

# Appendix B

## Timber Modeling

### **INTRODUCTION**

The 2005 Planning Rule (36 CFR Part 219) requires that the Responsible Official identify areas within the National Forest System as generally suitable for uses that are compatible with desired condition and objectives for that area. Such Identification is guidance for project and activity decision making, is not a permanent land designation, and is subject to change through plan amendment or plan revision. Uses of specific areas are approved through project and activity decision making.

Additionally, the National Forest Management Act (NFMA) requires that the Chief of the Forest Service must include in the Forest Service Directive System procedures for estimating the quantity of timber that can be removed annually in perpetuity on a sustained-yield basis in accordance with 16 U.S.C. 1611.

This appendix addresses the suitability of lands for timber production and the estimation of Timber Sale Program Quantity (TSPQ) and Long-term Sustained-yield Capacity (LTSYC)

To address these requirements the following tools and models were used:

**Geographic Information System (GIS)** – ArcGIS developed by Environmental Systems Research Institute (ESRI) was the software used. This tool was used to create and overlay data layers, classify and summarize the data, and display the data.

**Forest Vegetation Simulator (FVS)** – a stand level forest vegetation simulator developed by the USDA Forest Service. This model was used to estimate timber growth and yield.

**Spectrum** – a computer-based analytical tool for building natural resource management models.

### **SUITABILITY OF LANDS FOR TIMBER**

Requirements to perform analysis of timber suitability are found in 36 CFR Part 219 (the Planning Rule) and Forest Service Manual (FSM) 1920. Additional guidance is provided by Chapter 60 of Forest Service Handbook (FSH) 1909.12.

This process is largely a GIS exercise so the resulting acreages are only as good as the input data layers (above). No attempt was made to “balance” the GIS acres to those published in “Land Areas of the National Forest System”, USDA Forest Service, FS-383.

Direction at FSH 62.1 requires that we identify lands generally not suitable for timber harvest within the National Forest System. Specifically these lands are where:

- Statute, Executive Order, or regulation prohibits timber harvest on the land, or the Secretary of Agriculture or the Chief of the Forest Service has withdrawn the land from timber harvest.

- At the broad forest scale, the Responsible Official estimates that soil, slope, or other watershed conditions will be irreversibly damaged by timber harvest.
- At the broad forest scale, the Responsible Official estimates there is no assurance that lands can be adequately restocked within five years after harvest.
- Trees are unable to grow due to environmental conditions.

All lands not subtracted at 62.1 are classified as Lands Generally Suitable for Timber Harvest. These lands are further divided into:

- Lands where timber production achieves or is compatible with the achievement of desired conditions and objectives established by the plan (Lands Generally Suitable for Timber Production (FSH 1909.12, sec. 62.21)).
- Other lands where harvest for multiple-use objectives other than timber production, including salvage sales, may take place (Other Lands (FSH 1909.12, sec. 62.22)).

The GIS was used to develop the forest plan revision database. The resulting database was used to analyze lands suitable for timber harvest, build the forest planning model analysis areas, and perform other analyses for the revision. To identify lands generally suitable for timber harvest, the following data layers were overlaid in GIS:

- Existing vegetation – The Common Vegetation Unit (CVU) of the Integrated Resources Inventory (IRI), completed in September 2001.
- Proposed Plan landscape management themes – the information in this layer is shown on the landscape management theme maps in the Proposed Plan.
- Inventoried roadless areas – this layer contains the inventoried roadless areas on the Forest as described in Appendix I.
- Soils – the Common Land Unit (CLU) of the IRI
- Slope, aspect, and elevation – generated from the 30 meter digital elevation model (DEM)
- Geologic hazard – combines steep slopes (<50 percent) and highly erosive soils
- Land ownership and administrative boundaries from the Automated Lands Project (ALP) database.
- Riparian areas and wetlands – this layer combines data from the Colorado Division of Wildlife and US Fish and Wildlife Service inventories, a Forest willow survey, and the Common Water Unit (CWU) of the IRI.
- Congressionally designated areas from ALP.
- Existing and proposed Research Natural Areas
- Developed recreation and administrative sites
- Streams and water bodies
- Roads and trails – Forest roads and trails from the INFRA database
- Silvicultural activity – treatment history from the TimFacts database

This overlay process produced a layer containing sufficient information to classify lands as generally not suitable and generally suitable. The generally suitable stands were plotted for the Forests’ silviculturists to review and refine.

At the broad forest scale, assumptions are made which may not apply to on the ground conditions. Individual site-specific decisions based on field reviews may modify these assumptions and make site-specific changes to timber suitability.

The following table displays Suitability of Areas for Timber Production for the Forest.

| <b>Category</b>  | <b>Not Suitable Harvest Acres</b> | <b>Suitable Harvest Acres</b> | <b>Not Suitable Production Acres</b> | <b>Suitable / Production Acres</b> |
|--|-----------------------------------|-------------------------------|--------------------------------------|------------------------------------|
| Lands generally not suitable for timber harvest (62.1)   | 1,075,300                         |                               | 1,075,300                            |                                    |
| Timber production compatible with desired conditions and objectives (62.21)                                    |                                   | 660,500                       |                                      | 660,500                            |
| Timber production incompatible with desired conditions and objectives, but suitable for timber harvest (62.22) |                                   | 1,215,300                     | 1,215,300                            |                                    |
| Lands generally suitable for timber harvest (62.2)   |                                   | <b><u>1,875,800</u></b>       |                                      |                                    |
| Lands generally not suitable for timber production (62.3)  |                                   |                               | <b><u>2,290,600</u></b>              |                                    |
| Subtotals  | <b>1,075,300</b>                  | <b>1,875,800</b>              | <b>2,290,600</b>                     | <b>660,500</b>                     |
| Total National Forest Lands  |                                   | <b><u>2,951,100</u></b>       | <b><u>2,951,100</u></b>              |                                    |

## **ESTIMATING THE QUANTITY OF TIMBER THAT CAN BE REMOVED**

The lands generally suitable for timber harvest were stratified into logical subunits that respond similarly to management actions. These lands were stratified by cover type and habitat structural stage.

The strata and silvicultural prescriptions for each cover type were developed by the Forests’ silviculturists with the assistance of silviculturists with the Washington Office’s Timber Management Service Center in Ft. Collins, CO. The WO folks used the resulting strata in the Forest Vegetation Simulator (FVS) to develop yield tables for each strata (“Grand Mesa, Uncompahgre and Gunnison National Forests Plan Revision, Summary of Yield Table Development”, DRAFT, Chad Keyser, USDA-FS-FMSC).

**The forest cover types projected in FVS:**

| Name | Forest Cover Type |
|------|-------------------|
| TAA  | Aspen             |
| TLP  | Lodgepole pine    |
| TMC  | Mixed conifer     |
| TPP  | Ponderosa pine    |
| TSA  | Spruce/fir/aspen  |
| TSF  | Spruce/fir        |

**Habitat structural stage criteria for each forest cover type:**

| Name | Habitat Structural Stage      |
|------|-------------------------------|
| 2T   | Seedling/shrub                |
| 3A   | Sapling/pole – low density    |
| 3B   | Sapling/pole – medium density |
| 3C   | Sapling/pole – high density   |
| 4A   | Mature - low density          |
| 4B   | Mature – medium density       |
| 4C   | Mature – high density         |
| 5T   | Old growth                    |

**The strata for which prescriptions and yield tables were developed are as follows:**

|       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|
| TAA2T | TLP2T | TMC2T | TPP2T | TSA2T | TSF2T |
| TAA3A | TLP3A | TMC3A | TPP3A | TSA3A | TSF3A |
| TAA3B | TLP3B | TMC3B | TPP3B | TSA3B | TSF3B |
| TAA3C | TLP3C | TMC3C | TPP3C | TSA3C | TSF3C |
| TAA4A | TLP4A | TMC4A | TPP4A | TSA4A | TSF4A |
| TAA4B | TLP4B | TMC4B | TPP4B | TSA4B | TSF4B |
| TAA4C | TLP4C | TMC4C | TPP4C | TSA4C | TSF4C |
| TAA5T | TLP5T | TMC5T | TPP5T | TSA5T | TSF5T |

These strata, prescriptions, and yield tables were used in the timber model.

Forest plan modeling was accomplished using Spectrum, a computer-based analytical tool for building natural resource management models. Spectrum is based on FORPLAN, the tool used in the first round of forest planning. Spectrum documentation can be found at [www.fs.fed.us/institute/planning\\_center/files/Spectrum26\\_Overview.pdf](http://www.fs.fed.us/institute/planning_center/files/Spectrum26_Overview.pdf).

Revenue values were developed by the Regional economist and the Forest Timber Staff Officer from Cut and Sold reports.

Timber sale planning, preparation, administration, and road design costs used in the model are a five-year average of actual costs for 2002-2006.

The table below is a summary of the costs used in the model. The past and projected budget level (\$15,272,384) and the aspen and conifer costs/mcf (\$563.19 and \$1,036.28 respectively) were used in two separate Spectrum runs. The first run uses these cost and budget values and represents the low end of a range of possible outputs. The second run, with the costs reduced by 30 percent and the budget increased by 30 percent, represents the high end of the range. The low end is current condition while the high end is very much an aspirational objective.

**Budget allocation and timber unit costs:**

| <b>FY</b>                         | <b>NFTM (\$)</b>                | <b>SSSS (\$)</b>          | <b>Total (\$)</b>         | <b>Offered Volume (ccf)</b> | <b>Unit Rate/ccf</b> |
|-----------------------------------|---------------------------------|---------------------------|---------------------------|-----------------------------|----------------------|
| 2002                              | 1,371,400                       | 210,100                   | 1,581,500                 | 25,497                      | \$62.03              |
| 2003                              | 1,232,300                       | 273,000                   | 1,505,300                 | 24,156                      | \$62.32              |
| 2004                              | 1,191,100                       | 189,300                   | 1,380,400                 | 16,549                      | \$83.41              |
| 2005                              | 1,426,792                       |                           | 1,426,792                 | 17,794                      | \$80.18              |
| 2006                              | 1,442,200                       |                           | 1,442,200                 | 22,500                      | \$64.10              |
| Total                             |                                 |                           | 7,336,192                 | 106,496                     | \$68.89              |
| 2005-2006 anticipated SSSS add-on |                                 | 300,000                   | 7,636,192                 |                             |                      |
| Decade Total                      |                                 |                           | 15,272,384                |                             |                      |
|                                   |                                 |                           |                           |                             |                      |
|                                   | <b>Large Sale Conifer (ccf)</b> | <b>Other Volume (ccf)</b> | <b>Offer Volume (ccf)</b> |                             |                      |
| 2002                              | 7,210                           | 18,287                    | 25,497                    |                             |                      |
| 2003                              | 12,597                          | 11,559                    | 24,156                    |                             |                      |
| 2004                              | 5,785                           | 10,764                    | 16,549                    |                             |                      |
| 2005                              | 11,860                          | 5,934                     | 17,794                    |                             |                      |
| 2006                              | 11,122                          | 11,378                    | 22,500                    |                             |                      |
| Totals                            | 48,574                          | 57,922                    | 106,496                   |                             |                      |

$$\frac{57,922(x) + 48,574(2x)}{106,496} = \$68.89/\text{ccf}$$

$$1.46x = \$68.89/\text{ccf}$$

$$x = \$47.18/\text{ccf} + \$9.01/\text{ccf} = \$56.19/\text{ccf} = \$561.95/\text{mcf}$$

$$2x = \$94.36/\text{ccf} + \$9.01/\text{ccf} = \$103.38/\text{ccf} = \$1033.80/\text{mcf}$$

Road design = \$9.01/ccf

Several constraints were developed for the model in response to management requirements in the NFMA regulations (36 CFR 219.27) and desired conditions and objectives in the Proposed Plan. Constraints were also developed to improve the model's simulation of actual management of the Forest.

Constraints used in the Spectrum model include:

**General harvest controls:**

- Acres harvested on Other Lands (FSH 1909.12, sec. 62.22) must be equal to 500 in all periods.
- Since other resources drive timber harvest on Other Lands (FSH 1909.12, sec. 62.22), it is not anticipated that those lands will be entered very often.

**Natural burning levels:**

- Acres of cover types other than Ponderosa pine burned naturally must be equal to 500 in all periods.
- Acres of Ponderosa pine burned must be equal to 2,000 in all periods.

**Geographic Area harvest controls:**

Since not all of the acres within a timber sale area are available for harvest during an entry for a variety of resource and policy reasons (wildlife habitat requirements, harvest unit size, etc.), an attempt was made to determine what percent of an area might be available in each decade. Historical harvest data tempered with local knowledge produced the following results on Lands Generally Suitable for Timber Production (FSH 1909.12, sec. 62.21).

| <b>Geographic Area</b> | <b>Strata</b>     | <b>Percent of Strata Available in Each Period</b> |
|------------------------|-------------------|---|
| Grand Mesa             | Aspen             | 4   |
|                        | Spruce/fir        | 21  |
|                        | Spruce/fir/aspens | 21  |
| Gunnison Basin         | Aspen             | 2   |
|                        | Spruce/fir        | 21  |
|                        | Spruce/fir/aspens | 21  |
|                        | Lodgepole pine    | 6   |
|                        | Ponderosa pine    | 6   |
|                        | Mixed conifer     | 6   |
| North Fork Valley      | Aspen             | 6   |
|                        | Spruce/fir        | 8   |
|                        | Spruce/fir/aspens | 8   |
| San Juans              | Aspen             | 4   |
|                        | Spruce/fir        | 7   |

| <b>Geographic Area</b> | <b>Strata</b>     | <b>Percent of Strata Available in Each Period</b> |
|------------------------|-------------------|---|
|                        | Spruce/fir/aspens | 7   |
|                        | Mixed conifer     | 4   |
| Uncompahgre Plateau    | Aspen             | 9   |
|                        | Spruce/fir        | 22  |
|                        | Spruce/fir/aspens | 22  |
|                        | Ponderosa pine    | 6   |
|                        | Mixed conifer     | 6   |

**Long-term Sustained-yield (LTSY) controls:**

- Timber Sale Program Quantity in each period cannot be more than LTSY in period 15.
- Volume produced from Lands Generally Suitable for Timber Production (FSH 1909.12, sec. 62.21) in each period cannot be more than LTSY from Lands Generally Suitable for Timber Production (FSH 1909.12, sec. 62.21) in period 15.
- Volume produced from Other Lands (FSH 1909.12, sec. 62.22) in each period cannot be more than LTSY from Other Lands (FSH 1909.12, sec. 62.22) in period 15.

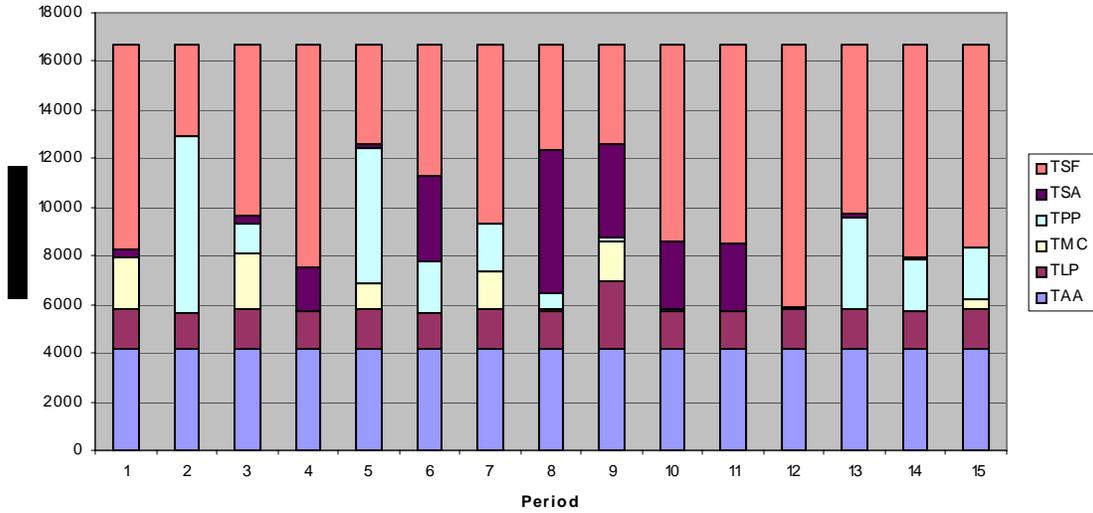
These constraints were used in the two separate Spectrum runs to develop a range of possible outputs:

- Low end – using past and projected budget levels and current organization and units costs.
- High end – using the above with a 30 percent increase in budget and a 30 percent reduction in unit costs.

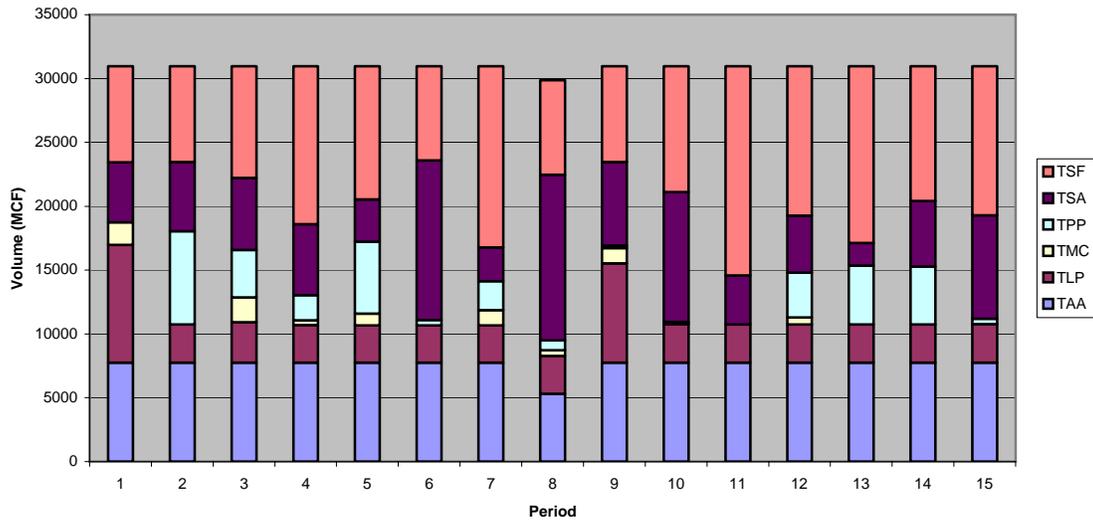
**Estimated Annual Long Term Sustained Yield Capacity (LTSYC).**

| <b>Long Term Sustained Yield Capacity (LTSYC)</b> | <b>Lands Generally Suitable for Timber Production (FSH 1909.12, sec. 62.21)</b> |                  |                  | <b>Other Lands (FSH 1909.12, sec. 62.22)</b> |                  |                  |
|---|---|------------------|------------------|--|------------------|------------------|
|   | <b>MCF/Decade</b>   | <b>MMCF/Year</b> | <b>MMBF/Year</b> | <b>MCF/Decade</b>                            | <b>MMCF/Year</b> | <b>MMBF/Year</b> |
|   | 73,343  | 7.3              | 36.7             | 1,600  | 0.2              | 0.8              |

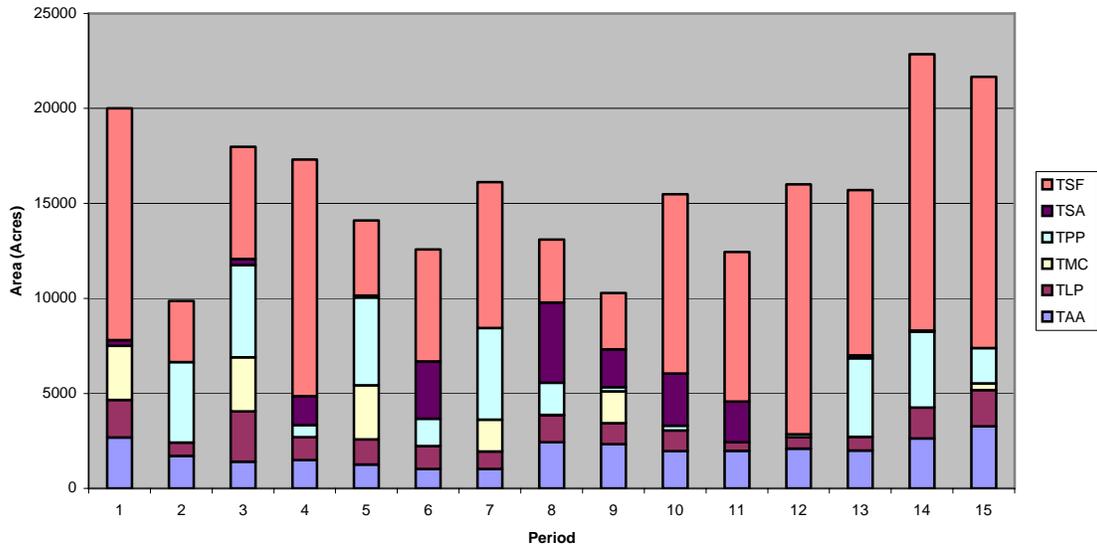
**Timber Sale Program Quantity on  
Lands Generally Suitable for Timber Harvest  
Low End of Range**



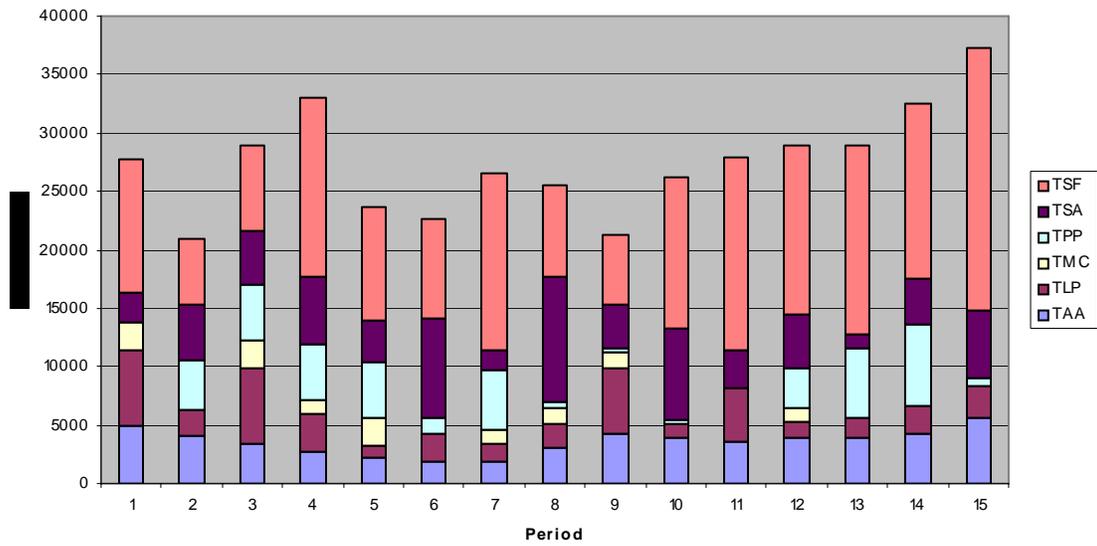
**Timber Sale Program Quantity on  
Lands Generally Suitable for Timber Harvest  
High End of Range**



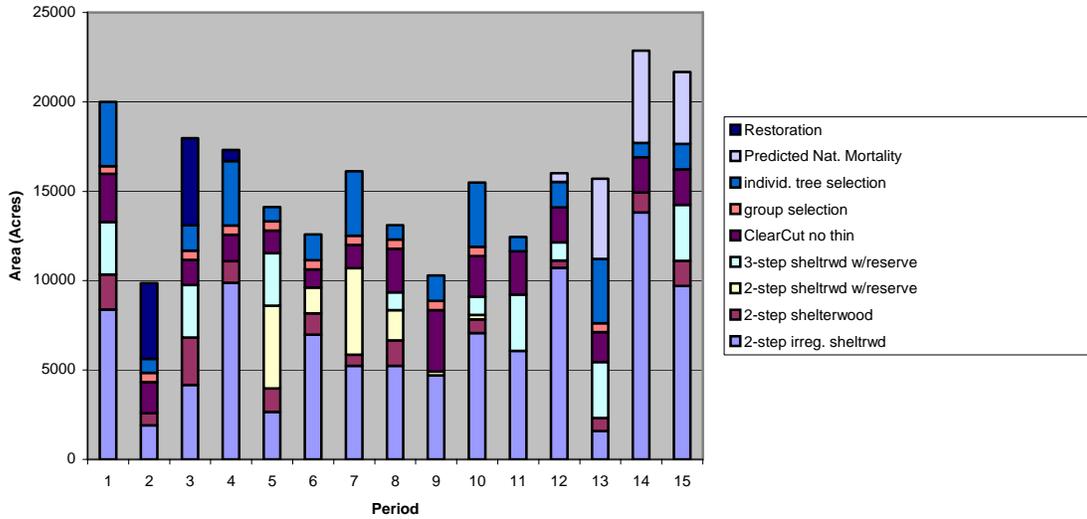
**Harvest Area from Lands Generally Suitable for Timber Harvest  
Low End of Range**



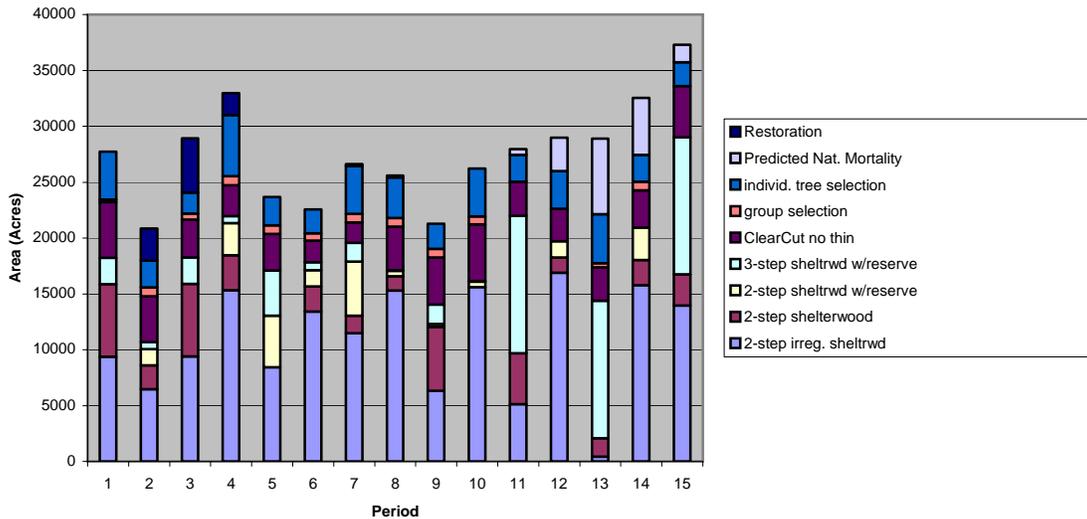
**Harvest Area from Lands Generally Suitable for Timber Harvest  
High End of Range**



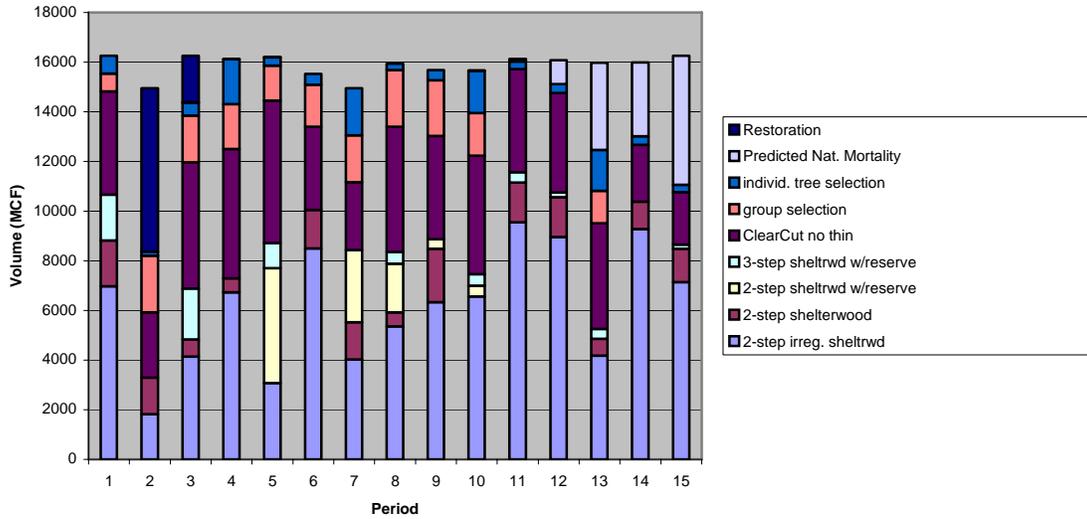
**Estimated Vegetation Management Practices  
(Treatment Area (Acres) for Lands Generally Suitable for Timber Harvest)  
Low End of Range**



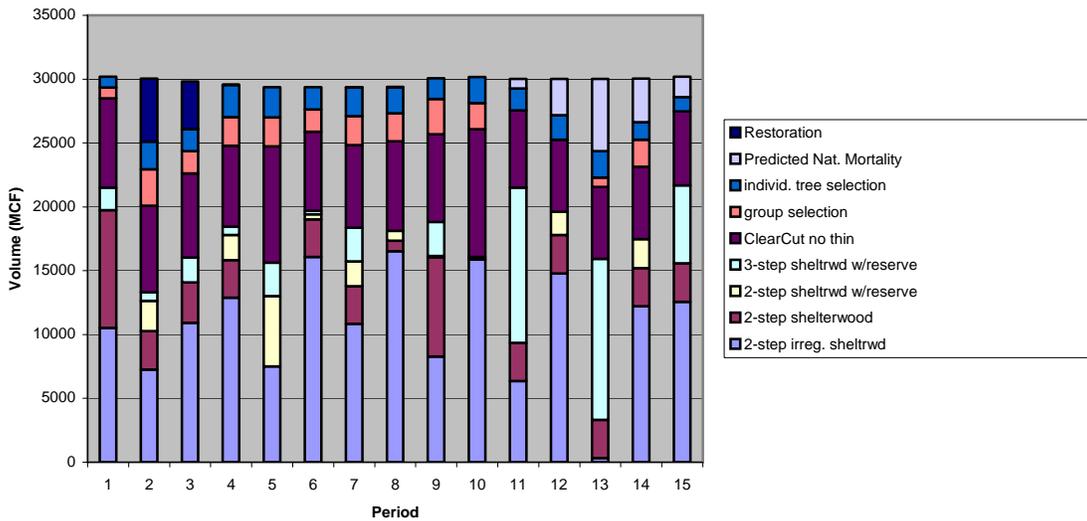
**Estimated Vegetation Management Practices  
(Treatment Area (Acres) for Lands Generally Suitable for Timber Harvest)  
High End of Range**



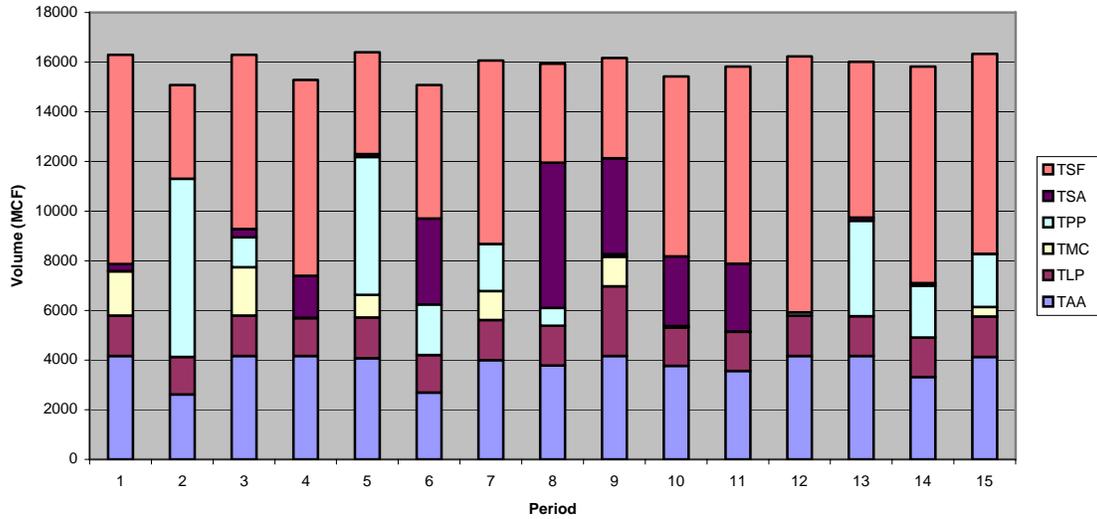
**Timber Sale Program Quantity  
(Volume Outputs by Decade)  
Low End of Range**



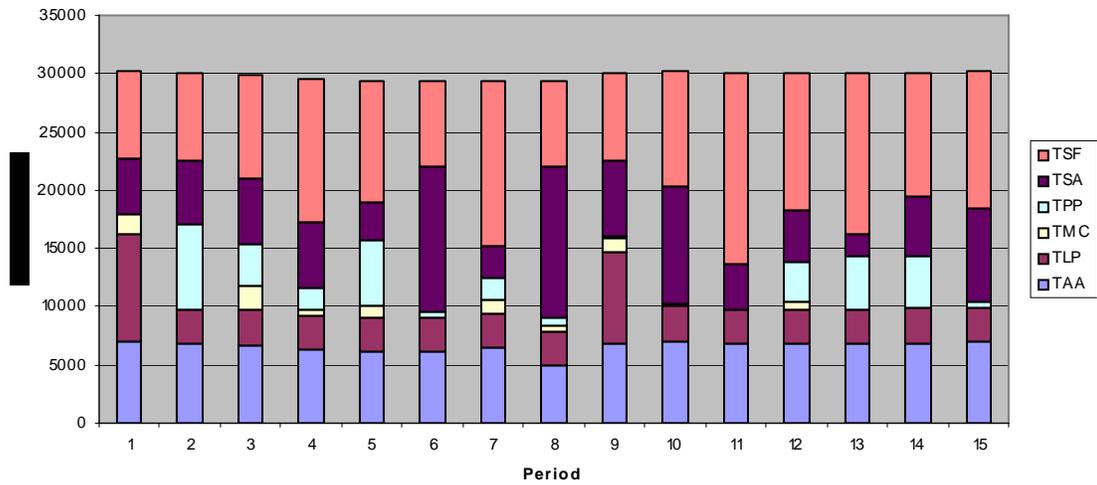
**Timber Sale Program Quantity  
(Volume Outputs by Decade)  
High End of Range**



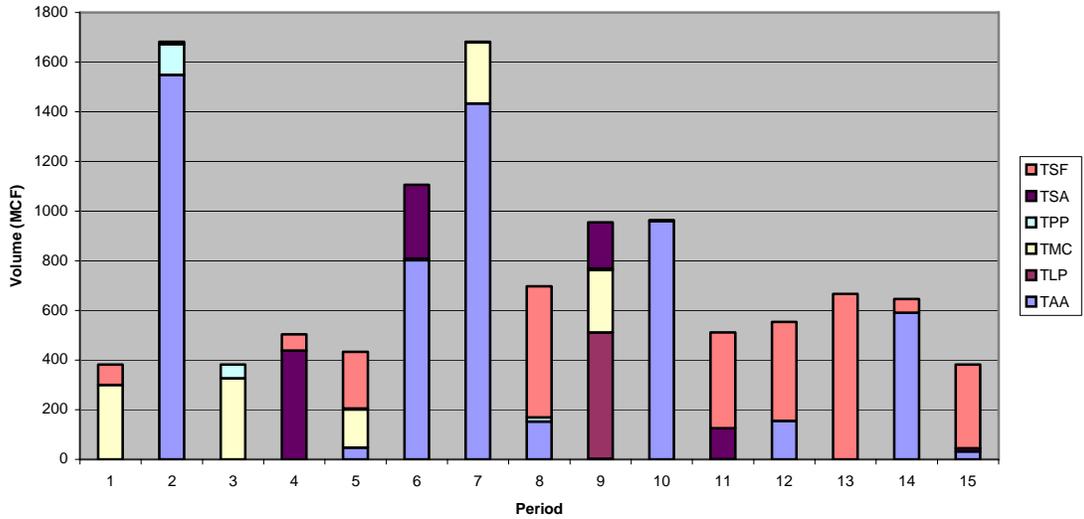
**Timber Sale Program Quantity on  
Lands Generally Suitable for Timber Production  
Low End of Range**



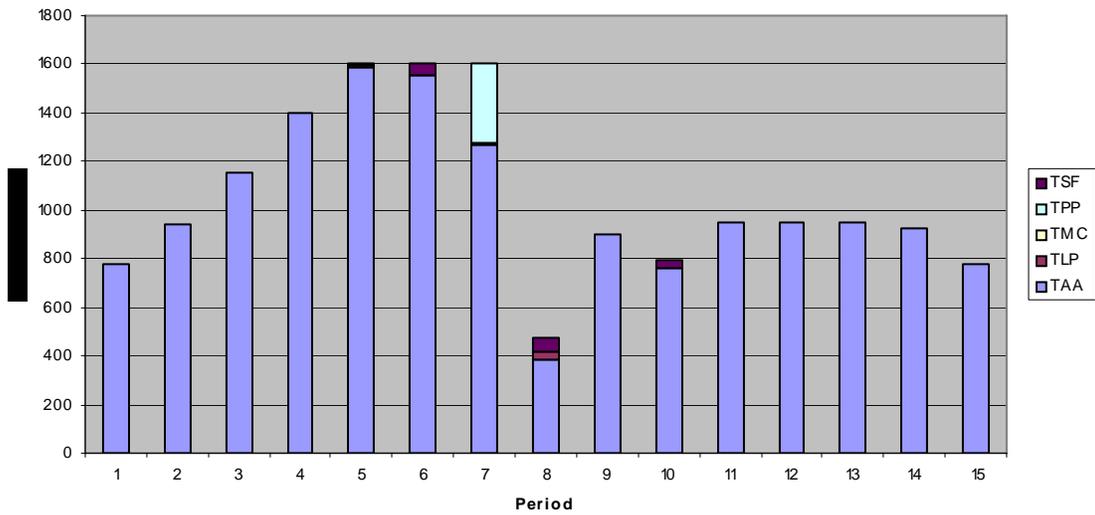
**Timber Sale Program Quantity on  
Lands Generally Suitable for Timber Production  
(Volume Outputs by Decade)  
High End of Range**



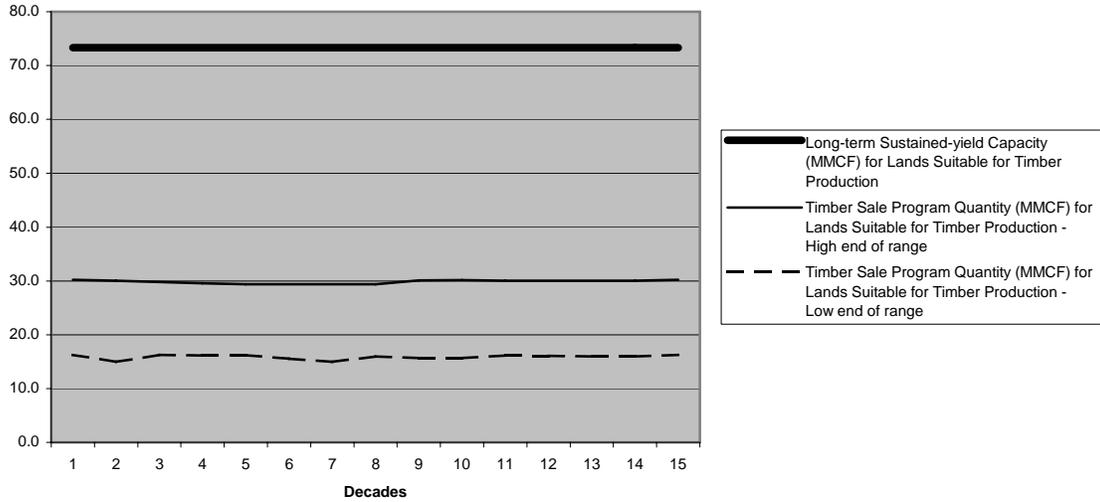
**Timber Sale Program Quantity on "Other Lands"  
(Volume Outputs by Decade)  
Low End of Range**



**Timber Sale Program Quantity on "Other Lands"  
(Volume Outputs by Decade)  
High End of Range**



**Display of Long-term Sustained-yield Capacity  
and Timber Sale Program Quantity on  
Lands Suitable for Timber Production  
Measured in Millions of Cubic Feet (MMCF)**



**Display of Long-term Sustained-yield Capacity  
and Timber Sale Program Quantity on "Other Lands"  
Measured in Millions of Cubic Feet (MMCF)**

