

Appendix H

Prescott National Forest Forest Wide Transportation Analysis Process Economic Analysis

The Forest Service's objective for road operation and maintenance is to operate and maintain National Forest Roads (NFR) roads in a manner that meets road management objectives (RMOs) and that provides for:

1. Safe and efficient travel;
2. Access for the administration, utilization, and protection of its lands; and
3. Protection of the environment, adjacent resources, and public investment.

The Forest Service (FS) is responsible for maintenance of NFRs resulting from traffic associated with:

- a. Administration of FS lands,
- b. Noncommercial uses and activities,
- c. Incidental noncommercial use related to ownership or occupancy of isolated parcels of private land served by an NFS road,
- d. Commercial road use that is not subject to cost recovery, and
- e. Incidental public use.

The amount and frequency of maintenance is subject to: availability of funding and obligations under agreements, and protecting the FS's investment.

Road Maintenance Levels

Maintenance levels are defined by the Forest Service Handbook (FSH) 7709.58 as the level of service provided by and maintenance required for, a specific road. The maintenance level must be consistent with RMOs, and maintenance criteria.

The maintenance level is determined by the Line Officer by considering the following factors:

- Resource program needs
- Environmental and resource protection requirements
- Visual quality objectives
- Recreation spectrum classes
- Road investment protection requirements
- Service life and current operational status
- User safety
- Volume, type, class, and composition of traffic.

The RMO will identify the current maintenance level or operational maintenance level and desired maintenance level or objective maintenance level for each road. The operational and objective maintenance level may or may not be the same for a road depending on the current needs, road condition, budget constraints, and environmental concerns and those forecasted for the future.

The following are the five levels classified by the FSH 7709.58:

Road Maintenance Level 5 (ML5) – roads that provide a high degree of user comfort and convenience. These roads are normally double-lane, paved facilities, some may be aggregate surfaced and dust abated. These roads are subject to the Highway Safety Act (HSA) and Manual of Uniform Traffic Control Devices (MUTCD). These roads have the following characteristics:

- Highest traffic volume and speeds
- Typically connect to State and county roads
- Usually arterial and collector roads
- Drainage addressed by use of culverts.

Road Maintenance Level 4 (ML4) – roads that provide a moderate degree of user comfort and convenience at moderate travel speeds. Most are double-lane and aggregate surfaced. These roads are also subject to the HSA and MUTCD and have the following characteristics:

- Moderate traffic volume and speeds
- May connect to county roads
- Usually a collector road
- Drainage addressed by use of culverts

Road Maintenance Level 3 (ML3) – roads that are open and maintained for travel by prudent drivers in a standard passenger car. User comfort and convenience are low priorities. These roads are typically low speed, single lane with turnouts, and spot surfacing. These roads are also subject to the HSA and MUTCD and have the following characteristics:

- Moderate to low traffic volume
- Typically connect to arterial and collector road, and/or are collector roads
- Combination of grade dips and culverts provide drainage
- Potholing or washboarding may occur.

Road Maintenance Level 2 (ML2) – roads are open for use by high-clearance vehicles; passenger car traffic is not a consideration. Traffic is normally minor, usually consisting of one or a combination of administrative, permitted, dispersed recreation, or other specialized uses. The following characterize these roads:

- Low traffic volume and speed
- Typically local roads
- Typically connect collector or other local roads
- Grade dips are the preferred drainage treatment
- Surface smoothness is not a consideration
- Not subject to HSA

Road Maintenance Level 1 (ML1) – roads that are closed to vehicular traffic intermittently for periods that exceed 1 year. Basic custodial maintenance is performed to protect adjacent resources and enable the road to facilitate future management activities. Planned road deterioration may occur at this level; may be open and suitable for non-motorized uses. Roads in this category may be of any type, class or construction standard, and may be managed at any other maintenance level during the time they are open for traffic.

Maintenance level 1 roads have the following attributes:

- Vehicular traffic is eliminated, including administrative traffic
- Entrance is physically blocked or disguised
- No maintenance other than a condition survey may be required so long as no potential exists for resource damage
- Not subject to HAS

Scope of the Economic Analysis for this report.

After reviewing existing Roads Analysis Processes for this area, and considering available resources (specialist’ time, and available funding), the Line Officer determined that the appropriate scope of analysis was all Level 1 and 2 roads within the forest that were not analyzed in the Bradshaw Vegetation Management Project TAP. The Level 3, 4, and 5, roads were all reviewed in a RAP conducted in 2003, and the recommendations are still valid.

Road Maintenance Frequency

The quantity and frequency of maintenance is subject to: availability of funding, obligations under agreements, and protecting the FS’s investment.

In accordance with the maintenance level described above the following table displays the cyclic activities required to maintain the road:

Table 1 – Road Maintenance Activity Frequency Road Maintenance Costs

Activity		ML1	ML2	ML3	ML4	ML5
Maintain traveled way for protection of investment, resource values, and to provide some degree of user comfort	Constructed Cost	0	0	\$6,843.37	\$12,989.46	\$55,756
	Frequency	0	0	3	3	20
	Annual Cost			\$ 2,281.12	\$ 4,329.82	\$ 2,787.80
Maintain road prism to provide for passage of high clearance vehicles	Constructed Cost	0	\$ 2429.82	\$ 2429.82	\$0.00	\$0
	Frequency	0	5	1		
	Annual Cost	0	\$ 485.96	\$ 2,429.82	0	0
Maintain shoulder	Constructed Cost	0	\$ 501.18	\$668.24	\$835.30	\$1,001
	Frequency	0	5	1	1	1
	Annual Cost	0	\$ 100.24	\$ 668.24	\$ 835.30	\$ 1,001.36
Keep drainage structures/features functional and prevent unacceptable resource damage	Constructed Cost	\$ 799.32	\$799.32	\$999.15	\$999	1260.9
	Frequency	10	5	5	1	1
	Annual Cost	\$ 79.93	\$ 159.86	\$ 199.83	\$ 999.15	\$ 1,260.90
Vegetation removal to provide for sight distance	Constructed Cost			\$835.30	\$835.30	\$835.30
	Frequency			10	10	10
	Annual Cost	0	0	\$ 83.53	\$ 83.53	\$ 83.53
Vegetation removal for access and to control resource damage	Constructed Cost		\$334.12			
	Frequency		15			
	Annual Cost	0	\$ 22.27	0	0	0

Alleviate erosion or sedimentation on or from roadway	Constructed Cost	\$ 835.30				
	Frequency	10				
	Annual Cost	\$ 83.53	0	0	0	0
Logging Out	Constructed Cost		\$213.11	\$532.77	\$532.77	\$686.30
	Frequency		1	1	1	1
	Annual Cost	0	\$ 213.11	\$ 532.77	\$ 532.77	\$ 686.30
Maintain structures to provide for passage of planned traffic and preserve structure	Constructed Cost		\$715.45	\$915.45	\$1,215.45	\$2,883.16
	Frequency		10	1	1	1
	Annual Cost	0	\$ 71.55	\$ 915.45	\$ 1,215.45	\$ 2,883.16
Install/maintain route warning, regulatory, and guide signs and other traffic devices to provide for safety	Constructed Cost		\$57.77	\$182.77	\$365.54	\$1,215.45
	Frequency		5	1	1	1
	Annual Cost	0	11.554	182.77	365.54	1215.45
	Total Annual Cost	\$ 163.46	\$ 1,064.55	\$ 7,210.00	\$ 8,278.03	\$ 13,834.97
	W/40% Overhead	\$228.85	\$1,490.36	\$10,094.00	\$ 11,589.24	\$ 19,368.96

Federally appropriated funds for road operation and maintenance funding on the Prescott National Forest (PNF) have allowed maintenance to be performed on approximately 10% of the road system for the past 5 years.

Besides the on-the-ground performance of maintenance related work, all road systems have fixed costs associated with operational management of the systems. Operational management includes:

- Oversight of the road system.
- Establishing and maintaining road management systems required by law (e.g., pavement management, bridge management, safety management, and congestion management).
- Collecting and maintaining data about the road system (e.g., conducting road condition surveys, gathering traffic count and vehicle accident information, etc.).
- Providing information services (e.g., maps, road condition reporting, etc.).
- Out-year project planning (e.g., specialist surveys/reports, etc.).
- Office support (contracting officers, utilities, equipment, etc.)

Over the last four years, fixed costs account for nearly 50% of the appropriated funds.

The Forest Service has conducted annual road condition surveys since 1999 to determine the maintenance and associated funding needed to maintain roads to the required safety standards and assigned maintenance levels. These surveys describe the features of the roads (e.g., surfacing, ditches, drainage dips, and culverts) and their condition. The maintenance cost of those roads and features is calculated from those surveys using a standard cost guide. Average of regional surveys indicates that the annual maintenance funding needed for all of the existing PNF System roads to be maintained is about \$3,583,305.

Table 2 lists the existing forest-wide average annual maintenance cost per mile per maintenance level for roads on the PNF.

Table 2 – Existing road maintenance costs by road maintenance level

Maintenance Level	Annual Cost per Mile	Miles	Annual Cost
5	\$19,368	15	\$290,520
4	\$11,589	7	\$81,123
3	\$10,094	31	\$312,914
2	\$1,490	1904	\$2,836,960
1	\$228	271	\$61,788
Totals		2228	\$3,583,305.00

The current and foreseeable PNF road maintenance budget can support only 10% of the required road maintenance, including fixed costs. Annual road maintenance costs need to be curtailed by reducing road mileage or road maintenance levels; the road maintenance budget increased or somehow augmented; or a combination of all of the above. The failure to fully fund road maintenance results in incremental loss of roadway infrastructure (surfacing, drainage, structure) further increasing future annual and deferred maintenance costs, or most commonly not fully maintaining the road to its assigned road maintenance level.

Resources for accomplishing maintenance activities

The FS currently utilizes three sources for performing maintenance on system roads; they include a FS Road Maintenance Crew (FS crew), Cooperative agreements, and Contracts to the public sector.

Each of the resources has its benefits. The FS crew is ideal for projects that require more engineering oversight due to the complex nature of terrain, resource protection requirements, and remote areas in which contractor's charges would not be cost effective. The FS crew can respond to a current road event such as a road failure which is preventing passage, or a windstorm event which causes a tree to fall across the road. The FS crew is ideal for this type of need. Contracts are needed when specialized equipment is required or projects are larger in scale requiring larger crews and multiple machines. Contracts have been used on roads that require routine maintenance, but have proven to be more costly for the government than the FS crew.

Cooperative agreements with counties are ideal for roads that serve private properties or access public areas. Counties often desire to maintain these roads to serve the residents and ranchers, and will maintain them more than once a year. These agreements between the Counties and the FS help to address our combined road maintenance needs and often significantly reduce FS maintenance costs.

Cost Reduction Strategies

The following includes some possibilities to align needed roads with the current and predicted road maintenance budget.

1. Decrease miles of roads
2. Decrease maintenance levels on roads.
3. Where appropriate transfer responsibility to other maintenance entities (including county and private)
4. Decommission roads
5. Convert roads to motorized or hiking trails.

Decrease Miles of Roads

The current road maintenance appropriations can only support 10% of the current road system (including fixed costs). System roads should receive recurring maintenance every five years or 20% of the roads per year. Therefore, to have a financial sustainable road system it would need to be reduced to a total of 1114 miles. Given the high degree of benefits for the ML 3-5 roads, the reduction would need to come from the ML 1-2 roads. The ML 1 roads would be decommissioned, and the ML2 road mileage would be reduced by placing them in ML 1. The table below shows the breakdown of ML and the annual cost reflecting this strategy.

Table 3 - Reduction of Road System Miles

Maintenance Level	Annual Cost per Mile	Miles	Proposed Annual Cost
5	\$19,368	7.5	\$145,260
4	\$11,589	3.5	\$40,561
3	\$10,094	15.5	\$156,457
2	\$1,490	952	\$1,418,480
1	\$228	135.5	\$30,780
Totals:		1114	\$1,791,538.00

Decrease Maintenance Levels

Maintenance levels (ML) are determined by considering the following factors: resource program needs (recreation, timber, etc.), environmental and resource protection requirements, user safety, composition of traffic (volume, type, class), surface type, and user comfort and convenience. The higher the maintenance level the higher the user comfort level and required cost for upkeep.

Therefore, one way to reduce the cost of the current system of roads is to decrease the ML on all roads (i.e., ML 4 are reduced to ML 3, ML 3 reduced to ML 2, and so on). In Table 2.0 there are three alternatives using ML reduction to achieve a financially sustainable system of roads using the typical budget received.

Table 3.1 - Reduction of Maintenance Levels on roads

Maintenance Level	Annual Cost per Mile	Existing Miles	#1		#2		#3	
			Proposed Miles	Annual Cost	Proposed Miles	Annual Cost	Proposed Miles	Annual Cost
5	\$18,368	15	0	\$				
4	\$11,589	7	15	\$173,835				
3	\$10,094	31	7	\$312,914	22	\$222,068		
2	\$1,490	1904	31	\$46,190	1161	\$1,728,890	1370	\$2,041,300
1	\$228	271	2175	\$495,900	1045	\$238,260	858	\$195,624
Totals:		2228		\$1,028,839.00	2228	\$1,244,154	2228	\$2,236,924.00

Alternative #1 reduces the ML 4, 3, 2 roads to ML 3, 2, and 1, respectively; allowing the PNF to maintain all the roads annually with 50% of the estimated annual costs. However, this alternative is not reasonable because 98% of the system roads are ML 1 meaning they are closed to all vehicular traffic for periods of time that exceed 1 year.

Alternative #2 reduces all ML 4 and 5 roads to ML3, reduces ML 3's to ML and reduces all 60% of ML 2 roads to ML 1. The alternative is also not reasonable in that 47% of the system roads would be closed (ML1), and the administrative and public benefits of forestlands accessed by

these roads would not be realized.

Alternative #3 contains a road system of only ML 1 and ML 2 roads. The current ML 3 ,ML 4 and ML5 roads would become ML 2 and ML 1 roads. The total ML 2 miles would be reduced to 61% of the current open system. The alternative is also not reasonable in that and the administrative and public benefits of forestlands accessed by these roads would not be realized.

In all three alternatives the total number of roads would be static at 3735 miles, the surface type and drainage structures would be modified to reduce the composition of the traffic and user comfort. These measures more than likely would not meet the program needs.

Transfer jurisdiction

Another way to reduce the cost of the PNF road system is to reduce the amount of miles. One method for removing roads from the FS system, but maintaining the benefits that the road provided is transferring the jurisdiction (ownership) and maintenance responsibility to another entity. Counties are often the ideal transfer candidate, as the road would then become a public road, allowing the FS to continue its use of it.

Another possible entity that we could transfer jurisdiction to would be home owner associations or private land owners that have properties bordering the Forest. These entities often desire easements so that they can improve the road to a level beyond the need of the forest, which they otherwise could not. Depending on the road, what it accesses and the resources of the area, the PNF may or may not grant the easement.

Decommissioning roads

This cost reduction method would also eliminate the total number of miles in the PNF road system and therefore the annual maintenance costs required. The decommissioning of roads is possible through two methods which includes abandonment or obliteration. Of the two methods, abandonment is the most cost effective, as no funds would be required to perform the action. However, this is only effective if there is no use of the road and the terrain will naturally reclaim itself, otherwise there will always be evidence of the road and will more than likely be used by the public as one.

The cost associated with obliteration varies greatly and is dependent on the method of decommissioning used. For example, the cost of felling trees or placing rocks to prevent access is much less expensive than reestablishing natural drainage patterns and stream channels (recontouring). Data for Region 3 (Southwestern Region) indicates that the average cost per mile for road decommissioning at \$1624.00 per mile, if the current road is outslopped, waterbarred, seeded and a barrier placed at the intersection of the road. A cost of \$2196.00 per mile is estimated if road side slopes are steeper, the ground requiring recontouring, seeding, slash placed and the entrance blocked. The majority of roads on the PNF would require more extensive decommissioning activities (e.g., recontouring) because they are on steep slopes or have erosive soils. These roads would also require drainage structures, such as waterbars and drainage dips, which would make the average closer to the \$2196.00 per mile cost.

Under this alternative alone, the cost to decommission roads to have a financial sustainable road system would be at least \$2,444,148 (reduce system mileage by 1113 at \$2196/mile). This alternative would impact other appropriation funds and therefore program areas, as the Road

Maintenance funds cannot be used to decommission roads.

Convert open and/or closed roads to motorized or hiking trails

This cost reduction alternative would also effectively eliminate the miles of road in the PNF road system and in turn the maintenance requirement needs. Converting roads to trails, maintains access to the Forest while reducing the maintenance costs. An additional benefit to the conversion is that the impact to the terrain will be lessened as trail widths are narrower than a single lane road. Closure or restriction devices may be required at intersections and junctions to prevent vehicular access, again impacting other (non-road maintenance) appropriation funds.

Conclusion

No cost reduction scenario on its own meets the need to balance road maintenance costs to our budgets. Well thought through combinations of these and other possible scenarios as well as creative management (i.e., partnering with counties for maintenance cost sharing) needs to continue. It is also clear that creating a road system to match our budget by simply closing roads will not result in a functional minimum sustainable road system for the public or the Forest.

Therefore a minimum system of roads will need to be established, realizing that the lack of adequate annual maintenance funding will cause the continual degradation of road conditions and serviceability. As the serviceability declines it will have an effect on:

- User safety (including personal injury, loss of life, or property loss);
- Environmental impacts (resource damage);
- Overall road maintenance system cost of restoring a safe and efficient road system (periodic reconstruction to eliminate deferred maintenance is more costly than timely preservation of the investment, through annual maintenance);
- Increased costs associated with wear and tear of vehicles.

After a minimum system of roads is established, with the available funding and appropriate planning the mileage of roads maintained can be maximized, such that the needs of the public and the Forest are met.