Appendix H

Forest Wide Travel 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 HSA

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

Activity	As needed		Annually		
	ML 1	ML 2	ML 3	ML 4	ML 5
Maintain traveled way for protection of investment, resource values, and to provide some degree of user comfort			Low	Moderate	High
Maintain road prism to provide for passage of high clearance vehicles		x			
Maintain shoulder		x	x	x	x
Keep drainage structures/features functional and prevent unacceptable resource damage	x	x	x	x	x
Vegetation removal to provide for sight distance			x	x	x
Vegetation removal for access and to control resource damage		x			
Alleviate erosion or sedimentation on or from roadway	x				
Remove roadside hazard trees			x	x	x
Maintain structures to provide for passage of planned traffic and preserve structure		x	x	x	x
Install/maintain route markers; warning, regulatory, and guide signs and other traffic devices to provide for planned traffic		x	x	x	x

Road Maintenance Costs

Federally appropriated funds for road operation and maintenance funding on the Cibola National Forest (CNF) have ranged from about $660,000 to $1,100,000 per year over the last four years, with the average funding being $940,000.

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. Those surveys indicate that the annual maintenance funding needed for all of the existing CNF System roads to be maintained is about $5.4 million.

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

Table 2 – Existing road maintenance costs by road maintenance level

Maintenance Level	Annual Cost per Mile	Existing Miles	Annual Cost
5			
4	$30,571.83	14	$428,006
3	$8,532.76	268	$2,286,780
2	$854.93	3,144	$2,687,900
1	$61.11	309	$18,883
Totals:		**3,735**	**$5,421,568**

The current and foreseeable CNF road maintenance budget can support only 9% 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. 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. Currently 179 miles of FS jurisdiction roads are included in cooperative maintenance agreements with the Counties within and bordering the CNF.

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 9% of the current road system (including fixed costs); therefore to have a financial sustainable road system it would need to be reduced to a total of 216 miles. The table below shows the break down of ML and the annual cost reflecting this strategy.

Table 3 - Reduction of Road System Miles

Maintenance Level	Annual Cost per Mile	Proposed Miles	Annual Cost
5			
4	$30,571.83	2	$61,144
3	$8,532.76	35	$298,647
2	$854.93	125	$106,866
1	$61.11	54	$3,300
Totals:		216	**$469,957**

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*	N/A	N/A	N/A	N/A	N/A	N/A		
4	$30,571.83	14	0	$0	0	$0		
3	$8,532.76	268	14	$119,459	75	$639,957		
2	$854.93	3,144	268	$229,121	96	$82,073	896	$766,017
1	$61.11	309	3453	$211,013	3564	$217,796	2839	$173,491
Totals:		**3,735**	**3,735**	**$559,593**	**3,735**	**$939,826**	**3,735**	**$939,509**

*** -** The Cibola National Forest does not have any maintenance level 5 roads under their jurisdiction.

Alternative #1 reduces the ML 4, 3, 2 roads to ML 3, 2, and 1, respectively; allowing the CNF to maintain all the roads annually with 120% of the available funds. The remaining 20% of funds would have to come out of the fixed costs. To achieve this reduction of fixed costs, less oversight, data collection, maintenance of data, safety inspections, office support and information services will be provided. However, this alternative is not reasonable because 92% 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 roads to ML3, reduces 77% (207 miles) of ML 3's to ML 2 and ML 1, and reduces all ML 2 roads to ML 1. This alternative would utilize 99.9% of the appropriations, leaving a mere $174/year for fixed costs. The alternative is also not reasonable in that 95% of the system roads would be closed (ML1), and the required safety inspections and office support could not be accomplished.

Alternative #3 contains a road system of only ML 1 and ML 2 roads. The current ML 3 and ML 4 roads would become ML 2 and ML 1 roads. The total ML 2 miles would be reduced to 24% of the current open system, and once again the fixed costs would be eliminated.

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 CNF 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.

In the 2003 Roads Analysis Process the interdisciplinary team identified 143.90 miles of ML 2 and 22.57 miles of ML1 roads that would be good candidates to transfer to the counties the roadway falls within.

Table 3.2 - Jurisdiction transfer cost savings

Maintenance Level	Annual Cost per Mile	Miles Transferred to other Entity	Savings
5			
4	$30,571.83	0.0	$0
3	$8,532.76	143.9	$1,227,864
2	$854.93	22.6	$19,321
1	$61.11	0.0	$0
Totals:		**166.5**	**$1,247,186**

This action alone would reduce the maintenance level 3 mileages by over 53% and bring the needed annual maintenance cost to $4,174,382. The current average budget of $940,000 would now cover 11% of the road system, versus the previous 9% (including fixed costs). These figures are dependant on the entities (Counties) accepting the transfer of jurisdiction.

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 CNF may or may not grant the easement.

Decommissioning roads

This cost reduction method would also eliminate the total number of miles in the CNF 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 is $1,126.00 per mile (1995 – 2002). This figure primarily reflects very light decommissioning activities (e.g., scarifying and seeding, signing, and blocking entrances) that are being used around the region. The majority of roads on the CNF would require one or more of the light decommissioning activities to effectively close them. Some roads, however, would require more extensive decommissioning activities (e.g., recontouring) because they are on steep slopes or have erosive soils. These roads would require drainage structures, such as waterbars and drainage dips, which would significantly exceed the $1,126.00 per mile average.

Under this alternative alone, the cost to decommission roads to have a financial sustainable road system would be at least $3.5 million (reduce system mileage by 3100 at $1,126/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 CNF 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 (in 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.