some of the 9A, in order to regenerate the stand and improve forest health. These low-volume areas are often part of a sale package that includes areas with better volumes. Therefore, a constraint was added to force the harvest of at least 5% of the tentatively suitable 9A of each species (LP and SF) for each of the first 3 decades.

12. Financial Efficiency

Because below-cost timber sales is still a national issue and because the model tends to do things in the future decades that may not be financially efficient, a constraint was built so revenues must exceed costs in all decades.

With the higher timber revenues used in the FEIS, this constraint is not binding in any alternative. It was included to ensure an above-cost timber program, but the model never ran up against this limit.

13. Watershed Constraint

A constraint was built to ensure water quality standards and guidelines are met. Analysis determined that, on average, 36% of the suitable timber lands in a watershed could be disturbed and still meet standards and guidelines.

To build the watershed constraint in FORPLAN, two output codes were created to track the acres disturbed. One output code tracked the acres currently disturbed. The other output

code tracked new disturbance acres. The disturbance factor (e.g., one acre disturbed equals one acre or less of disturbance) diminishes over time.

The output code that tracks current disturbance is 0WTR. For areas in size class 6, the disturbance factor equals 1 (one acre of size class 6 equals one acre of disturbance) in decade one. The disturbance factor diminishes by 0.1 acre over time, until it is 0.2 (one acre of size class 6 equals 0.2 acre of disturbance) in decade 9. The factor is then zero in decade 10.

For areas in size class 7, the disturbance factor equals 0.7 (one acre of size class 7 equals 0.7 acre of disturbance) in decade 1. The disturbance factor diminishes by 0.1 acre over time, until it is 0.2 in decade 6. The factor is then zero in decade 7.

The output code that tracks new disturbance is WTRT. The factor for disturbance varies based on harvest method. For a shelterwood prep cut, the disturbance factor equals 0.5 for decades 0 and 1. The factor increases to 1.0 in decade 2 and then diminishes by 0.1 for the next 10 decades. For all other regen cuts, the disturbance factor equals 1.0 for decades 0 and 1, diminishing by 0.1 for the next 8 decades. For selection harvest, the factor equals 0.3 for all decades.

An aggregate output, AWTR, was then built to reflect the total of 0WTR and WTRT. A General Relation Constraint was built to constrain the aggregate output AWTR to limit the amount to no more than 36% of suitable acres for each decade. This constraint was applied separately to currently roaded areas, roadless areas not requiring a collector system, and roadless areas requiring a collector system.

This constraint was not binding under any alternative. However, it was binding under the benchmark runs.

14. Budget Constraint

To assess effects under current budget levels, each alternative was run with a budget constraint. At the experienced budget level, the constrained budget varies by alternative, based on the theme. The model was run with this constraint to determine the estimated volume offer.

To determine ASQ, all alternatives except Alternative C were run without a budget constraint. To generate a somewhat realistic budget level for the ASQ in the Revised Plan, Alternative C was run with a budget constraint at the full implementation level. The budget was constrained to 130% of the experienced budget constraint for Alternative A (which used a 3-year average of the timber budget for 1992, 1993, and 1994). The timber budget on the Forest has declined over the past several years. In 1992, the constrained timber budget (does not include KV, salvage sale, brush disposal, or purchaser road funds) for the Routt was $1,860,800. This declined to $1,691,500 in 1993, to $1,582,200 in 1994, and to $1,544,300 in 1995. The constrained timber budget for Alternative C is $2,154,700. This is a 40% increase over the 1995 timber budget. Furthermore, timber budgets have continued to decline since 1995, making the percent increase over current years even higher. Thus, the budget constraint allows a substantial increase over current timber budget levels without allowing the budget to double or triple. If the budget was allowed to double or triple, the ASQ associated with Alternative C would be unrealistic and unachievable.

15. Mix of Silvicultural Prescriptions for 5.11 and 5.13

The interdisciplinary team and district timber management assistants (TMAs) developed a mix of silvicultural prescriptions to define 5.11 and 5.13 management area prescriptions. Because 5.11 is less intensive, more uneven-aged management was emphasized, while

5.13 allowed more even-aged management. The following constraints were used to define the mix of silvicultural systems by management prescription:

For Rx 5.11 and species lodgepole pine:

- 2-step shelterwood is minimum of 20% acres harvest.
- Irregular shelterwood (no overstory removal) is minimum of 10% acres harvest.
- Group selection is minimum of 10% acres harvest.

For Rx 5.13 and species lodgepole pine:

- 2-step shelterwood is minimum of 20% acres harvest.

For Rx 5.11 and species spruce/fir:

- 3-step shelterwood is minimum of 45% acres harvest.
- Irregular shelterwood (no overstory removal) is minimum of 10% acres harvest.
- Group selection is minimum of 35% acres harvest.
- Individual tree selection is minimum of 5% acres harvest.

For Rx 5.13 and species spruce/fir:

- 2-step shelterwood is minimum of 10% acres harvest.
- 3-step shelterwood is minimum of 40% acres harvest.
- Group selection is minimum of 40% acres harvest.
- Individual tree selection is minimum of 5% acres harvest.

16. Limit Harvest in 5.11 to Stands Aged at least 200 Years

The rotation age for lodgepole pine and spruce/fir in the 5.11 management area prescription is a minimum of 200 years. To ensure that existing stands are at least 200 years old before harvest, constraints were built, limiting the amount of acreage within 5.11 that could be harvested over the first four decades. To determine the acre limits, the RMRIS data base was queried to determine the percent of timber acres by species (lodgepole pine or spruce/fir) outside of wilderness that were greater than or equal to 200 years old. These percentages were then applied as limits to harvest within 5.11.

Sensitivity Analysis

Fifteen FORPLAN runs were made to examine the trade-offs caused by the constraints or yields. In each run, a single constraint was either removed or added or a yield or price changed. The maximize PNV benchmark was used as the base run. When compared to the maximize PNV run, the change in PNV and the change in timber volume offered reflect the opportunity cost of meeting that constraint or the effect of changing a yield stream or price. This analysis can then be used to assess the effect a particular constraint, yield, or price may have on the solution and the level of sensitivity in the model.

Table B-7 summarizes the effect on the PNV over the planning horizon and the conifer sawtimber offered in decade one for each sensitivity run. Following is an explanation of each

FORPLAN run. For each run, the change (adding or releasing a constraint or changing a yield or price) was made to the maximize PNV benchmark run.

Table B-7. Summary of Sensitivity Analysis on the FORPLAN Model

FORPLAN Run	Description	PNV (M$)	ASQ in MMBF (decade 1)
Max PNV	Benchmark to maximize PNV	38,231.5	403
Max TMB	Benchmark to maximize Timber	-24,519.8	539
Run 1	release watershed constraints	38,746.6	405
Run 2	release visual constraints	40,882.5	431
Run 3	add financial constraint	37,700.3	405
Run 4	add species mixture constraint	38,223.9	402
Run 5	add constraint to harvest 9A	37,089.9	405
Run 6	add constraint to do PCT	36,304.2	404
Run 7	change timber price to stat hi bid	124,267.3	447
Run 8	change all mgt rx to 5.13	31,818.6	377
Run 9	change all mgt rx to 5.11 with partial retention visuals	14,519.7	171
Run 10	change all mgt rx to 5.11 with modification visuals	21,006.5	234
Run 11	same as run 10 but release constraints to harvest >200 yr old	22,444.0	307
Run 12	reduce timber yields by 10%	30,773.2	353
Run 13	reduce timber yields by 5%	34,483.0	379
Run 14	increase timber yields by 5% (release snag reduction)	41,984.1	425
Run 15	add timber price trends of 2% increase per year	138,445.1	454

FORPLAN run 1 was made by releasing the watershed constraints to the maximize PNV benchmark. Compared to the maximize PNV benchmark, these constraints did not have much of an effect on the model. Model sensitivity to this constraint appears to be low.

FORPLAN run 2 was made by releasing the visual constraints to the maximize PNV benchmark. These constraints have an effect on the volume offer and PNV. Release of these constraints increase ASQ by 7%, indicating the model is moderately sensitive to the constraints.

FORPLAN run 3 was made by adding the financial constraint to the maximize PNV benchmark. This constraint shows very little effect on the model, indicating low sensitivity. Although this run shows a very slight increase in MMBF in decade 1, the LTSY is slightly less [8723 thousand cubic feet (MCF)] than that found in the max PNV benchmark (8733 MCF). This means the max PNV benchmark harvests a higher volume of timber over the planning horizon.

FORPLAN run 4 was made by adding the species mix constraint to the maximize PNV benchmark. This constraint had very little effect on the solution, causing little reduction to PNV and volume offer. The model is not sensitive to this constraint.

FORPLAN run 5 was made by adding the constraint to harvest some of the low density, mature conifer in decades 1, 2, and 3 to the maximize PNV benchmark. This constraint had very little

effect on the solution, reducing the PNV and increasing the ASQ slightly. The model is not sensitive to this constraint.

FORPLAN run 6 was made by adding the constraint to do pre-commercial thinning in existing stands in decades 1 and 2 to the maximize PNV benchmark. This constraint had very little effect on the solution, indicating low model sensitivity to the constraint.

FORPLAN run 7 was made by changing the revenue value for conifer sawtimber. The revenue value used in the benchmarks and all alternatives was a 4-year average of actual returns to the U.S. Treasury. To estimate the effect of conifer revenue value on the model, the Forest developed a second price for conifer. This second revenue value is based on the last 4-year average Statistical High Bid, which is another indicator of timber price. This analysis resulted in a revenue value for conifer of $231.77/MBF (as opposed to the $153.16/MBF from the 4-year average returns). This FORPLAN run was made to see what effect the timber price from statistical high bid would have on the solution. This change in price had a moderate effect on the model, causing the volume offer to increase approximately 10%. This sensitivity of the model to change in price was described in the DEIS, pages B-29 and 30. For the FEIS, the model is still sensitive to the price of timber.

FORPLAN run 8 was made by treating all suitable acres in the maximize PNV benchmark as if they were in management area prescription 5.13. This run shows the opportunity cost of managing the suitable timber using the mix of silvicultural prescriptions defined for 5.13. The effect of applying these silvicultural prescriptions has a moderate effect on the benchmark, causing a 7% reduction in the sawtimber volume offer.

FORPLAN run 9 was made by treating all suitable acres in the maximize PNV benchmark as if they were in management area prescription 5.11 with a VQO of partial retention. This run shows that applying the mix of silvicultural prescriptions and partial retention VQO as defined in 5.11 has a large effect on the model's solution. The application of this management area prescription and VQO causes a 58% reduction in the sawtimber volume offer.

FORPLAN run 10 was made by treating all suitable acres in the maximize PNV benchmark as if they were in management area prescription 5.11 with a VQO of modification. This run shows that applying the mix of silvicultural prescriptions as defined in 5.11 has a large effect on the model's solution. The application of this management area prescription and the modification VQO causes a 42% reduction in the sawtimber volume offer.

FORPLAN run 11 was the same as Run 10, but released the constraints to limit harvest of the existing stands to those greater than or equal to 200 years old . Releasing these constraints increased the ASQ and PNV significantly over Run 10, showing a 31% increase in timber volume. Thus, the model is sensitive to this constraint.

FORPLAN runs 12 and 13 were made by reducing the conifer timber yields by 10% and 5%, respectively. These runs showed that a reduction in timber yields does have an effect on the model, indicating that the model is sensitive to timber yields.

FORPLAN run 14 was made by increasing timber yields by 5%. This is the same affect as not retaining trees for snag-dependent wildlife species. The increase in timber yields caused a moderate increase in PNV and ASQ, showing that managing for retention of some snags does have an impact on the model outputs.

FORPLAN run 15 was made by adding a timber price trend of 2% increase per year for the first 50 years. Including a price trend had a significant effect on the PNV and ASQ levels, similar to the effect from a change in price (see description for FORPLAN run 7 on previous page). The model is sensitive to price and including a price trend would increase PNV and ASQ.

In summary, the sensitivity analysis indicates that the model is sensitive to: timber price and price trends; management for visual quality objectives; the mix of silvicultural prescriptions and rotation ages defined for the management area prescription 5.11; and timber yields and the requirement to retain snags. A change to any of the preceding items would cause a significant change in the solution. However, because this analysis was performed using the maximize PNV benchmark as the base, the actual effect of each constraint, yield, or price on any one alternative is not known. The effect may be larger or smaller, based on the land allocation for an alternative.

Changes to the FORPLAN Model Between Draft and Final EIS

The revision data base and district information on future timber sales was updated between the draft and final EIS. The most current information was included in the FEIS. Page B-18 of the DEIS indicated that this would occur for the FEIS.

In response to public comment and to update analysis for the FEIS, the following changes were made to the FORPLAN model:

- Updated the timber price for a new, 4-year average. The 4-year average reflects timber revenues for FY93 through FY96. Four years was used because that is the amount of time allowed to harvest a sale. The timber value went from $89.38/mbf in the DEIS to $153.16/mbf in the FEIS.
- Updated timber unit costs. Added a cost for litigation and appeals.
- Added specific silvicultural prescriptions and treatment types for acres entering the model in some kind of harvest condition. In the DEIS, any current harvest acres were treated as seedlings; the modeling in the FEIS better reflects the current and future condition of these stands.
- Included the cost of roads in the calculation of PNV for the objective function.
- Corrected the helicopter logging cost. The DEIS incorrectly used a cost of $300/mbf, while the cost was estimated to be $166/mbf.
- Changed PCT in regenerated stands so that all lodgepole pine would have a PCT while all spruce/fir would not have a PCT.
- Updated timber suitability for the most current data and information. Added riparian lines that were buffered 100 feet.
- Adjusted the management area prescription allocation for Alternative C.
- Re-ran all timber yield tables for the latest FVS model.
- Added constraints to ensure that the model would not harvest existing stands that are <200 years old in management area prescription 5.11.
- Changed the visual constraint to include effects from selection harvests.
- Changed the constraint to provide for aspen harvest under the experienced budget level from 2 MMBF/yr in DEIS to 1 MMBF/yr.
- Added a budget constraint to the full implementation level for Alternative C at 130% above the experienced budget.

The change in timber price between the DEIS and FEIS had a significant effect on the model, resulting in higher ASQ levels in all alternatives except Alternative F. (Alternative F is constrained by the management area prescription allocation and was not affected by the change in timber price.) With the higher revenue value, roadless areas became more economical, as did cable and helicopter logging, creating an increase in ASQ levels. Under the experienced budget level, however, there was no increase in timber volume offer because of the limit on the budget. This model sensitivity to timber price was described and documented in the DEIS (see pages B-29 and B-30 of the DEIS).

Analysis of Range Capability and Suitability for Livestock Grazing

An analysis of the capability of rangelands to support livestock grazing and an analysis of the appropriateness for livestock grazing to occur on particular areas of land within the Routt National Forest was completed as part of the forest planning process. The following definitions were used to complete the analysis.

36 CFR 219.3 Definitions and terminology.

Capability - 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. It also includes the application of management practices, such as silviculture, or protection from fire, insects, and disease.

Suitability - the appropriateness of applying certain resource management practices to a particular area of land, as determined by an analysis of the economic and environmental consequences and the alternative uses foregone. A unit of land may be suitable for a variety of individual or combined management practices.

At the project level, rangeland capability and suitability may be reviewed and updated if it is an issue for that project. For instance, rangelands identified as capable and suitable for domestic livestock grazing in the land and resource management plan may include areas that are not appropriate for domestic livestock grazing when analyzed at the site-specific level (i.e., some wetlands or some campgrounds).

In some situations, domestic livestock need not be prohibited from areas not identified in the plan as capable and suitable. For example, a forested area with sufficient forage to support domestic livestock may not be identified as capable and suitable, but the presence of domestic livestock drifting from a adjacent suitable area may not conflict with other uses. In this situation, it would not be necessary to physically prevent access to the forested area by domestic livestock, but there would be no forage allocation made.

Capability Analysis

The analysis of capable rangelands was developed using the following criteria:

1. Geologic Hazards - Those areas that displayed characteristics of unstable landmasses were not considered to be capable for supporting livestock grazing.
2. Fragile soils with high inherent erosion potential and areas with naturally high amounts of surface rock and rock outcrop were not considered to be capable for supporting livestock grazing. These areas are typically low in forage production and are susceptible to livestock trampling and are not considered to be capable for supporting livestock grazing.

3. Topography with slopes of 0%-40% were considered capable of supporting both cattle and sheep grazing. Slopes between 40%-60% were considered capable of supporting only sheep grazing.
4. Water availability is not a limiting factor on the Routt National Forest due to the high elevation and numerous spring and stream sources. For this reason, water for livestock consumption was not considered as a limiting factor for determining capability. Water availability can be addressed at the site-specific level of analysis if identified as an issue during the allotment management planning process.
5. Forage production was not identified as a limiting factor for determination of capability due to the high elevation and generally high site productivity on the Routt National Forest. Forage availability can be addressed a the site-specific level of analysis if identified as an issue during the allotment management planning process.
6. Lakes and reservoirs were removed from the capable range area.

The above criteria were applied using a Geographic Information System (GIS). The resulting acres are displayed in Table **B-8**. Maps displaying the capable acres are part of the planning record.

Based on the criteria for developing acres capable of supporting livestock grazing, there are 1,060,452 acres capable of supporting cattle and sheep grazing. An additional 166,926 acres are capable of supporting just sheep grazing, for a total of 1,227,378 acres capable of sheep grazing. Accordingly, approximately 78% of the Forest is capable of being grazed by cattle and sheep with an additional 12% capable of supporting sheep use only.

Table B-8. Acres of Land Determined as Capable for Livestock Use

Classification/Description	Acres Deducted	Running Totals
Net National Forest	1,356,000	
Deductions for Non-Capable Acres		
a. Barren land, rock outcrop	59,483	1,296,517
b. Geologic Hazards - Unstable land masses	11,119	1,285,398
c. Lake or Reservoir	3,350	1,282,048
d. Slopes greater than 60%	54,670	1,227,378
e. Slopes between 40-60% (not capable cattle)	166,926	1,060,452
Total capable for sheep grazing	1,227,378	
Total capable for cattle grazing	1,060,452	

Suitability Analysis

A suitability analysis identified where grazing is appropriate, considering environmental and economic consequences and alternative uses foregone.

Alternative Range Management Prescriptions

To assess the environmental and economic consequences of range management, three different range management prescriptions were developed and analyzed.

The first range management prescription is the continuation of current management. This is the baseline, or "no action" prescription. Under the current management prescription, existing improvements that have reached the end of their physical life span will be reconstructed. New improvements will be added to the Forest as identified by project analysis. Areas identified as being in unsatisfactory condition will become satisfactory through mitigation identified in site-specific analysis and allotment management plans. Under this management prescription, about 5.2 acres per head month (or 0.19 head months/acre) is sustainable over the 50-year planning period.

The second range management prescription is a reduced level of grazing. In most areas, existing improvements that have reached the end of their physical life span will be reconstructed. Very few new improvements would be added. The priority for improvements would be areas where there is a conflict with wildlife or areas in unsatisfactory condition. Under the reduced level of management, about 6.9 acres per head month (or 0.14 head months/acre) is sustainable over the 50-year planning period.

The third range management prescription analyzed is a no grazing prescription. This is a benchmark prescription and developed only to analyze affects. Under this prescription, few structural improvements are maintained for livestock management. Most improvements, such as fences, are for other management purposes. There would be no permitted livestock on the Forest.

Environmental Consequences

The environmental consequences discussed in this section apply only to the suitability analysis and are not related to the effects of alternatives discussed in Chapter 3 of the FEIS.

Use of prescribed fire would likely show no change in the short term, since nearly all burns are also carried out for wildlife benefits, forest health, and fuels reductions. In the long term under the no grazing prescription, more prescribed fire would probably be needed to manage the increased risks of wildfire brought about by the lack of vegetative removal by domestic livestock.

Noxious weed control is likely to stay relatively constant since weed populations are more prevalently influenced by the level and type of timber harvest and recreational use than by ungulate grazing.

In the Rangeland Vegetation Management program, pests are primarily restricted to animal damage control (coyote, bear, lion) that is carried out by the State Department of Agriculture. Efforts in this area would be reduced under the reduced and no grazing prescriptions.

Wild animal populations could increase slightly under the reduced grazing prescription while larger increases could be expected under the no grazing prescription.

Improvement of range conditions, where needed, is handled by establishing allotment-specific forage utilization levels.

There are no known acres of rangelands in unsatisfactory condition. They are either meeting Plan objectives or are moving toward objectives.

Economic Consequences

The Forest desires a managed livestock grazing program, where cost efficiencies are among the factors taken into consideration when deciding between range management prescriptions.

Economic analyses were undertaken from two perspectives. The first considers a taxpayer perspective, including only revenue received from grazing fees and agency expenses in managing for livestock production. This is referred to as a "financial efficiency" analysis. The second considers the full market value of grazing under permit as benefits and the same agency expenses as costs. This is referred to as a "cost efficiency" analysis.

The first analysis uses the 1996 grazing fee rate established by Congressional formula of $1.35 per head month for cattle and $0.27 per head month for sheep. The second analysis uses the RPA market clearing value of $8.00 per head month for cattle and $48.00 per head month for sheep.

Agency costs include permit administration and a portion of the development, maintenance, and reconstruction of allotment improvements.

Financial efficiency and cost efficiency are expressed in terms of present net value (PNV) on a per-acre basis. Revenues, benefits, and costs are discounted over 50 years at a 4% discount rate. The results are shown in Table B-9.

The economic analysis indicates that Prescription A provides the highest cost efficiency PNV per acre and the lowest financial efficiency PNV per acre. Prescription C provides the lowest cost efficiency PNV per acre and the highest financial efficiency PNV per acre.

The local economic impacts of grazing suitable lands in each alternative is included in the comprehensive estimate of jobs and income. This is found on page 3-294 of the FEIS.

Alternative Uses Foregone

Some lands are incompatible with grazing or browsing. Management area prescriptions identify forest management activities that are allowed and appropriate for the area. Livestock grazing has been identified as an appropriate activity in all the management areas with the exception of research natural areas, and to a minimal extent, core areas. Grazing is not appropriate in these management areas in order to prevent the loss of alternative uses (i.e., scientific research in ungrazed areas in Research Natural Areas). Table 3-88 in the FEIS describes the level of grazing restrictions that would occur by management area prescription. Suitability would vary by alternative, based on the allocation of proposed research natural areas.

There are other areas of land within the Forest that do not have permitted livestock grazing for various reasons. Areas such as campgrounds and administrative sites are not suitable for livestock grazing. There are also areas on the Forest where no range allotments exist, due to various administrative reasons. These unsuitable areas are common to all alternatives.

Table B-9. Summary of Economic Analysis for Livestock Grazing Suitability

Measure	Prescription A (Current	Prescription B (Reduced	Prescription C (No

	Management)	Level)	Grazing)
Annual Average over 50 Years			
Head Months - Sheep	191,400	145,000	0
Head Months - Cows	43,400	32,900	0
Head Months - Total	234,800	177,900	0
Acres Capable	1,227,378	1,227,378	1,227,378
Head Months per acre	0.1913	0.1449	0
Acres per Head Month	5.2273	6.8993	0
Revenue/Head Month - Sheep	0.27	0.27	0.27
Revenue/Head Month - Cows	1.35	1.35	1.35
Weighted Average Revenue/Head Month	0.47	0.47	0
Revenues/acre	0.09	0.07	0
Benefits/Head Month - Sheep	48.00	48.00	48.00
Benefits/Acre	8.00	8.00	8.00
Weighted Average Benefits/Head Month	40.61	40.60	0
Benefits/Acre	7.77	5.89	0
Permit Administration Costs	494,000	296,000	0
Range Improvement Costs	254,000	219,000	50,000
Total Cost	748,000	515,000	50,000
Costs Per Acre	0.61	0.42	0.04
Net Revenues per Acre	-0.52	-0.35	-0.04
Net Benefits per Acre	7.16	5.47	-0.04
Financial Efficiency per Acre			
Present Value Revenues	2.02	1.53	0
Present Value Costs	13.70	9.43	0.92
Present Net Value	-11.68	-7.90	-0.92
Cost Efficiency per Acre			
Present Value Benefits	174.64	132.31	0
Present Value Costs	13.70	9.43	0.92
Present Net Value	160.94	122.88	-0.92

Suitable Lands

Suitability is affected by the incompatible uses listed above. The allocation of proposed Research Natural Areas (RNAs) varies by alternative, based on how each alternative was developed. The change in allocation of proposed RNAs has the greatest effect on the suitable acres for each alternative.

The environmental and economic consequences for the three range management prescriptions show no affect on suitability. For prescriptions A and B (the two "action" range management prescriptions), environmental consequences are acceptable and cost-efficient. Range prescriptions are applied to the alternatives in a cost-efficient manner, based on the theme of the alternative and allocation of management area prescriptions. Because range is not an issue for the Plan Revision, prescription A (current management) is applied to the suitable acres of all alternatives except F. Because of the theme of the alternative and the allocation of management area prescription 1.41 (core areas), prescription B (reduced management) is applied to Alternative F.

Table B-10 summarizes the suitable range acres available on the Forest by Alternative. Figures B-9 through B-12 show the distribution of the lands suitable for livestock grazing for each alternative.

Table B-10. Summary of Lands Suited for Livestock Grazing (in M Acres) by Alternative

Classification	Alternative			
	A	B,D,E,G	C	F
Suitability for Sheep Grazing				
Acres Capable for Sheep Grazing	1,227,378	1,227,378	1,227,378	1,227,378
Deductions for Unsuitable areas--				
— Environmental Consequences	0	0	0	0
— Economic Consequences	0	0	0	0
— Alternative Uses Foregone--				
• Research Natural Areas	-588	-57,416	-29,628	-58,892
• Campgrounds/Recreation Sites	-259	-259	-259	-259
• Forest Service Administrative Sites	-8	-8	-8	-8
— Areas outside range allotments	-67,292	-54,315	-56,717	-54,315
Suitable Acres for Sheep Grazing	**1,159,231**	**1,115,380**	**1,140,766**	**1,113,904**
Suitability for Cattle Grazing				
Acres Capable for Cattle Grazing	1,060,452	1,060,452	1,060,452	1,060,452
Deductions for Unsuitable areas--				
— Environmental Consequences	0	0	0	0
— Economic Consequences	0	0	0	0
— Alternative Uses Foregone--				
• Research Natural Areas	-582	-44,525	-26,258	-45,980
• Campgrounds/Recreation Sites	-254	-254	-254	-254
• Forest Service Administrative Sites	-8	-8	-8	-8
— Areas outside range allotments	-47432	-36,536	-37,437	-36,536
Suitable Acres for Cattle Grazing	**1,012,176**	**979,129**	**996,495**	**977,674**

Economic Impact Analysis

Economic effects to local counties was estimated using the Micro IMPLAN and IMPLAN PRO models. IMPLAN is an economic input-output model that describes inter-industry dependencies and dependencies between production and consumption sectors in a regional economy. The model was developed over the last 15 years by the Forest Service and is now maintained by the Minnesota IMPLAN Group (MIG) at the University of Minnesota. MIG completely revised and updated the IMPLAN software to create IMPLAN PRO. The models were run on a personal computer.

The IMPLAN models track how industries purchase inputs from other industries for use in the production of outputs, which are then sold either to other industries or final consumers. With these transactions, associated economic effects, such as jobs and personal income, are predicted.

Diversity and Dependency Analysis

IMPLAN was used to assess the economic diversity and dependencies of the Routt National Forest economic zone of influence (regional economy) and each local county. The economic data from 1977 and 1991 were used for this analysis. The data from 1991 was the most current data available when this analysis was completed for the FEIS. After the DEIS was published, 1993 data became available. The diversity and dependency analysis was rerun for the zone of influence using the 1993 data. The updated analysis showed very little change from the 1991 data. Because of the small amount of change, the analysis completed for the DEIS remains valid and is used in the FEIS. Data from 1977 was used to indicate trends.

Economic diversity is the strength of the economy, providing resilience in the face of sudden changes. Economic diversity is defined as the number of sectors in an area and the distribution of economic activity, such as employment and income, within each sector. Generally, there are a large number of sectors in an area economy, with only a few sectors producing the majority of the economic activity. Economic activity is measured in terms of total income, employment, exports, final demand, and total output.

Economic dependency is another way of assessing the strength of regional and local economies. Rural economies in the Rocky Mountain Region generally depend most on their exports to sustain their income and employment. Frequently, over 90% of the economy's final demand is in their export activity. Based on this data, it is reasonable to estimate economic dependency on an analysis of the area's export base.

Export base analysis measures economic dependence by the percentage each sector produces for the export market. On a relative basis, the larger the percentage of total exports in a given industry, the greater the dependence of the rural economy on that industry. The economic dependency analysis evaluated each industry to estimate the degree of dependence of the economy on the industry's exports. This dependency is expressed in terms of total income and employment.

Economic diversity and dependency were calculated using reports generated by IMPLAN and moving them to a Paradox database, where the data was sorted using a Paradox script. For the diversity analysis, the Paradox script analyzed the IMPLAN report of total dollar output, employment, and income for each sector. For the dependency analysis, the script analyzed the total value of goods and services exported from the region, increased by a multiplier to track effects as the dollars circulate through the economy.

From the economic diversity and dependency analysis, the impact of Forest activities and outputs could be tied to the individual counties within the economic zone of influence.

Economic Impact Analysis

Impact analysis describes what happens when a change is made to the demand for commodities (e.g., animal unit months, AUMs, or recreation visitor days,RVDs) in the model region. Economic impacts were estimated using the best available data and tools. Not one tool or data set were used for all purposes. As noted in each section below, data that was best suited for estimating the impacts of one resource were not necessarily the best for estimating impacts of other resources. Some data are confidential in nature, other data are available to the public. IMPLAN PRO was the primary tool for determining impacts, but the method of using IMPLAN PRO varied by resource and data availability.

Impacts to local economies can be measured in several ways. Typically, employment and income are the most common and best understood measures. Employment is expressed in jobs; a job can be seasonal or year-round, full-time or part-time. The income measure used was Personal Income expressed in 1996 dollars.

The most comprehensive and nationally consistent data available for employment and income are provided by Bureau of Economic Analysis Regional Economic Information System (REIS). The most recent release of county-level data was June 1996. This release included data from 1969 to 1994. IMPLAN PRO uses this data as well as ES-202 data from the BLS (Burea of Labor Statistics) as the fundamental basis in its economic data base. Adjustments to the data are necessary to complete the IMPLAN PRO data base and fully integrate it into the input-output framework.

For the purpose of analyzing the impacts of Forest Plan revision alternatives, the 1993 database was used. Although IMPLAN PRO models reflect 1993 conditions, the dollar impact results were expressed in 1996 dollars.

IMPLAN PRO was used to provide Type II multipliers for direct dollar changes or response coefficients for changes in output production. Because input-output models are linear, multipliers or response coefficients need only be calculated once per model and then applied to the direct change in output. Spreadsheets were used to calculate total effects. Specifications for developing response coefficients are stated in each section below.

Three IMPLAN PRO models were developed: one for Routt and Moffat Counties; one for Jackson (CO), Carbon (WY), and Albany (WY) Counties; and one for Grand County. Data provided by MIG, Inc. was used in model development, except for the sawmill and logging sectors in the Jackson-Carbon-Albany model. Primary survey employment data collected by the University of Wyoming was used in place of MIG, Inc. data for these sectors. Additional information on these data is provided in the record.

Timber

Data - Primary data for the sawmill and logging sectors in the Rocky Mountain Region are not readily available in published data bases. Because there are often only 1 or 2 mills in a county, privacy laws restrict access to this data. Occasionally, informal surveys done by industry agreement or state-wide surveys by public agencies provide the best available data. The best and most recent employment data that allows correlations with production were collected by the timber industry in New Mexico and Arizona and by the University of Wyoming for southern Wyoming. The New Mexico and Arizona information was provided to the Forest Service in 1990 in conjunction with studies done regarding the Mexican Spotted Owl. The Wyoming data was provided in January 1996. While data for individual firms is confidential and was not made

available to the Forest Service, industry-wide employment data was available. A comparison of direct employment per MMBF log scale to the mills was made and revealed small differences between the studies. The Wyoming data was used to estimate impacts from sawmill and logging production.

The best source of wages and salaries came from *1995 Statewide Wage Survey Results: Agriculture Forestry, Construction and Operator Occupations* in the September 1995 issue of Wyoming Labor Force Trends (Wyoming Employment Resources Division). Another study by the same state agency in June 1992, entitled *Wyoming Timber Industry: Structure, Conduct, and Expectations,* provided similar information. In both studies, payroll expenses per employee were shown by three-digit Standard Industrial Classification (SIC) numbers (241 & 242). Because personal income includes all sources of income rather than simply employee compensation, the relationship between the two in IMPLAN PRO was used estimate personal income from this payroll data.

Use of the Model - Type II multipliers for employment and personal income were developed by industry aggregate from model reports. Multipliers for the Logging sector (#133) and Sawmill sector (#134) were then applied to the direct employment and personal income per MMBF from above to determine total effects per MMBF. Results were then multiplied by total MMBF production to estimate total effects in the local economy.

Grazing

Data - The best available data for agriculture is found in the 1992 Census of Agriculture. Total farm livestock inventory from Tables 14 and 17 were multiplied by 12 months to provide an estimate of total animal months in the model area. Animal months of grazing on Forest land were provided from Forest permit records. A proportion of Forest animal months to total animal months was calculated.

Use of the Model - To use the data above, it was necessary to know the impacts of a one percent change in total production. Range-fed Cattle (sector #4) and Sheep, Lambs, & Goats (sector #6) in IMPLAN PRO were used to estimate impacts. One percent of this sector's total industry output was run through the model, without using local purchase coefficients. Results were then multiplied by the changing proportion of Forest animal months to total animal months for each alternative.

Recreation & Wildlife

Data - Surveys of recreationists expenditures for different kinds of recreation activities have been collected by Forest Service researchers over many years. PARVS is the Forest Service data base which holds national recreation expenditure information. This information has been organized for use in IMPLAN PRO by the Washington Office. The expenditures were distributed among different industries according to their spending patterns. The results were then converted to a common unit of measure -- Recreation Visitor Day (RVD). National expenditure profiles for non-residents expenditures within 50 miles of the activity site were used for estimating impacts from all recreation except for wildlife-related recreation.

The U.S. Fish & Wildlife Service periodically conducts a national survey to obtain, among other information, data on recreation expenditures for hunting, fishing, and other wildlife-related recreation. This information is available by state. These expenditures profiles were also organized for use in IMPLAN PRO by the Washington Office. Expenditure profiles for non-resident expenditures in Colorado were used for estimating impacts from wildlife-related recreation.

Use of the Model - Expenditures for every 1,000 RVDs (MRVD) were run through the model without local purchase coefficients applied. The results (response coefficients for employment and total income) were then incorporated into a spreadsheet where they were multiplied by nonlocal MRVDs. Only nonlocal recreation expenditures (tourism export) use is considered for impact analysis because it is customarily considered a basic economic activity.

Federal Expenditures & Employment

Data - Total Forest obligations by budget object code for FY 1996 were obtained from the National Finance Center. Expenditure profiles by budget object code were provided by the Washington Office. The salary/non-salary ratio was determined by examination of the budget object code data. Forest Service employment per one million dollar of salary expenditures was based on personal examination of historical Forest Service obligations within the Rocky Mountain Region.

Use of the Model - To obtain an estimate of total impacts from Forest Service spending, each portion (direct, indirect, and induced) of the impact must be handled separately. Direct impacts are simply Forest Service employment and salaries (cost to government). Indirect and induced impacts as the consequence of local non-salary expenditures are determined by using the budget object code information noted above. This profile was run through the model for non-salary expenditures per one million dollars. Induced impacts result from Forest employees spending a portion of their salaries locally. IMPLAN PRO includes a profile of personal consumption expenditures for three income categories; the middle income category was used to represent average Forest Service employees. This profile was also run through the model per one million dollars. Across the U.S., Americans typically spend about 67% of their total salary plus benefits. Therefore, Forest Service salaries are multiplied by 0.67 before the induced coefficient on a per million dollar basis is applied.

Revenue Sharing -- 25% Fund Payments

Data - Federal law requires that 25% Fund Payments be used for only schools or roads or both. Colorado law further requires that at least 5% of these funds must be spent for each purpose. A split of 5% for schools and 95% for roads was used, based on information from the counties.

Use of the Model - National expenditure profiles for state/local government education (schools) and state/local government noneducation (roads) are provided within IMPLAN PRO. One million dollars of each profile was used to obtain an estimate a response coefficient for these Forest Service payments to impact area counties.

Output Levels

Table B-11 displays the output levels that were used to perform the impact analysis.

Table B-11. Output Levels used in IMPLAN (average annual outputs for decade one)

Activity	Base Yr	A	B	C	D	E	F	G
	Desired Condition Level							
Camping (MRVD)	104	168	168	168	168	168	164	168
Dispersed Nonmotorized (MRVD)	77	190	190	190	190	190	190	190
Dispersed Motorized (MRVD)	119	133	151	155	155	155	129	154
Downhill Skiing (MRVD)	396	498	498	498	498	498	498	498
Water-based Rec (MRVD)	5	6	6	6	6	6	6	6
Big Game Hunting	252	254	261	259	256	254	260	251

(MRVD)								
Other Hunting (MRVD)	1	1	1	1	1	1	1	1
Fishing (MRVD)	112	128	128	128	128	128	93	128
Timber - Sawtimber (MMBF)	16.5	23.0	9.4	14.8	17.1	26.0	4.9	22.6
Timber - POL (MMBF)	3.0	2.0	1.0	2.0	1.0	2.0	0.0	2.0
Grazing - Cattle (HM)	38,200	43,400	37,600	40,000	40,000	43,400	32,900	43,400
Grazing - Sheep (HM)	168,900	191,400	165,700	176,000	176,000	191,400	145,000	191,400
FS Expenditures ($MM)	8.389	11.276	9.888	10.424	10.536	11.899	9.345	11.762
25% Payments ($MM)	0.755	1.056	0.581	0.777	1.157	1.156	0.411	1.042
	Experienced Budget Level							
Camping (MRVD)	104	168	168	168	168	168	164	168
Dispersed Nonmotorized (MRVD)	77	190	190	190	190	190	190	190
Dispersed Motorized (MRVD)	119	133	151	155	155	155	129	154
Downhill Skiing (MRVD)	396	498	498	498	498	498	498	498
Water-based Rec (MRVD)	5	6	6	6	6	6	6	6
Big Game Hunting (MRVD)	252	254	261	259	256	254	260	251
Other Hunting (MRVD)	1	1	1	1	1	1	1	1
Fishing (MRVD)	112	128	128	128	128	128	93	128
Timber - Sawtimber (MMBF)	16.5	11.8	6.8	10.1	10.6	12.0	4.9	12.4
Timber - POL (MMBF)	3.0	1.0	1.0	1.0	1.0	1.0	0.0	1.0
Grazing - Cattle (HM)	38,200	34,200	29,600	31,500	31,500	34,200	25,900	34,200
Grazing - Sheep (HM)	168,900	150,700	130,500	138,600	138,600	150,700	114,200	150,700
FS Expenditures ($MM)	8.389	7.868	7.647	7.750	7.738	7.914	7.497	7.944
25% Payments ($MM)	0.755	0.661	0.577	0.599	0.620	0.669	0.407	0.682

Changes from Draft to Final EIS

Many changes were made for the FEIS. The differences from DEIS to FEIS are:

- IMPLAN PRO was used, rather than IMPLAN.
- Type II multipliers were used, rather than Type III.
- Personal Income was used as the measure of income, rather than Total Income by industry.
- Three models were developed in place of one.
- Before model development, Sawmill and Logging sectors were adjusted with local employment data.

- Impacts from sawtimber were based on local survey data for direct employment and wages rather than generalized estimates.
- National PARVS expenditure data for recreation were used, rather than Region 2 data.
- U.S. F&WS expenditure data for hunting and fishing in Colorado were used, rather than Region 2 data.
- Only nonlocal recreation RVDs were included, rather than total RVDs.
- Impacts from grazing were corrected from thousand animal unit months to head months.
- Forest-specific budget object code data was used, in place of generalized estimates.
- County and school district expenditures of revenue-sharing (25% fund) payments were included in impact estimates.

Financial and Economic Efficiency Analysis

Financial and economic efficiency is defined as how well the dollars invested in each alternative produce benefits to society. Present Net Value (PNV) was used as an indicator of financial and economic efficiency.

To calculate PNV, a spreadsheet was used which tracks revenues, costs, and benefits for a 50-year period. Built into the spreadsheet were predicted increases and decreases to output levels over time. A 4% discount rate was used.

The financial values used were based on actual revenues (actual returns to the Federal Treasury). Economic values were based on either actual revenues or on a willingness to pay evaluation. These economic values were developed by the Regional Office of the Rocky Mountain Region, U.S. Forest Service. Output levels were those generated by each alternative.

Table B-12 displays the economic values and revenues that were used for each resource.

Table B-12. Economic Benefits and Financial Revenue Values

Activity	Unit	Economic Benefit	Financial Value
Big Game Hunting	RVD	64.00	0
Disp. Motor Rec	RVD	11.00	0
Disp. Nonmotor Rec	RVD	12.00	0
Developed Camping	RVD	9.00	1.06
Fishing	RVD	72.00	0
Downhill Ski	RVD	52.00	1.19
Small Game Hunting	RVD	45.00	0
Water Based Rec	RVD	12.00	0
Nonconsumptive Wildlife	RVD	56.00	0
Grazing - Cattle	AUM	8.00	1.35
Grazing - Sheep	AUM	48.00	0.27
Aspen	MBF	65.30	65.30
Conifer Sawtimber	MBF	153.16	153.16

Wildlife Analysis

This analysis focused on effects to wildlife habitat and wildlife species other than those listed as threatened, endangered, or sensitive. The analysis addressed issues within the revision topics of biological diversity and recreational opportunity. All threatened, endangered, and sensitive (TE&S) species are addressed in the biological diversity section in Chapter 3 of the FEIS and in the Biological Assessment and Biological Evaluation. Additional information and data on TE&S species are included in Appendix D (Biological Diversity). This general wildlife analysis was divided into three sub-sections:

- Wildlife Habitats
- Wildlife Disturbance and Displacement
- Recreational Opportunity (Hunting)

Data and input was requested from the Colorado Division of Wildlife for this analysis. They also supplied maps of important habitat for various wildlife species. The Colorado Natural Heritage Program, under contract with the Forest Service, provided species locations on the Forest and identified and mapped areas they considered important habitat for plant and animal species and communities.

The identification of wildlife and fish indicator species is required at this level of planning under current Forest Service Planning Regulations (36 CFR 219). The decision was made to use the same species identified in the 1983 Plan. These included 24 species that were selected to represent the majority of species associated with various vegetative successional stages, species that were economically important (those that are hunted, fished, or trapped), and species that have unique or special habitat requirements. All 24 indicator species have been addressed in the Wildlife section or in the TE&S section under biological diversity in Chapter 3.

Based on the analysis of predicted changes in habitat composition, structure, distribution, and effectiveness, a determination was made on the proposed alternative's ability to maintain viable populations of existing native and desired non-native vertebrate species in the planning area. The viability determination is included in the biological diversity section of Chapter 3 and includes all species (i.e. TE&S species), as well as the many species not considered to be at risk that are addressed in the general wildlife section.

Wildlife Habitat

Estimate of Potential Habitat by Habitat Complex for Selected Associated Wildlife Species on the Routt National Forest - Six habitat complexes, two structural components, and a specialized component were selected to analyze effects on wildlife habitat by alternative. The 15 selected indicator species were grouped within their preferred habitat or habitats. This grouping was based on publications by Finch (1992) and Hoover and Wills (1984).

The changes in the eight habitats (the two structural components, i.e., snags and course woody down and dead, were lumped into one) were analyzed on how their composition, structure, and distribution would be affected under the proposed alternatives for both the short and long term. The habitat complex cover types included only the appropriate habitat structural stages (SS). For example, for late successional spruce/fir habitat, only structural stages 4b, 4c, and 5 were evaluated and considered as potential old growth. All structural stages except the seedling/sapling stage (SS1) were evaluated for lodgepole pine (LPP). It was assumed that LPP would be regenerated within 5 years and for the first half of the decade following even-aged harvest, the habitat SS would be 1 (grass/forb), with the SS for the second half being a 2

(shrub). This prediction was based on advice from local Forest Service silviculturists. For the aspen community type, only the later structural stages (SS 3, 4, and 5) were considered.

The habitat structural stages are from the RMRIS Data Dictionary as defined for Forest Service Regions 2 and 4.

In addition to the Forestwide analysis, 30 geographic areas were also evaluated to assure that wildlife habitats and indicator species would remain well distributed over the planning area.

The predicted changes in acres of tree species and habitat structure was taken from reports generated on the solution for each alternative FORPLAN run. Structural stage was modeled as an output in the FORPLAN model. The solution and the output levels for structural stage from FORPLAN were loaded into Paradox. This data was then combined with the revision data base (see earlier discussion) to estimate the acres of vegetation and structural stage by geographic area. From this data, several summary reports were generated.

Data on existing conditions of vegetation and structural stage and wildlife habitat by geographic areas from the revision data base and various GIS analyses was also used to predict effects by alternative. The analysis for snags and dead and downed woody habitat was based on GIS analysis and Forest Stand Exam Data included in the RMRIS data base.

The report titled *Literature Review For The Routt National Forest To Assist With The Determination Of The Range Of Natural Variability 12-94* was used to compare the predicted changes in the composition, structure, and distribution of wildlife habitats to what occurred historically by alternative for the short and long term.

Disturbance and Displacement

Predicted Changes in Percentage of Miles of Road per Section Compared to the Current Condition by Alternative at the End of the First and Fifth Decades - This analysis compares the current total miles of road per section forestwide with the predicted miles of road per section added by the proposed alternatives following the first and fifth decades. The road density was derived by simply dividing the total Forest acres by 640 (the acres in a section) and dividing this total into the miles of road on the Forest. Miles of road to be obliterated by decade, as shown in the S-Tables, was also factored in. The effect by alternative was determined by calculating the percentage increase over the current estimate of just under 1 mile per section.

Predicted Change in Forestwide Habitat Effectiveness by Alternative Following the First and Fifth Decades - For purposes of this analysis, habitat effectiveness is defined as the percentage of usable habitat during the nonhunting season (Christensen and Lyon 1992). The habitat effectiveness model developed by Lyon (1983) and modified for Region 2 ecosystems, was used to predict effects on Forest Habitat Effectiveness (HE) by alternative for the short and long term. The HE model was run on a personal computer spreadsheet using the variables of road density and hiding cover. For this analysis, hiding cover was defined as vegetation capable of hiding 90% of a standing adult elk from human view at a distance equal to or less than 200 feet (Christensen and Lyon 1992). It was assumed that cover types in habitat structural stages 3c, 4, and 5 provided hiding cover and that 80% of habitat structural stages 3b and 4b provided hiding cover (from research and field validation on the Medicine Bow and Big Horn National Forests).

The miles of open road per section was used to calculate a road density index. The acres of hiding cover was totaled to determine a hiding cover index. The road density index and the hiding cover index were then multiplied to calculate the habitat effectiveness percentage.

Recreation Opportunity (Big Game Hunting)

The Forest GIS was used to analyze and map the current potential fall hunting season security areas (as defined by Hillis and others 1991). Effects on these potential security blocks by implementing the proposed alternatives were evaluated by considering projected increases in road miles, acres harvested, roadless acres proposed, and projected levels of habitat effectiveness. The definitions and concepts in *Elk Management in the Northern Region: Considerations in Forest Plan Updates or Revisions* (Christensen, Lyon, and Unsworth 1993) were used extensively in this analysis.

Because hunting data generated from the Colorado Division of Wildlife does not differentiate between National Forest Systems lands and other lands for annual summary reports of animals harvested, population trends, hunter recreation days, and other statistics, estimates of hunting data actually occurring on Forest had to made. These estimates were made jointly with the Colorado Division of Wildlife.

Recreation Analysis

Introduction

The recreation topic is "what variety and mix of opportunities will be provided, taking into account resource protection measures."

The complexity of the issue involves the full range of recreation opportunities that are currently available on the Forest:

1. Developed recreation, specifically campgrounds that are in need of rehabilitation and modernization to meet visitor needs, and trailheads to facilitate backcountry motorized and nonmotorized recreation.
2. Trail dependent recreation; spatial differences between systems and crowding. Trail capacities are dependent on the time of day in use and typical lengths of stay, depending on the trail activity.
3. Dispersed recreation; the all-encompassing term that includes all activities for which the Forest Service provides along roads and trails, and in the open backcountry.
4. Visitor preferences for opportunities are constantly changing, and need to be part of implementation and visitor contact.

Analysis Process

There are several analysis processes used to analyze this issue. Following is a summary of the steps taken in the analysis:

1. Recreation Opportunity Spectrum (ROS)

The Recreation Opportunity Spectrum (ROS) is a recreation allocation process used to compare opportunities and resource capability according to experience and management. An adopted ROS map (current condition and management objectives) was developed in 1983 and updated in 1993. Limitations to the ROS data include:

- The lines are estimations and not exact.
- ROS mapping is not an exact science, and it is subject to various interpretations, depending on training.

During the updating process, the 1983 maps were used as reference. Districts were instructed to change the boundaries as appropriate, given eight years of implementation. Differences in interpretation when the 1983 map was prepared ("base" map) lead to a modified version in 1991. The base year represents a 1991 inventory and the current management emphasis.

The ROS was then integrated into other areas of resource management. Recreation demand and supply data was used to help make final land allocations based on other resource outputs and their affect on recreation.

Alternatives A through E were mapped after the revised prescriptions were developed; few prescriptions have an exclusive ROS. Alternatives F and G were mapped with assistance from the groups who proposed them; the Colorado Environmental Coalition mapped Alternative F with one ROS for each prescription, and the Multiple-Use Coalition mapped Alternative G using the Roaded Modified (RM) classification. The RM ROS class was then incorporated into all alternatives with management area prescriptions of 5.13. A final computer-generated set of Desired Condition ROS maps was developed using the GIS and management area prescriptions. The final analysis was based on these acreages.

2. Use and Demand Analysis

Use and future demand information was taken from the Recreation Information Management (RIM) reports that have been filed with the regional office, annually. Although these data lack statistical accuracy, much of the information was provided by district personnel with a best guess interpretation (institutional memory). Other RIM information from regional and national levels were used for comparison.

Futuring was accomplished by using the past. Only the years 1991 through 1994 were used to project future trends. Information from the years prior to 1991 indicate that a different interpretation was used to develop the reports, and these data distort the linear relationship from one year to the other. The analysis concentrated on developed camping, trail use (motorized and nonmotorized), wilderness use, and wildlife related activities. Dispersed recreation use levels are difficult to interpret since most activities on Forest Service system lands are dispersed, and there is a possibility of double counting them.

3. Needs Analysis

Developed needs were determined using the 40% rule. After use levels reach 40% of built capacity, the impacts to the resource become more pronounced. It is at this point that the Forest needs to consider an aggressive reconstruction program and/or new construction. Use in most developed campgrounds currently exceeds 40%. Trail needs were analyzed using the same principle, capacity minus current use (and projected use in 2005).

A preliminary list of projects still in the Capitol Investment Program are included in the FEIS.

4. Budget Analysis

The final step in the process is to determine just how much can be accomplished, given the realistic budget projections. There are two budget levels planned for in this analysis; realistic three year averages and full implementation (if we could really do what we want to do, with few additions to the current full time staff).

For this analysis, activities are planned, and budgeted for in the constrained budget. Projects include developed site construction and reconstruction, trail construction and reconstruction, and heritage resources evaluations. Budget is displayed in Supplemental Table 3 - Budget Costs, and projects are in Supplemental Table 2 - Activities and Outcomes.

5. Individual Activity Participation Assumptions

In order to complete the Economic Impact and Efficiency Analyses, use levels had to be estimated as follows:

Dispersed Motorized Activities

Snowmobiling - assumes use will be proportionate to the acres of lands managed as motorized winter use and location and mileages of groomed trails. Currently, there are 323 miles of groomed trail forestwide.

Routt RIM Numbers = 2% of total Forest use.

GOCO (1996) = 7% of Colorado residents participated (24% on Federal Land).

NSRE (1997) = 5% of population in the Rocky Mountain Region.

Cordell et al. (1990) = 9% of total population participated in 1989.

Dispersed Camping - assumes use changes as a function of roaded natural and semi-primitive motorized acres per alternative, although camping can satisfactorily take place in any setting. Many campers identify their setting choice variables as 'being away from sight and sound of humans, away from noise, and prefer an unmodified environment' (Yuan, Michael, and McEwe 1989).

Routt RIM Numbers = 12% of total Forest use.

GOCO (1996) = 80% of Colorado residents participated (29% on Federal land) - Camping, in general.

NSRE (1997) = 24% of population in the Rocky Mountain Region.

Cordell et al. (1990) = 11% of total population participated in 1989.

Gathering Forest Products - assumes use will change as a function of available forest products in roaded natural and roaded modified areas.

ROUTT RIM Numbers = 1% of total use.

Motorized Trail Use - Nonlocal Use = approximately 30%.

1990 Wyoming SCORP = 32 miles one-way travel distance.

Daigle, Watson, Haas (1993) = 77 miles one-way travel distance (nationally).

Use may change with management emphasis where trails would be expected to be obliterated in order to achieve some desired condition. In addition, many trails will no longer be available where the ROS changes to a nonmotorized class.

Routt RIM Numbers = 2% of total Forest use.

GOCO (1996) = 19% of Colorado residents participated (35% on Federal land).

NSRE (1997) = 20% of population in the Rocky Mountain region.

Cordell et al. (1990) = 12% of total population participated in 1989 Rec Roundtable, 1996 = 5% of total population participated in 1996.

Dispersed Nonmotorized Recreation

Nonmotorized Trail Use - Nonlocal Use = approximately 50%.

1990 Wyoming SCORP = 78 miles one-way travel distance (backpacking)

1990 Wyoming SCORP = 31 miles one-way travel distance (horseback riding)

1990 Wyoming SCORP = 31 miles one-way travel distance (cross country skiing)

Daigle, Watson, Haas (1993) = 96 miles one-way travel distance (nationally)

Cordell et al. notes an average 18 trips per year reported by bicyclists.

Local population and travel times are closely associated with nonmotorized trail use since more use is for a single day rather than multiple days. There are also concerns that this group of users isn't accurately accounted for because of the anticipated turnover rate (3-4 times per day per trailhead according to the Wyoming SCORP Standards) potential for any one trail. Forest Service personnel aren't available to monitor use at one area all season long. Reported use is most likely conservative.

Furthermore, use is dependent on access to and availability of trails. If use figures aren't conservative, it can be assumed that, relative to national figures, the Routt trail system is not over-used. The number of trail miles will most likely remain constant, throughout all alternatives.

Routt RIM Numbers = 6% of total Forest use.

GOCO (1996) = 70% of Colorado residents participated (21% on Federal Land).

NSRE (1997) = 48% of population in the Rocky Mountain Region.

Cordell et al. (1990) = 62% of total population participated in 1989 (all types of nonmotorized trail uses combined).

Rec Roundtable (1996) = 41% participated in nonmotorized trail use.

Developed Camping

Developed camping - assumes demand could exceed capacity by 2010, with 25% local and 75% nonlocal. Average miles traveled according to Daigle et al. (1994) is 183 miles; 78 miles in Wyoming (Wyoming SCORP 1990). There will be little or no difference between alternatives in terms of use, the exception being Alternative F where all use can be expected to decrease, forestwide.

Routt RIM Numbers = 25% of total Forest use.

GOCO (1996) = 80% of Colorado residents participated (29% on Federal Land).

NSRE (1997) = 27% of population in the Rocky Mountain Region.

Cordell et al. (1990) = 20% of total population participated in 1989 Rec Roundtable, 1996 = 12% (down from 16% in 1995).

Hunting

Big Game Hunting - assumes 30% of the hunters are local, averaging 104.3 one-way miles to hunt (Daigle et al. 1993) six times per year, and that hunting participation is flat (not increasing or decreasing). Hunting, or the decision to hunt, is related to success and satisfaction which is also influenced by migration patterns. Roads with traffic tend to move big game out of an area. Therefore, where more roads exist, it is assumed that there will be fewer hunters. According to the 1985-86 PARVS survey, hunters in Wyoming and Colorado tend to have a low "consumer surplus" or willingness to pay. The idea is that there are substitute conditions in these two states and that if a person wants to hunt, that person can.

Routt RIM Numbers = 17% of total Forest use.

Rec Roundtable (1996) = 7% (in 1996; down from 8% in 1994).

NSRE (1997)= 13% of population in the Rocky Mountain Region.

Cordell (1990) = 7% (in 1989).

Wyoming SCORP (1990) = 21% of Wyoming residents hunt.

Other Hunting - assumes 80% local population, 20% nonlocal. In Wyoming, small game hunters travel 33.8 one-way miles to hunt (Wyoming SCORP 1990) and 41 miles to hunt waterfowl. The NSRE estimates an average 10.5 trips per year per hunter. The total small game hunting population on the Routt is estimated at less than 6,000 RVDs or less than 1/10 of 1%.

Other Wildlife Use

Wildlife Observation - typically occurs in conjunction with other activities (such as trail use, picnicking, driving for pleasure, and camping.) The Forest doesn't record wildlife viewing RVDs, but there are studies to substantiate the importance of providing opportunities to forest visitors. Thirty-seven percent (37%) of residents in the Rocky Mountain Region claim to participate in wildlife viewing activities nearly 36 days out of the year (NSRE 1997). Demand is expected to exceed supply of opportunities (projected gap) by 2010 (USDA Forest Service - English et al. 1993).

Just as roads are a concern for hunter satisfaction, their availability for use is a double-edged sword for wildlife observation as well. Areas with high open road density would not provide quality wildlife viewing opportunities for species sensitive to human interaction.

Fishing - assumes more (60%) local use on a daily basis, with most visitors participating as part of a multiple-activity group. People take an average of 12-14 fishing trips per year (NSRE 1997; WY SCORP 1990), traveling 45 miles, one way, on average (WY SCORP 1990).

Routt RIM Numbers = 10% of total Forest use.

NSRE (1997) = 31% of population in the Rocky Mountain Region.

Wyoming SCORP (1990) = 54% of Wyoming residents fished in 1989.

GOCO (1996) = 48% of Colorado residents fished in 1995, 24% on federal lands.

Rec Roundtable (1996) = 22% (in 1996; down from 24% in 1994).

Cordell (1990) = 15% (in 1989).

Downhill Skiing

Use occurs at the one ski area on the Forest (Steamboat Springs). A total of 1,017,342 tickets were sold during the winter of 1995-1996. Use is concentrated in a small area of the Forest, compared with the rest of the user density figures [1,358,600 acres and 2,225,800 RVDs per year (less downhill skiers)]. Use levels actually dropped in 1995-96 from 1994-95 because there was too much snow; travel into the area became difficult at prime times during the season. Use by locals makes up at least 30% of the skiers. Downhill skiing is expected to increase 421% by 2040 (English et al. 1993), depending on facility development.

Data Limitations

There are limits to the use of these data, as described above. Recreation use data is difficult to accurately assess because of the mobility of the subject. Recreation data is collected randomly

(with no statistical validity) and is used for relative comparisons of activity preferences. Absolute use figures cannot be determined with this data.

Futuring in an industry that is so changeable is difficult, at best. Based on the assumption that "people generally maintain recreation and leisure preferences based on learned activities while growing up," uses are expected to increase relative to current use levels. As we age, we tend to prefer those activities that we feel most comfortable in, which means those we learned when we were least vulnerable -- childhood.

Roadless Area Inventory and Evaluation

An important determination in developing the roadless area inventory was the definition of a "road." This definition was provided in the FSH 1909.12, but the definition was difficult to interpret. A regional task force was convened in August 1992 for the purpose of providing a definition that could be used regionwide for consistency. This regional task force determined that, in order to be considered a road (and disqualify an area for the roadless area inventory), a road must be maintained for use by passenger type vehicles (not 2-WD high clearance or 4-WD). Primitive roads may be included in inventoried roadless areas.

The Roadless Inventory was primarily generated using GIS. Roads (as defined above) were buffered by 1/8 mile and then overlaid with a land status map. Unroaded areas were then identified as preliminary roadless areas. The districts reviewed the preliminary roadless areas to confirm that they were accurate (i.e., that they did not contain roads).

Members of the interdisciplinary team met to refine the preliminary roadless area inventory by analyzing the maps and determining if there were areas included in the preliminary inventory that:

1. Did not meet the statutory definition of wilderness.
2. Did not include timber harvest areas where logging and prior road construction is evident.
3. Did not include areas where signed NEPA decisions for vegetation treatments had been made.
4. Other minor considerations as directed in FSH 1909.12-7.11a, 1-11.

Meetings were held at each Ranger District to determine where the conditions listed above did occur. The District Ranger provided maps that displayed areas which did not qualify for the roadless inventory. A flight over most tentatively inventoried roadless areas was conducted on 10/13/92. The District Rangers and Forest Supervisor used the flight to analyze the spatial relationships of the roadless areas to high multiple-use areas, roads, wilderness areas, etc.

The inventory was refined by creating new boundary lines for the roadless areas based on all the criteria mentioned. Final GIS maps and acreages were generated and provided to the District Rangers for use in developing the narrative description of each area. These narratives were then used in determining capability, availability, and need.

The process for determining capability, availability, and need are outlined in FSH 1909.12-7.21. Based on the district narratives, capability ratings were developed using an interdisciplinary team.

The determination of availability was completed by the Forest Wilderness Specialist. All areas that were capable were also found to be available.

The 15 areas that were found to be capable and available were also analyzed for need. The need analysis includes looking at current wilderness use on a regional basis and plant series representation. Detailed results of this analysis can be found in the planning record.