APPENDIX B

ECOLOGICAL, SOCIAL, AND ECONOMIC CONSIDERATIONS

Cibola National Forest
Magdalena Ranger District – Travel Management
Travel Analysis Process

Ecosystem Functions and Processes (EF)

EF(1): What ecological attributes, particularly those unique to the region, would be affected by designating motorized use and motorized routes or areas in a currently non-motorized area?

The two largest unroaded areas on the Magdalena Ranger District are the Apache Kid Wilderness Area and the Withington Wilderness Area. There are eight other areas on the Magdalena Ranger District that have been identified as Inventoried Roadless Areas (IRA'S). The District contains four distinct mountain ranges, the Bear/Gallinas Mountains, the Datil Mountains, the Magdalena Mountains and the San Mateo Mountains. Currently, the majority of the areas outside of designated wilderness are relatively moderately roaded (former logging roads, roads created from illegal firewood harvesting, roads used by range permittees to access range developments). A number of private developments exist on private land in-holdings in the Bear/Gallinas, Datil, Magdalena, and San Mateo Mountain ranges. Any additional road networks in unroaded areas could increase habitat fragmentation, runoff, and erosion, and could result in additional invasive plant species along the road corridor. Designation of motorized routes in non-motorized areas which have high-frequency, low-intensity fire regimes could alter those regimes. Motorized routes function as a fuelbreak to ground fires; therefore the extent of area burned by each fire could be reduced due to their presence.

EF(2): To what degree do the presence, type, and location of roads increase the introduction and spread of exotic plant and animal species, insects, diseases, and parasites? What are the potential effects of such introductions to plant and animal species and ecosystem function in the area?

The presence of roads increases the risk of spread of existing and new invasive plants to the Forest and surrounding landscapes. Higher assigned maintenance levels and subsequent frequency of road maintenance increases the chances for spread of many invasive plants into new areas. These invasive plants may displace the habitat of existing native species. Ecosystem function can be dramatically altered by the introduction and spread of invasive plants and our road systems may provide a major opportunity for introduction of new species from other states, areas, or nearby infestations.

Motorized vehicle use can be responsible for landscape-level conversions through soil disturbance, the transportation of seeds and edge habitat created by wider trails. OHVs are vectors for invasive plants, transporting thousands of seeds on the undercarriage of vehicles for many miles (Havlick 2002). Fragmentation created by roads and trails increases the ratio of non-forest to forest, and of forest edge to interior habitats, increasing the potential for spread of invasives to interior habitats. These environmental changes at forest edges may provide points of entry for invasive species (Spellerberg 1998). Information on New Mexico invasive species can be found at: http://weeds.nmsu.edu/

EF(3): To what degree do the presence, type, and location of roads contribute to the control of insects, diseases, and parasites?

Roads provide a transportation network that may be important in managing pathogens, including plant

diseases and pest insects. Transportation plans should evaluate the role of roads in maintaining these management functions in light of the risks present in the area of interest.

Currently, annual surveys for insect-related mortality and defoliation are completed through aerial surveys. This method requires no road system to achieve an accurate survey. Native pathogens (primarily dwarf mistletoe) require on-the-ground field inspections to identify their presence. Field inspections occur on a 20-30 year interval. A road spacing equivalent to a 2-mile x 2-mile grid is sufficient for inventory access. If action for either native insect outbreaks or pathogens is necessary and possible, further NEPA would be completed to address site-specific road needs.

EF(4): How does the road system affect ecological disturbance regimes in the area?

Roads can affect the rates of flow of various disturbance processes, especially fire. Fire frequency and severity can be affected by the fragmentation of forest caused by roads creating fuel breaks. Unroaded areas allow fire to perform its natural role in the ecosystem. The unroaded areas are not without their challenges for fire management activities, providing for the potential for fires of greater extent and severity.

The most common disturbance regimes on the Cibola National Forest are fire, drought, insects, and disease in the piñon, ponderosa pine, and mixed conifer forest types. These regimes are interrelated since drought often leads to increased incidences of fire and outbreaks of insects and disease. Fire is thought to be the most significant disturbance regime. Multiple large stand replacing fires have occurred in the San Mateo and Magdalena Mountain Ranges. The most recent were the Coffee Pot Fire (1994) which burned 22,000 acres in the San Mateo Mountains and the Ryan Fire (1994) which burned 1,400 acres in the Magdalena Mountains. Both of these fires occurred in the mixed conifer fuels types. In the Bear/Gallinas and Datil Mountain Ranges there have not been any large stand replacing fires in the last 36 years. The largest of these fires was the Unnamed Fire (1974) that burned 670 acres in Ponderosa pine.

Road access increases risk for human-caused fires on the Forest by dispersing people. Roads also allow rapid response opportunities for fire suppression. Even though it is acknowledged that road access in the Forest increases risk for human caused fire, this risk can be minimized through administrative means such as smoking and campfire restrictions and complete closures during high and extreme fire danger periods. Forest Service gates may be used to restrict public access while allowing for fire management resource access.

EF(5): What are the adverse effects of noise caused by developing, using, and maintaining roads?

Noise from developing, using and maintaining roads may affect people and wildlife within hearing distance. There is no specific data on the effects of noise from Magdalena Ranger District roads on people.

Fletcher and Busnel (1978) pointed out shortcomings in experimental studies of noise on wildlife. They stated that using decibel scales keyed to the relatively narrow range of human hearing may miss important, unobserved impacts to wildlife species that have a much greater hearing range. Usually, disturbance from OHV use is qualified as the vehicle use itself, as well as the associated noise from the activity. The most common interaction identified in the literature was displacement and avoidance, where animals altered their use of habitats in response to the motorized routes.

In general, effects of roads and trails on most wildlife species are negative (Boyle and Samson 1985). Studies on the issue of road avoidance as it impacts species are relatively numerous (primarily for big

game species such as elk, deer, and bear). Rost & Bailey (1979) examined deer pellet groups adjacent to and at a distance from forest roads in Colorado. They found that mule deer (and elk) tend to avoid areas within 200m of a road, particularly when the road was heavily traveled. They noted this was more important in shrub habitats (open habitat) than in piñon juniper (denser habitats). Perry & Overly (1977) in a study on the Starkey Experimental Forest in Oregon, showed displacement distances of up to 800m from a road. Yarmoloy et al., (1986), subjected collared mule deer to experimental harassment by ATV's (five deer were collared and three harassed for a period of nine minutes per day for a total of 15 days). His results showed that the deer abandoned their home ranges more often, shifted their feeding activity to nighttime, and increased their flight distance from the ATV's (compared to the non-harassed deer). (Wisdom et al., 2004) in a study examining the effects of ATV's, horseback riding, hiking, and mountain biking on deer and elk showed elk increasing their avoidance of ATV's (versus that of the other activities). His preliminary results noted that mule deer did not show a greater flight response to the off road vehicle treatments. However, he postulated that mule deer may respond to off road activity by seeking dense cover, instead of running. This would result in reduced foraging opportunities, with the concomitant reduction in weight gain.

Similar to humans, wildlife species can be individual in their response to disturbance. Some animals may become somewhat habituated, and to the casual observer, may appear to be unaffected. Cassier and Ables (1990), in a study of elk reactions to cross-country skiers in Yellowstone National Park, found that heart rates of the animals increased measurably even when they appeared to show no flight response. For bighorn sheep MacArthur et al., (1982) reported that even without evidence of obvious behavior changes, the animal's heart rates increased 20% when humans moved to within 50m. King and Workman (1986) observed similar stress responses in desert bighorn sheep. Even brief disturbances can have long-lasting effects on bighorn sheep heart rate and thus are probably energetically costly to animals (Hutchins and Geist 1987). Other ungulates (deer, elk, and pronghorn antelope) would be expected to show similar results to stress. The interactions associated with non-motorized trails were similar to that of motorized trails and include displacement, avoidance, and disturbance at a specific site during a critical period. The interaction varied depending upon wildlife species, with some more sensitive to motorized trail use and others more sensitive to non-motorized trail use. Although both forms of recreation have effects on wildlife, motorized trails showed a greater magnitude of effects than non-motorized trails, such as longer wildlife-displacement distances, for a larger number of focal species (Gaines et al., 2003).

What is important, particularly where OHV trails are concerned, is that users stay on existing trails. Ruediger (1996) estimates that displacement of some species, or indirect habitat loss due to roads, may average 1 km on each side of a highway in a forested area and up to 3 km on each side in open habitats. Traveling off the existing network of roads and trails MacArthur et al., (above) showed much greater stress responses when desert bighorns were exposed to activity off of existing road and trail networks. Schultz and Bailey (1979) showed the same results for elk in National Parks.

The following table from Forest Service General Technical Report #586, (Gaines et al. 2003) shows the areas impacted by roads (deer and elk avoidance zones) on summer ranges on the Okanagan and Wenatchee National Forests:

Table 1: The zone of influence applied to each side of a motorized trail or road based on road type and use level for the deer and elk summer habitat influence index.

Trail or road type and status	**Zone of influence*** (*Meters*)
Motorized trails	300
Closed road (no vehicular traffic but open to all-terrain vehicles)	300

Low traffic open road (>0 to 1 vehicle per 12 hours)	900
Moderate traffic open road (>2 to <4 vehicles per 12 hours)	1000
High traffic open road (>4 vehicles per 12 hours)	1300

* Zone of influence distance may be modified by topographic features.

The New Mexico Department of Game & Fish (2003), in the publication "Wildlife Parameters for Timber Sales" recommends the following road densities in big game habitats:

In primary big game winter range, no more than 0.1 (one tenth) of a mile of roads per section (square mile). In winter range, no more than 0.5 (one half) of a mile of road per section. In summer range, no more than 1 mile of road per section. The Magdalena Ranger District's big game habitat areas are considered year round range. They also note that "permanent roads should avoid saddles, ridge tops, riparian, meadows and edges of meadows, big game migration routes, and other key habitat areas." These areas are considered as wildlife travel routes.

For black bear habitat (spruce fir and mixed conifer habitat), the NMG&F timber guidelines state (regarding road densities): "open roads negatively affect bears by allowing increased hunter access. In addition, a 600 foot area on each side of the road is rendered largely unusable for bedding. This combined 1200 ft. width amounts to a loss of approximately 150 acres of bear habitat for each mile of open road". Idaho black bears responded to increases in road densities by shifting their home ranges to areas with lower road densities (Young and Beecham 1986, Beecham and Rohlman 1994). In the Pisgah National Forest of North Carolina, a study looked at whether bears avoided paved roads more than secondary roads (where collisions were not a factor on the low-speed roads). Reynolds-Hoagland and Mitchell (2007) found that bears avoided areas within 800m of gravel (secondary) roads.

In a study completed for the Bureau of Land Management in California, Weinstein (1978) observed that OHV use in riparian areas caused many bird species to alter their use of habitat, by flushing more readily and abandoning key nesting areas. Mountain lions in Arizona and Utah were noted to utilize areas of lower road density and established their home ranges in areas where improved dirt roads (and paved roads) were scarce (Van Dyke et al., 1986).

Aquatic, Riparian Zone, and Water Quality (AQ)

AQ(1): How and where does the road system modify the surface and subsurface hydrology of the area?

Roads and trails affect the hydrology of a watershed in three ways: 1) Interception of surface water flows on the road surface and subsurface flows through the hill slope; 2) Concentrating water; and 3) Redirecting water from natural flow paths. These changes can result in changes to peak flows, formation of gullies (Wemple et al 1996), extension of the channel networks (Montgomery: 1994), reduce infiltration (Elliot: 2000) and increases in erosion and sediment delivery to channels (USDA FS 2001).

It is likely that all roads on the Forest modify surface and subsurface hydrology to some degree due to the nature of the road prism on the landscape. The loss of vegetation, compaction of the soil, and

modification of the slope all contribute to changes in surface hydrology. These affects are mitigated to various degrees by the design of the road and condition of the road surface. For example, an in-sloped road would divert surface runoff to the inside of the road where it is concentrated for a given distance until it is diverted off the road prism, where an out-sloped road would shed water off the road surface along its length. Condition of the road surface is notable as well since a well-vegetated road surface will typically shed water at a slower rate than a road without a vegetative cover due to increased roughness associated with vegetation. All of these changes modify and extend the drainage network resulting in changes to runoff and infiltration characteristics including changes to peak flows and reduced infiltration.

In particular, surface hydrology can also be modified where watercourses are intercepted by the road and trail systems (Croke, et al, 2005). The existing condition of this effect was assessed by analyzing the connection of watercourses, roads, and trails using the available GIS data layers. This data is used because it is the most complete data layer of all of the features which have the potential to interact with roads and trails, thereby modifying the surface and subsurface hydrology of the project area. Data obtained from these sources may change with time as updates and improvements are made.

There are about 4580 locations where mapped roads intersect watercourses (perennial and ephemeral) within the National Forest Lands in the Magdalena Ranger District Analysis Area. Ninety-five percent (95%) of the roads and trails are within 100 meters of a watercourse on the Magdalena Ranger District. An analysis of roads and trails within 50 meters is not very different – 91% of roads and 95% of trails fall within this category. Conversely, 29% of watercourses have a road within 100 meters and 3% of streams have a trail within 100 meters. Some watersheds have a higher density while other watersheds have very few roads. Each of these locations has the potential to modify surface hydrology and to some extent subsurface hydrology. The tables below show the extent that roads and trails interact with the hydrologic features on the Magdalena Ranger District. Maps and GIS coverage are available in the project record.

Table 2. Surface hydrologic Features and Road/Trail Interactions

Unit	**Number of Road-Watercourse Crossings**	**% of Watercourses within 100m of Roads/Trails**	**% of Perennial Streams within 100m of Roads and Trails**
San Mateo	2244	26/4	62
Magdalena	271	23/8	0
Datil\Gallinas\Bears	2065	34/0	0
Total	4580	29/3	62

Modification of subsurface flow or groundwater by the road and trail system can occur in several ways. Roads and trails can intercept groundwater by exposing permeable layers and/or water tables by the road bed and cut slopes. Roads and trails can also divert water away from natural recharge pathways and alter the way an area receives water (Elliot, 2000). Both of these effects can impact groundwater dependent ecosystems such as wet meadows, wetlands, sub irrigated patches of riparian vegetation, and springs/seeps. Wet meadows, wetlands, and riparian ecosystems are identified through the use of the

Terrestrial Ecosystem Unit Inventory (TEUI) data. There are 1915 acres of this type of ecosystem on the Magdalena Ranger District, primarily in TE units 5 and 24. Groundwater dependent ecosystems were identified by merging the data layers for riparian TEUI types, perennial streams, springs, and stream reaches downstream of springs.

When determining the potential influence of a road system on subsurface hydrology, several factors are important. These include soil characteristics, geology, and location including proximity to groundwater dependent ecosystems. The TEUI provides one way to determine the potential for roads and trails to influence subsurface processes since it combines geology, soil characteristics into its classification methodology (Strenger, 2007). Roads also intersect geologic features such as faults and formation contact zones within the Magdalena Ranger District. Proximity to groundwater dependent ecosystems was done using GIS analysis as shown in table 2. Another factor is where roads occur adjacent to stream and result in a cut bank. These areas disrupt the flow of groundwater, especially the near subsurface flow paths which occur during and after storms. These flow paths are important conduits for recharging water to streams. Tables 1 indicates that 26-34% of all streams have a road adjacent to them. This is likely having an affect on recharge processes.

Table 3. Subsurface (groundwater) features and Road/Trail Interactions

Unit	**% of Springs & Seeps within 100m of Roads/Trails**	**% of Groundwater Dependent Ecosystems within 100m of Roads & Trails**
San Mateo	50/50	71
Magdalena	53/27	68
Datil\Gallinas\Bears	83/0	62
Total for Magdalena Ranger District	58/32	67

AQ(2): How and where does the road system generate surface erosion?

Surface erosion can be generated from the roadbed, from the back or fill slope, and the area adjacent to the back and fill slopes. Accelerated erosion from the roadbed is typical; the prevalence of the erosion is dependent on the road surfacing, road grade, traffic volume, maintenance scheduling, and effectiveness and spacing of drainage structures (Gucinski et al., 2000).

Native surfaced roads, often referred to as un-surfaced roads, generally have the most roadbed erosion because there is no surface to protect the soil particles from rain impact. Commercial gravel surfacing provides a good level of protection to the road surface from rain impact and moderate vehicle traffic. Harder limestone gravel surfacing provides even more protection from rain impact and heavy vehicle traffic. Generally, the addition of gravel, both commercial and limestone, increases the porosity and increases the hydraulic conductivity of the road, which decreases the runoff and associated erosion (Flerchinger and Watts 1987). Gravel also reduces the formation of ruts and reduces water flow path within the roadbed (Foltz and Truebe 1995). Overall, properly sized and applied gravel has been shown to result in reductions in erosion of 79 to 97% over un-protected, un-surfaced roadbeds (Swift 1984; Burroughs et al., 1985; Kochenderfer and Helvey 1987). Paved roads rarely experience any erosion of

the roadbed, but often direct high amounts of water off the road so that there is more erosion adjacent to the road.

Roadbed erosion primarily occurs through rain splash movement and sheet erosion just as on exposed soils. Roadbeds erode more readily than typical exposed soils because they have lost soil structure due to extreme compaction (Froelich 1975). Rilling and gullying are also common erosion processes on roadbeds (Novotny and Olem 1994). Traffic volume on a given road, especially those with native and gravel surfacing, can increase the erosion from the roadbed (Reid and Dunne 1984; Sullivan and Duncan 1981). Often heavy traffic volume is an indication to increase the durability of the road surface to limestone or pavement. Another solution to the issue of high traffic volume is to restrict traffic by closing or restricting travel on the road. The times for restriction are typically in the spring to avoid periods when roads and trails are on saturated soils that are susceptible to damage.

The steeper the grade of the road the greater the erosion potential from the roadbed (Elliot and Tysdal 1999). The steeper the slope perpendicular to the road the greater the fill slope erosion potential and potential erosion of adjacent areas from excess water draining off the road (Burroughs and King 1989; Soil Survey Staff 1999). Erosion of the fill slope can create unstable conditions in the roadbed or even gullies that extend into the roadbed. Back slope erosion is also greater on steeper slopes perpendicular to the road as runoff from land above the road or from subsurface flow intercepted by the road cut increases velocity on the often-exposed back slope soil. Runoff in the drainage ditch can also cause accelerated erosion if it is allowed to concentrate for great lengths (Burroughs and King 1989). Typically this erosion will occur in the drainage ditch itself, but it may extend into the roadbed or onto the fill slope and land down slope where the drainage ditch runoff is deposited (King 1979; Burroughs and King 1989).

Back and fill slopes often have exposed soil, the degree to which is dependent on the slope, soil type, amount of soil removed, and time since disturbance. The exposed soil is easier to erode than vegetated soil or soil that has other ground cover that is effective in dissipating the rain splash energy and reducing the velocity of sheet flow movement (Novotny and Olem 1994).

Road maintenance involving ditching and crowning of the road can cause short-term increases in roadbed and drainage ditch erosion as the armored, and sometimes vegetated, surface is displaced. A vegetated drainage ditch has been observed to produce only about 10-20% as much sediment as a freshly graded drainage ditch (Luce and Black 1999). Road construction produces the same high increase in short-term erosion as road maintenance, but also adds new long-term chronic increased levels of erosion (Megahan and Kidd 1972). The wider a newly constructed or maintained road, the more effect it will have on runoff and in turn, potential soil erosion.

Even though road maintenance can cause short-term increases in erosion and sedimentation, it will typically reduce erosion in the long-term. Road maintenance can range from simple grading to ditching and crowning to adding gravel surface to improving road drainage to stabilizing back and fill slopes. Grading, while bringing up highly erodible fine soil material, can remove ruts, which if left alone would create long flow paths for carrying water that could erode and transport sediment for long distances (Elliot 2000). Ditching and crowning is a form of grading that also pulls sediment out of the drainage ditch along with any vegetation or armoring and incorporates it back into the roadbed. Adding gravel will also reduce rutting and reduce rain splash erosion of the roadbed (Foltz and Truebe 1995). Gravel also allows a road to hold up better under heavy traffic volumes with less maintenance. Improved drainage will help to avoid concentrated water creating gullies on steep slopes (Weaver et al., 1995; Wemple et al., 1996) and place water in proper locations to avoid increasing the hazard of mass wasting (see AQ3). Drainage of the road can also help to deposit sediment-laden runoff onto low gradient, well vegetated areas where the sediment can settle out before reaching the stream. Back and fill slopes

stabilized with rip-rap, slash windrows, geo-textiles, erosion mats, straw, etc. are more resistant to erosion and mass wasting (Burroughs and King 1989).

The beneficial effects of road maintenance discussed above are based on the assumption that the road is receiving some level of use. If a road is completely closed off to use it will usually stabilize on its own over time, but it can continue to be a chronic source of increased sediment (Elliot et al., 1996). Often stabilization of sediment inputs can take several decades so decommissioning, which will cause a short-term increase in erosion, is preferred. Decommissioning also has other benefits such as improved hydrological function, restored landform, improved slope stability, and reduced compaction. The decision to allow a closed road to stabilize over time or to decommission it must be site specific as a closed road can be a chronic source of sediment if left alone, but sometimes decommissioning a road can create more erosion and sedimentation than it will save (Elliot et al., 1996; Elliot 2000).

Soil loss is the removal of surface particles by wind or water. The potential for soil to erode is obtained from TEUI data which combines a number of factors to develop a soil erosion hazard rating. Soil loss is of concern when the soil loss becomes the dominant process in a landscape and when soil is transported into watercourses, leading to sedimentation. This occurs when roads and watercourses are near each other, especially where roads cross streams.

Twenty-nine percent (29%) of soils in the Magdalena Analysis Area have severe erosion potential (Strenger et al. 2007). Overall, roads located on soils with high erosion potential pose an increased risk for surface erosion. Fifteen percent (15%) of all mapped roads are located on severe erosion potential soils within the analysis area on the Magdalena Ranger District. Many roads are built in river valleys and on flatter areas and this coincides with lower erosion potential on the Forest. Nonetheless, roads up channel bottoms can destabilize the channel bed causing increased channel erosion, development gullies from increased runoff from roads, and sedimentation.

Erosion from a site can have localized detrimental effects to soil productivity, but if the eroded sediment reaches a watercourse it can have detrimental impacts to the stream system and the aquatic biota, especially to a perennial or intermittent stream. Sediment in the streams can have additional impacts when a stream contains fish habitat or serves as a drinking water source for a community. Important factors that influence the probability of eroded sediment getting into streams include proximity of the road to a stream and road crossings of a stream (see AQ4 and AQ6).

AQ(3): How and where does the road system affect mass wasting?

The road system can increase the occurrences of landslides and mass wasting by changing “natural” soil and hill slope conditions in many ways (Dyrness 1967; Dunne and Leopold 1978). In addition to creating steep cut slopes that may cause slope failures, several other factors are involved. The road cut can intercept water moving laterally through the soil down the hillside. Intercepted subsurface water along with other water draining from the road can add weight to the downhill soil and reduce friction holding the soil on the hillside (Dunne and Leopold 1978). The added weight of the fill and water within the fill can also add weight to the soil and create conditions that could induce a landslide or slow soil creep or the road cut can be through weaker soil and geological layers causing a landslide or other form of slope movement (Robinson et al., 1972). All effects of a road on mass wasting are amplified when a road is made wider as a wider road can intercept more water, adds more fill down slope, and creates a deeper and steeper back slope.

The potential for mass wasting is evaluated using the TEUI data which contains information on slope, geology, and soil characteristics. TEUI data combines these factors into an interpretation for mass wasting hazard: 212,004 acres on the Magdalena Analysis Area have a high potential for mass wasting (Strenger et al.2007) as derived from the TEUI data. Overall, roads located on soils with high mass

wasting potential pose an increased risk for landslides and other forms of mass wasting (Dunne and Leopold 1978). One hundred thirty six (136) miles of mapped roads in the Magdalena Ranger District Analysis Area have a high potential for mass wasting. These soils are highly prone to mass wasting due to low cohesion between soils and geology and low cohesion within the underlying geological layers.

Mass wasting can cause detrimental increases in sedimentation to streams if the bottom end of a slump or landslide ends up in a stream or associated erosion of the material can easily enter the stream. The factors that influence sedimentation from mass wasting are similar to those stated in AQ2 and are expanded upon in AQ4 and AQ6.

AQ(4): How and where do road-stream crossings influence local stream channels and water quality?

Roads can act as conduits for the delivery of more water and sediment to the channel than it has naturally received and formed under and can influence channel formation and water quality. Road stream crossings are an important point of connection between the road and the natural drainage on the landscape.

The greatest potential impact that roads have on water quality on the Magdalena Ranger District is the production and delivery of sediment to the channel. The major source of sediment is derived from water running on the surface of the road, since other portions of the road prism (cut slopes, fill slopes, and road ditches) are typically well vegetated and on stable slopes. Therefore, the type of road surfacing is important to reduce surface erosion and, where streams are near, sedimentation. Where roads are open and used by the public, a harder running surface is required to minimize water resource effects. Roads are surfaced with native materials (considered un-surfaced), commercial stone other than limestone, and limestone aggregate. Limestone surfacing and to a lesser extent the commercial stone, form a more durable and erosion resistant running surface than the native “dirt” surfacing.

A culvert can modify flow energy as stream flow moves from the channel to the pipe and into the channel again. Stream flow at a culvert that is too small to effectively pass flow produced by a runoff event or that becomes plugged by debris or sediment can exceed the culverts inlet capacity and result in overtopping of the inlet and thus a rise in water level on the fill slope. When doing so, the risk of fill slope failure and flow diversion out of the channel increases, as does the potential for erosion and sedimentation. When road crossings overtop and the crossing does not allow water to pass over the road fill and back into the channel below the crossing, flow can be diverted away from the crossing and down the road ditch or running surface. Thus, erosion can occur on the road prism and/or down slope of the road as it leaves the road. I f this diverted flow were to travel down to a neighboring stream crossing then additional adverse impacts could occur at the crossing and in the receiving stream channel. Stream crossings without a bridge or culvert, such as ford crossings, allow greater sediment delivery to streams because of the direct connection from a road to a stream as compared to culvert crossings or bridges. The Forest Service sizes culverts to pass flows of a 50 to 100-year return period in a large stream, and flows of 25 to 50-year return periods for smaller streams (USDA-FS 1994). Other parameters considered in the design of a stream crossing are; matching channel width at bank full, reducing diversion potential, providing passage stream dependent life forms, and passing sediment, rocks and woody material. Where crossings are not designed with these factors in mind, impacts to channels and dependent resources can occur.

There are about 4,580 locations on USFS roads on the Magdalena Ranger District where roads cross stream channels. This data came from an ArcGIS intersection of the mapped roads on the USFS lands with all mapped watercourses. Table 1 also provides information about locations of roads that are close to stream channels. About 30% of all mapped watercourses have roads adjacent to them and 62% of the perennial streams have roads alongside them. Yet, perennial streams account for only 0.14% of the

mapped stream network. These locations present an opportunity for improvement.

AQ(5): How and where does the road system create potential for pollutants, such as chemical spills, oils, de-icing salts, or herbicides, to enter surface waters?

Roads on the Magdalena Ranger District may create potential pollutants in several ways. Roads can become contaminated by material from vehicles, including accumulation of small spills or from accidental spills of hazardous or harmful materials being transported over roads. Applied or spilled materials may have access to water bodies, depending on road proximity to the water body. The severity of damage depends on what organisms might be exposed, their susceptibility to the material, and the degree, duration, and timing of their exposure (USDA-FS 1999).

Maintenance Level (ML) 3 and 4 roads commonly occur in valley bottoms in many of the major stream channels on the Forest (along with State and other federal roads) and therefore have a relatively high risk of contributing pollutants to the stream. In addition, these roads are the major collector roads on the Forest, and receive a higher level of traffic. State and other federal roads are often salted and cindered to maintain safe travel in winter months and thus provide a mechanism for these pollutants to get into nearby waterways. These occur primarily downstream of National Forest System lands on the Magdalena Ranger District.

Roads with the greatest risk of contributing pollutants to the stream channel are those closest to the stream out to those within 100m of a water course. Approximately 57% of the mapped roads on the Magdalena Ranger District are within 100 meters of stream channels. 3.2 miles of these are along perennial streams which accounts for more than ½ of the perennial streams on the district.

AQ(6): How and where is the road system "hydrologically connected" to the stream system? How do the connections affect water quality and quantity (such as, the delivery of sediments and chemicals, thermal increases, elevated peak flows)?

"Roads frequently generate Horton overland flow resulting from relatively impermeable running surfaces and cut-slopes. In addition, interception of interflow at cut-slopes can generate runoff by converting subsurface flows to surface flows. Where these surface flows are continuous between roads and streams, such as where inboard ditches convey road runoff to stream channels, the road generating or receiving the runoff is considered hydrologically connected to the stream network. Wherever a hydrologic connection exists, rapid runoff, sediments, and road-associated chemicals (for example, spills or oil) generated on the road surface and cut-slopes are provided an efficient route into the natural channel network." (USDA-FS 1999)

Therefore, most roads alter natural drainage patterns to some degree. Whether or not the runoff pattern has an impact on water quality and quantity is a function of hydrologic connectivity or the connection between the road and the stream. Connectivity in arid and semi-arid landscapes (Bracken and Croke, 2007) where most runoff is produced by overland flow (Dunne and Leopold, 1978). It is harder to get hydrologic connectivity in the dry lands and may be localized. Snowmelt in the spring achieves the highest degree of connectivity with runoff and subsurface flow more continuous across the watershed. As discussed in the article by Bracken and Croke (2007), hydrologic connectivity depends on the interaction of saturated areas along watercourses and hill slope depressions and the areas that are sensitive to overland flow and intense rainfall (steep slopes, road surfaces).

The degree of hydrologic connectivity between roads and streams is estimated in this analysis by determining where roads are close enough to directly contribute water to streams during runoff events using the available data. Interaction occurs, and therefore the risk of hydrologic connectivity is considered "high," where road or trail segments cross any stream channel either perennial or intermittent

and where roads are within 50 meters of a stream. This distance was used to capture high risk areas where runoff can quickly enter a stream from the road system.

There are 4,580 locations where roads cross stream channels and 714 miles where roads are within 50 meters of a stream. 1.3 miles of these are along perennial stream reaches in the San Mateo's. These areas have a high risk of being hydrologically connected to the stream system during rainfall events. Where these "high" risk roads do occur, it is recommended that the connection between road and stream be evaluated to reduce or eliminate connectivity where possible. By doing so, the potential for adverse impacts to the nearby stream channel and water quality would be reduced.

AQ(7): What downstream beneficial uses of water exist in the area? What changes in uses and demand are expected over time? How are they affected or put at risk by road-derived pollutants?

"Water and water bodies have a great many potential uses and benefits, and the distribution, value, and sensitivity of the beneficial uses often differs greatly from area to area. Identifying what values can be affected and making an assessment of the degree to which they are affected by roads is crucial to maintain or improve these uses." (USDA-FS 1999)

Beneficial uses are termed "Designated Uses" by New Mexico Water Quality Control Commission (20.6.4 NMAC). Designated beneficial uses determine which water quality standards apply to a given stream reach or body of water. Designated uses for all state waters include the following: human health; aquatic life - limited, warm water or coldwater (marginal, regular and high-quality); fish culture; livestock watering; irrigation; irrigation storage; domestic water supply; municipal water supply; industrial water supply; wildlife habitat; primary contact and secondary contact. Water quality standards are assigned for each designated use and the most restrictive standard is followed if two or more designated uses have differing standards. On the Magdalena RD, no streams have been assessed by the State to determine if water quality standards are being met.

Roads and trails of particular concern are those that parallel streams and receive heavy use and roads with numerous stream crossings. An example of this condition is National Forest Service Road 10 located along the central part of the Gallinas sub-unit of the Bear/Gallinas Mountains unit of the analysis area. Other activities such as road construction, timber haul, ATV use, deteriorating road conditions, and restoration work, may also create an increased risk to aquatic life to varying degrees where connectivity exists between the road and the stream channel.

As stated in previous questions, about 57% of the roads are in close proximity to streams throughout the analysis area. These roads and trails in close proximity to streams and the road-stream crossings put these streams at risk of not meeting the designated uses, especially for the perennial stream areas.

AQ(8): How and where does the road system affect wetlands?

The road system can affect wetlands in two primary ways:

- Direct loss through filling and heavy sedimentation;
- Alteration of wetland type through changes in water levels and flow rates.

Depending on the location and type of wetland and road, a road can have many varying effects on a wetland and its function. A road through or near a wetland can increase direct sedimentation, impede hydrologic function, fill in part of the wetland, cause a change to a non-wetland land type due to changes in both hydrology and plant composition, and more. Sometimes a road can create a wet area, though not technically a wetland, by changing the hydrology and drainage of an area. Roads can also impact wildlife that depend on wetlands for habitat through fragmentation of habitat, increased mortality

rates from vehicle collisions, and alteration of behavior and movement of wildlife. A road can also influence the spread of invasive species into a wetland.

When found, wetlands are avoided in road and trail construction unless there is no "practicable alternative" (Carter 1977). Due to the complexity of a wetland, mitigation of road impacts is very costly and has varying degrees of effectiveness. Recommended alterations to road construction near and through a wetland include vegetated buffers between the road and the wetland, water flow structures under and through the road, elevating the road, incorporating wildlife tunnels and associated drift fencing to aid in movement and migration, and restricting road use and speed of travel during the breeding season (may be fall or spring).

Most wetlands on the Cibola National Forest are associated with springs, water bodies, or perennial streams. TEU data also captures the location of some wetlands. Much of this data was combined into a GIS layer and was used to assess impacts to groundwater dependent ecosystem. While this data is more extensive than the actual existing wetlands, it is used to determine locations where roads may be affecting wetlands. The response to AQ(1) provides this information with its associated map.

AQ(9): How does the road system alter physical channel dynamics, including isolation of floodplains: constraints on channel migration; and the movement of large wood, fine organic matter, and sediment?

"Stream channels are dynamic. They migrate within historic floodplains, eroding the bed and banks in one place while aggrading the bed and building new banks in other places. Streams also transport and deposit large pieces of woody debris and fine organic matter, and provide physical structure and diverse aquatic habitat to the stream channel. When roads encroach directly on stream channels, these processes can be modified. Wood and sediment can be trapped behind stream crossings, reducing downstream transport and increasing the risk of crossing failure. Road alignment and road fills can isolate floodplains, constrict the channel, constrict channel migration, and simplify riparian and aquatic habitat. In some places, road encroachment can divert stream flow to the opposite bank, thereby destabilizing the hill slope and resulting in increased land sliding." (USDA-FS 1999)

Road encroachment on stream channels and their adjacent floodplains is occurring in many of the smaller drainages and arroyos. For example, Indian Creek is encroached by Forest Service road 959A along much of its length on National Forest System land. Many of the intermittent and ephemeral drainages have become trails and even high clearance roads such as the North Fork of Water Canyon. Trails and roads up drainage bottoms change the ability of the channel to migrate by destabilizing stream bank and bed. Maintenance of these roads and trails also removes wood which is typically in short supply in these systems. Destabilization of the stream bed affects the sediment output of these drainages and can result in continually degrading channels (i.e. gullies).

Road-stream crossings are locations where the movement of large wood, fine organic matter and sediment are often modified. Fills within the floodplain typically characterize road-stream crossings and culverts that can constrict flood flows. During flood events when flows inundate the floodplain, a road crossing typically creates a "bottle neck" condition and a temporary impoundment as the water funnels through the culvert or bridge opening. During these situations, stream flow is slowed upstream of the crossing and the potential for deposition of entrained material increases, thereby reducing the likelihood of downstream transport. As a result, channel-forming processes can be altered. Sites of particular concern include those on streams where multiple road crossings occur over a relatively short distance. The likelihood of channel modification because of the road is increased.

As discussed in AQ(1) and AQ(4), there are about 4580 locations on USFS roads on the Magdalena Ranger District where roads cross stream channels. Table 1 also provides information about roads close

to stream channels. About 30% of all mapped watercourses have roads adjacent to them and 62% of the perennial streams have roads alongside them. Yet, perennial streams account for only 0.14% of the mapped stream network. These locations present an opportunity for improvement.

AQ(10): How and where does the road system restrict the migration and movement of aquatic organisms? What aquatic species are affected and to what extent?

Road systems can restrict the movement of aquatic organisms in streams on the Magdalena Ranger District. Where a road crosses a perennial stream, the most common crossing method is with a round corrugated culvert. This is because these are the least expensive and are the easiest to install. Other pipes that can restrict movement are squashed pipes and box culverts. Low water crossings can also restrict aquatic organisms from moving due to flow becoming more shallow and warm at these locations.

Several things can restrict the movement of a variety of species. First, and the most common, is the pipe is elevated above the channel at the outlet end making it difficult or impossible for all or some species to move upstream. Secondly, a round pipe concentrates flow in a long narrow flow path without velocity breaks, thus becoming a velocity barrier during higher runoff events. Third, inadequate water depth can prevent the movement through a pipe during low flow periods. This is more prone to happen with a squashed pipe or a box culvert. And last, the length and slope of the pipe can prevent upstream movement during all flow periods.

A variety of aquatic species can be affected by an impassable crossing. Trout receive the highest amount of attention because of their life history requirements. Because of their size and location, these headwater streams are typically crossed by a road with a culvert. Adult trout, because of their ability to jump, can sometimes navigate through an elevated pipe. However, many non-game fishes or younger trout do not have this ability and would have their upstream movement restricted.

The effects to aquatic insects are not so well known because of the lack of information in this area. According to Vaughan (2002) in his review of literature and discussions with experts in the field of aquatic insects, the effects of culverts on the upstream passage of stream insect populations would be localized. Most upstream movement of nymphs and larvae occurs over relatively short distances (<300 m). If upstream movement is restricted by an elevated pipe, upstream reaches will likely be colonized by aerially dispersing adults.

As discussed in AQ(1) and AQ(4), there are about 4580 locations on USFS roads on the Magdalena Ranger District where roads cross stream channels.

AQ(11): How does the road system affect shading, litterfall, and riparian plant communities?

Road systems can affect shading, litter fall, and riparian plant communities along streams. The effects from roads are dependent on slope, aspect, and proximity to a stream. Many roads on the Forest that parallel a stream have forested vegetation growing between the two, thus providing shade and litter fall to the stream. The corridor cut for the road can however allow additional light to enter the riparian area and cause increased temperatures in the stream and the riparian area as a whole. Typically this break in shading does not happen with narrow trail, but there is a potential for wider vehicle trail to have the same effect in and along riparian areas. The road and trail system can also affect riparian communities by providing a conduit for the introduction of invasive species. The transportation system can also affect riparian vegetation by altering flow paths of springs and underground water sources.

AQ(12): How and where does the road system contribute to fishing, poaching, or direct habitat loss for at-risk aquatic species?

The endangered Rio Grande silvery minnow does have habitat down stream of the analysis area in the middle Rio Grande River. The reasons stated for its decrease in population are well outside of the influence of transportation management on the Magdalena Ranger District (e.g. flow regulation, substrate changes from sand/silt to cobbles/gravels). Therefore, it does not appear that transportation management in the analysis area is or could contribute to direct, or even indirect, habitat loss.

Habitat loss for at-risk aquatic species occurs where the road prism results in direct or indirect loss of habitat. Direct loss of habitat results from the placement of roads in or near streams and riparian areas. For example, loss of stream habitat can occur by the placement of culverts in a stream, where a culvert and associated fill replaces native streambed materials. Encroachment of the road prism along streams also indirectly affects habitat by reducing riparian habitat that provides food, and shade that helps cool stream waters. In addition, added silt from roads that run parallel to streams affects spawning habitat by covering gravel beds and suffocating eggs and larvae.

AQ(13): How and where does the road facilitate the introduction of non-native aquatic species?

How: Road systems that are open to public traffic and lead to a body of water or stream provide an avenue for the potential introduction of invasive species. Roads and trails leading to streams provide the avenue for anglers using live bait (which may include invasive species) to release any unused bait into these waters. Additionally popular rainbow and brown trout are not native but could be introduced into coldwater streams and possibly survive and out compete native species. Equipment or clothing worn in other streams that may contain whirling disease (*Myxobolus cerebralis*) can transport the parasite to the "target" waterbody.

Where: There are no known non-native aquatic species on the Magdalena Ranger District.

AQ(14): To what extent does the road system overlap with areas of exceptionally high aquatic diversity or productivity, or areas containing rare or unique aquatic species or species of interest?

With the exception of the Chiricahua Leopard Frog (CLF) in the Alamosa Warm Springs area, there are no areas of exceptionally high aquatic diversity or productivity, or areas containing rare or unique aquatic species or species of interest on, or immediately downstream of, the Magdalena Ranger District Analysis Area.

Terrestrial Wildlife (TW)

TW(1): What are the direct affects of the road system on terrestrial species habitat?

Direct affects to terrestrial species habitat from the Cibola National Forest road system include: 1) loss of habitat due to conversion of native vegetation to a particular road surface (paved, gravel, dirt), 2) fragmentation of habitats due to road system development, 3) interruption in migratory patterns of wildlife to reach breeding habitat or winter range habitat, and 4) lack of habitat use by wildlife due to disturbance caused by use of the road system.

Loss of wildlife habitat can be correlated to road miles by converting road width and road distance into acres of habitat. The road mileage differs between each off-highway vehicle (OHV) planning unit. Most single lane roads, level 2 and some level 3 roads, have a width standard of 12 feet. Most double lane roads, level 4 roads, have a width standard of 24 feet. For this analysis, an average width of 16.5 feet will be used. A road 16.5 feet wide and one half mile long is equivalent to 1 acre. Table 1

illustrates each OHV planning area's total road miles based on current road layer analysis in the Cibola National Forest's Geographical Information System and the amount wildlife habitat in acres that has been converted to a road surface over time. Note that this effort only applied to roads, not motorized trails; these impacts are additive to the direct habitat loss but are not quantified, so areas with motorized trail access would have more direct habitat loss, but exact amount is not known.

In Table 4, miles of road are based on road analysis maintenance levels 1 through 3 within the 4 planning areas on the Magdalena Ranger District and associated acres of wildlife habitat converted due to existing roads:

Table 4: Totals of Direct Habitat Loss

Name of area	Miles of road*	Habitat converted to roads (acres)
Bear/Gallinas Mountains –Magdalena Ranger District	200.12	400.14
Datil Mountains-Magdalena Ranger District	173.19	346.38
Magdalena Mountains – Magdalena Ranger District	118.56	377.12
San Mateo Mountains – Magdalena Ranger District	825.4	1,650.8
Totals (entire District)	1,317.27	2,634.54

*Roads include only those Maintenance Level 1-3 roads that fall within the Forest Service boundary.

While the totals of direct habitat loss are relatively low, there is an indirect habitat loss around roads where wildlife will avoid using that habitat. This can be thought of as a "buffer" around the road that wildlife will generally avoid while the roads are in use (see the discussion of noise impacts below). This does not mean the animals never use these areas, only that the majority of animals tend to avoid these zones while the road is in use.

The above table does not show direct habitat loss due to trails, which would add more acres to the total and increase the percentages of disturbed habitat. For the purposes of disturbance effects to wildlife, these unpaved OHV routes, whether roads or trails are similar. Lack of wildlife use in habitats along roads and trails can also be correlated to the level of use a road receives over a period of time. Low use roads may tend to have wildlife using road-side habitats more frequently than roads with high traffic volume. This rationale has been evident during the 2002 forest fire closure that was implemented on the Cibola National Forest. Based on observations by law enforcement personnel, wildlife have been seen more frequently along roads and crossing roads during the fire closure, than when the forest is open and road use by the public is higher (Gurule 2003).

Off-highway vehicle travel on undesignated routes (i.e. cross-country) is presently allowed from existing roads, whether it's a level 1, 2, or 3 road. Off-highway vehicle use affects wildlife more directly by harassment and displacement, reducing the security of areas between the roads. Off-highway vehicle travel affects habitat through trampling of vegetation, compaction of soil, loss of vegetation and soil, and contribution of sediment to stream waters. Impacts to habitat can either be short term or long

term. Short term impacts may be where an off-highway vehicle makes one pass across a stream and the resulting sediments clear up in a few minutes. Long term impacts are where multiple passes occur across the stream resulting in eroded banks and loss of vegetation and soils for an extended period of time.

Amphibians and reptiles are particularly susceptible to mortality on two-lane roads with low to moderate traffic (Forman and Alexander 1998). Roads by wetlands and ponds have high roadkill rates and roadkill is probably the greatest transportation impact on amphibians (Forman and Alexander 1998). Many reptiles are killed by vehicles because they use roads for heating and cooling (Wisdom et al. 2000). Predators and scavengers feeding on road kill and animals attracted to salts or vegetation on or alongside roads, also suffer mortality (Baker and Knight 2000). In general, effects of roads and trails on most wildlife species are negative (Boyle and Samson 1985).

While wintering areas have traditionally received the most attention as a high stress period for many wildlife species, the importance of summer habitat (breeding and foraging areas) is now perceived as just as important where impact analysis is concerned. Animals must have access to adequate forage which allows them to nurse young and provide young animals and themselves with enough fat stores to help them survive the winter. This not only includes suitable forage quality, but areas where they are not constantly being disturbed and utilizing energy to avoid the disturbance. Canfield et al. (1999) and Toweill and Thomas (2002) both state that the effects of open motorized trail use are likely similar to those resulting from open roads.

TW(2): How does the road system facilitate human activities that affect habitat?

Human activities that affect habitat and are facilitated by the existing road system include:
1) Off road vehicle travel, 2) Developed recreation 3) Large group special uses, 4) Forest Service commodity production (i.e. fuelwood harvesting), 5) Dispersed camping.

Recreational uses such as dispersed camping or large group events also impact wildlife habitat to varying degrees. For example, large group events occur periodically and over a short period of time. Most often, they occur over a weekend and result in trampling of vegetation in a meadow or open area. The effects of such an activity are likely to last only a short period of time, a few days or a week. Other effects include displacement of wildlife due to noise associated with vehicles and other human activities.

Past Forest Service commodity production and recreational uses have created the existing road system and network present today. Human activities such as timber harvest, fuelwood gathering, and hunting affect wildlife to varying degrees. Wildlife forage, nesting, and thermal cover habitat are affected by these activities depending on the degree of use and extraction that occurs and timing, frequency, and duration.

TW(3): How does the road system affect legal and illegal human activities (including trapping, hunting, poaching, harassment, road kill, or illegal kill levels)? What are the affects on wildlife species?

The existing road system influences both legal and illegal human activities. Legal activities such as hunting and trapping are facilitated by the existing road system. The road system facilitates hunting and trapping by making access to areas easier and faster and also helps distribute road hunters (those who hunt from their vehicles or along roadways) over a greater area. In addition, level 2 roads and above also facilitate access for sportsmen with disabilities. In contrast, the same benefits of roads for legal activities such as hunting and trapping also help facilitate some illegal activities such as poaching. Poachers benefit and find it easier to take wildlife in areas with a well established road system. As discussed earlier poachers prefer road systems with loops or interconnected road networks, and tend not

to use “dead end” roads or roads with no secondary outlet (i.e. one way in, one way out).

High road densities can also affect wildlife negatively through harassment, displacement, or vulnerability to hunters and poachers. The Rocky Mountain Elk Foundation has funded several studies on the effects of roads on elk, and in particular to effects on mature bulls (Stalling, 1994). These studies have found that hunter densities increase in proportion to road densities. The more roads you have in an area, the more hunters you will have, resulting in more hunting pressure and harvesting of mature bulls. Stalling (1994) summarized one study that looked at elk mortality in three different areas; 1) high density of open roads, 2) roads closed to motorized vehicles during hunting season, and 3) area with no roads. In the area with a high density of open roads, only 5% of all bulls lived to maturity (4.5 years). None of the bulls lived past 5.5 years, and the herd contained about 10 bulls for every 100 cows. In the area with roads closed during the hunting season, 16% of the bulls lived past maturity, most reaching 7.5 years. The herd contained 20 bulls for every 100 cows. In the area with no roads, 30% of the bulls lived to maturity, most reaching 10 years. This herd contained 35 bulls per 100 cows.

The study found that as road access increases, elk become increasingly vulnerable to hunting mortality. This trend will result in elk populations with undesirable sex and age structure, increasingly complex and restrictive hunting regulations to protect elk herds, and a loss of recreational opportunity. Mule deer are expected to show the same responses to road access.

Illegal motorized vehicle use off road has become a problem that is possibly linked to road systems. New roads/trails are constantly being created on the Forest by illegal use of off-highway vehicles.

TW(4): How does the road system directly affect unique communities or special features in the area?

Unique communities or special features for wildlife that may be affected by the road system include crucial big game wintering areas, big game birthing and breeding areas, (although none have yet been identified in the analysis area) riparian and wetland areas (including meadows), water developments, and habitat for threatened, endangered, candidate, proposed and sensitive wildlife and plants. There are four (4) known Northern Goshawk nesting areas (Post Fledging Areas, PFAs) in the San Mateo Mountains. None of these PFAs are being impacted by roads. The Northern Goshawk is a Regional Foresters Sensitive Species. There are also four (4) Mexican Spotted Owl (MSO) nesting areas (Protected Activity Centers, PACs) in the Magdalena Mountains and twenty-nine (29) PACs in the San Mateo Mountains. Seventeen (17) of the 29 PACs in the San Mateo Mountains are located within the Apache Kid and Withington Wilderness Areas. Two (2) of the 4 PACs in the Magdalena Mountains are being impacted by roads; while 6 PACs in the San Mateo Mountains are being impacted by roads. Numerous decommissioned routes, which are being utilized by public users, impact several MSO-PACs in the San Mateo Mountains.

The Mexican spotted owl is a Threatened Species under the Endangered Species Act. A list of other Regional Foresters Sensitive species, as well as Cibola National Forest Management Indicator Species (species that are relatively low in number and associated with particular habitat types) can be found in the Risk Assessment section.

Economics (EC)

EC(1): How does the road and trail system affect the agency’s direct costs and revenues? What, if any, changes in the road system will increase net revenue to the agency by reducing cost, increasing revenue, or both?

Roads: This question can be answered in broad terms as a detailed cost/benefit economic assessment is not feasible (refer to Appendix H for a broad forest-wide economic analysis). The IDT for the

Magdalena Ranger District addressed this question by developing the Road Risk versus Benefit matrix and used this tool to determine which roads fell into what Road Management Category. The IDT identified nine road management categories for this District-scale roads analysis.

The Magdalena Ranger District - Travel Analysis Process (TAP) considered maintenance level (ML) 1, 2, and 3 roads. There is one (1) ML-4 road on the Magdalena Ranger District. That road provides paved access to the Magdalena Ranger Districts Work Center Administrative Site. There are no ML-5 roads on the Magdalena Ranger District. The IDT determined early in the process that an assumption that most of these roads would always be kept open (with the exception of the ML 1 Closed Roads) for obvious reasons—they access resources that the Forest needs to manage. Most of these roads were developed over the years for a variety of access needs, and considerable capital investments were incurred to construct these roads. Most of these roads were analyzed in some form, which likely included use needs, construction design standards, environmental considerations, and economic assessment.

The IDT's challenge was to develop a process to sort out those maintenance level 1, 2, and 3 roads that might not be meeting current and future land management needs, at least not at their current maintenance levels. This process helps identify opportunities to reduce road maintenance costs on some roads. Currently, with the existing Cibola National Forest transportation budget is able to maintain 9% of our existing transportation system to standard.

Road operation/maintenance funding and costs
Road condition surveys conducted in 2006 reveal a total maintenance backlog (deferred maintenance) of $22,954,302 on the Forest. The condition surveys document a need of about $3,306,807 annually to maintain all roads in the CNF system. Road operation and maintenance funding is expected to stay stagnant in the foreseeable future.

The appropriated roads budget available for operation, maintenance has been declining over the past three years:

- 2006 - $950,000
- 2007 - $740,000
- 2008 - $800,000

A cooperative maintenance agreement between the Counties and the Forest Service helps to address our combined road maintenance needs. Approximately 65 miles of Forest Service jurisdiction roads are included in cooperative maintenance agreements with the Counties that the CNF border. Of the 65 miles, 46 miles are with Socorro County and 19 miles are with Catron County. The Forest Service occasionally provides materials or equipment towards maintenance of the roads under the cooperative agreements.

Commodity Production

Timber Management (TM)

TM(1): How does road spacing and location affect logging system feasibility? How does the road system affect managing the suitable timber base and other lands?
The existing road system is used to determine which timber stands can be accessed for treatments. The low value of the timber on the Magdalena Ranger District makes it unlikely that new roads will be constructed to access more remote timber stands. Some areas that have no existing access will be left untreated, because of the limitations of moving heavy equipment in and out of those areas. Other areas will be treated by hand with no timber product removal. Temporary skid trails would be constructed and used within timber sale areas for product removal; no new roads would be needed. If the timber program on the Magdalena Ranger District grew and large timber sales were being offered, additional

roads would be identified and analyzed during the NEPA process for the timber sale. Cable logging is not currently being considered for timber removal on the District.

TM(2): How does the road system affect managing the suitable timber base and other lands?

Road systems provide for faster and less expensive access to national forest lands for resource inventory data collection, for monitoring activities and conditions, law enforcement, fire suppression, watershed restoration, site preparation and tree planting, treating noxious weeds, thinning operations, and numerous other forest management activities.

TM(3): How does the road system affect access to timber stands needing silvicultural treatment?

The emphasis in silvicultural practices is shifting from even-aged management to managing for uneven-aged stands. These multistory stands require treatments with greater frequency, needing road access more often. Overstocked timber stands can generally be economically thinned only if adjacent to existing forest roads. Likewise, mechanical restoration projects to remove excessive fuels or treat diseased trees are usually only feasible if road access is present.

The information below is based on the following assumptions:

1. Natural regeneration of trees is by far the most common method due to good success and heavy rock formations, which makes planting difficult to impossible.
2. Most ponderosa pine or mixed conifer management consists of various thinning and selection methods which require re-treatment on a 20 to 30-year cycle.
3. Treatment of piñon-juniper is on a 50+ year cycle due to slower growth.
4. The local demand for small (5-9" DBH) wood maybe strong enough that pre-commercial thinning contracts are being dropped in lieu of small sales, at least where roads and rights-of-ways are in place.
5. Harvesting will be done with a variety of equipment including rubber tired skidders and farm tractors, bulldozers, front end loaders, off-road pickup, dump, and stake-bed trucks, with limitations during wet-soil periods. There is no local skyline yarding equipment.
6. Native-surface roads left open after harvest treatments quickly become eroded and hard to use with full-sized vehicles.

The ideal road system needed in order to implement timber management on the Magdalena Ranger District would consist of system roads spaced a ½ mile apart allowing for a ¼-mile maximum ground-based yarding (skidding) distance, known as "external yarding distance or EYD". In instances where a "long corner" exists, EYD can reach a maximum distance of ½ mile. Unlike skyline yarding, long skidding distances do not generate a need for larger equipment or wider roads. The ideal road system is unlikely to be attained; rather, the transportation needs would be filled using temporary roads and skid trails.

When defined ridges are present, the ideal location for roads would be along the north and some of the east and west slope "breaks" (where the slope changes from gentle to steep). This affords the optimum road position to uphill yard the steep slopes with non-traditional logging systems, to allow for drainage of water off the road, and to aid in fire suppression. "Non-traditional" in this area means skyline cable or state-of-the-art ground based machinery, both of which can move logs uphill on slopes greater than 20%. South slopes here generally have inadequate volume and less woody-fuel hazard than the other slopes. Given the NW-SE orientation of most mountain range ridges and the SW prevailing winds, these locations are potentially ideal for use as firelines and for burning out.

The presence of defined ridges or major drainages overrides the ideal ½-mile spacing, i.e., skidding over ridges and across drainages would generally be avoided for economic and environmental reasons. The result in broken country is a road density higher than the ideal.

Steep slopes in all four mountain ranges are currently either unmanaged, managed by hand thinning without product removal, or managed with prescribed fire. This is due to a lack of local steep-slope logging equipment. If skyline logging, including necessary slope-break roads, were proposed, additional NEPA would be required. It is unlikely that any substantial amount of mid-slope roads would be constructed for skyline yarding due to the relatively short length of most slopes here.

Road spacing to meet timber management inventory, planning, and sale preparation needs between harvests are described under part EF3.

Minerals Management (MM)

MM(1): How does the road system affect access to locatable, leasable, and salable minerals?

The Maintenance Level 3 roads on the Magdalena Ranger District serve as access to general areas and provide adequate access. Many mineral operations occur on maintenance level 1 and 2 roads especially for the purpose of locatable mineral exploration, development, and production. We can place reasonable restrictions on access to miners for resource protection purposes but we cannot prevent access altogether. However, larger operations, such as oil and gas wells that use heavy equipment, large trucks, pipelines, etc. and thus require higher level roads, bear the cost and responsibility of planning and design to Forest standards, construction, maintenance and rehabilitation of improvements.

If there are leasable minerals then the Forest Service can determine whether or not surface occupancy is allowed or not, and under what conditions and recommend to the BLM that certain stipulations be adopted.

With salable minerals the Forest Service will decide whether or not we want to sell those minerals or not, and if so the Forest Service dictates the conditions, including access, that determines how and when they can be mined. We are under no obligation to provide any road access for salable minerals other then the Forest Service policy to “foster and encourage” the development and use of mineral resources.

Range Management (RM)

RM(1): How does the road system affect access to grazing allotments?

The Magdalena Ranger District has 42 grazing allotments. Eight (8) of these allotments are located in the Bear/Gallinas Mountains, 6 allotments are located in the Datil Mountains, 11 allotments are located in the Magdalena Mountains, and 17 allotments are located in the San Mateo Mountains; totaling 762,558 acres, respectively. Roads with maintenance levels 1, 2, or 3 are suitable for access in grazing allotments to perform various duties. Administrative range management duties require vehicle access for allotment inspections, repair and maintenance of range improvements, control of invasive plants, placing nutritional supplements, seeding projects, and the need to attend sick or injured livestock.

Winter snow melt, spring rains, summer monsoons and rutting by users impair road conditions. Many existing allotment roads (level 1 & 2) have serious rutting and erosion problems and are not maintained; resulting in the unauthorized re-routing of roads around heavily damaged areas. Across the district many new cross country routes have been created, as access for woodcutting, pinyon nut gathering, and hunting activities. Two extensive unauthorized roads have been created by the public to continue access to Forest Service lands behind private in-holding lands that have been fenced and locked (Muleshoe

Allotment and Datil Allotment). Some decommissioned roads (mainly in the Datil Mountains) have been re-opened (berms removed) by the public, primarily for hunting and other recreational use.

Term Grazing Permits used to administer grazing on the National Forest are recognized as a Special Use Permit which is on-going and has a long history on the Magdalena Ranger District. Per 36 CFR 261.13, grazing permittees will have specific written authorization for single use administrative roads, trails, and cross-country motorized travel needs as specified in Part 3 "Terms and Conditions" of a valid grazing permit, Allotment Management Plan or Annual Operating Instructions. The permittees will be authorized use of non-designated motorized routes while conducting necessary activities related to authorized grazing on their grazing allotment.

After a signed decision for Travel Management is complete, those access needs not included in the designated travel system will be identified as a special provision in the Term Grazing Permits for the Magdalena Ranger District. Included in these details will be a brief discussion of the "current access needs" use of vehicles on the designated road system, any single purpose use roads or trails, and a description of the annually anticipated level of cross-country travel. Annually, any travel needs not previously contemplated in the Term Grazing Permit will be discussed and appropriate authorization and guidance given in the Annual Operating Instructions.

Permittees are required to satisfactorily maintain existing range improvements listed on their Term Grazing Permits. These include fences, exclosures, water wells, windmills, storage tanks, earthen tanks, pipelines, drinkers, corrals, cattle guards, and gates. The construction of new range improvements are required when identified and authorized as part of the on-going management system of an allotment. Fences and gates need to be checked constantly to insure livestock are in the correct pasture for compliance with permit terms and conditions. Nutritional supplements are used throughout the year to enhance livestock condition and improve distribution across the allotment. Access to sick and injured livestock is also a common and reasonable need for access outside designated roadways. Vandalism to Forest Service property, resource theft, and recreational use increases the need for permittees to travel across the allotment to insure gates, fences and other grazing resources are intact.

Water Production (WP)

WP(1): How does the road system affect access, constructing, maintaining, monitoring, and operating water diversions, impoundments, and distribution canals or pipes?

The road system on the Magdalena Ranger District provides the necessary access for operation and maintenance of water diversions, spring developments, impoundments, and pipelines. Sometimes this access is provided by state roads and highways over which the Forest Service has no jurisdiction.

WP(2): How does road development and use affect water quality in municipal watersheds?

Public water supplies on the Magdalena Ranger District are from groundwater wells. There is local use of springs. Road development is not expected to affect water quality in public water supplies. There are no municipal watersheds on the Magdalena Ranger District**.**

Special Forest Products (SP)

SP(1): How does the road system affect access for collecting special forest products?

Collecting special forest products often depends on using existing forest roads. These activities provide employment opportunities, but typically do not support developing or maintaining roads.

The current road system (arterial, collector- state, county, and Maintenance Level 3 roads) provides

adequate access for gathering special forest products including boughs, wildlings, herbs, and plant materials. The current open local roads (Maintenance Level 2 roads) provide adequate access for Christmas trees, firewood, latillas and vigas on the Magdalena Ranger District.

The current road system facilitates the use of the Magdalena Ranger District lands for collection of boughs, piñon nuts, plants, and minerals for ceremonial use by American Indian traditional practitioners. Forest products are also collected for personal use by American Indians.

Special-Use Permits (SU)

SU(1): How does the road system affect managing special-use permit sites (concessionaires, communications sites, utility corridors, and so on)?

Road access for special-use permits are analyzed as part of the permit and conditions included therein.

General Public Transportation (GT)

GT(1): How does the road system connect to public roads and provide primary access to communities?

County roads, U.S. highways, and State highways give communities, tourists, and industries access to the Magdalena Ranger District. These roads connect to arterial, collector, and some local Forest Service roads, where traffic is dispersed into the District for a variety of uses. Some county roads and state highways traverse into or through the National Forest, as shown on the maps, and listed in the tables. Among the more important U.S. and State highways are: U.S. HWY 60, NM 1, NM 12, NM 52, NM 107, NM 142, NM 168, and NM 169.

Roads included in this analysis, are only those under Forest Service jurisdiction (approximately 1,317.5 miles).

National Forest system roads connect to numerous public roads managed and operated by the U.S. DOT, State of New Mexico, and county governments. Forest Service jurisdiction roads create the sole or primary access to several parcels of private land within the Forest Boundary.

Traditional road access to the National Forest is being lost by lack of legal right of way through private lands within the Forest. This issue is expected to grow as private land parcels change hands and use of the roads increases. The Forest Service negotiates with landowners to gain public access with varied results. Where these roads create access that is of interest to the County, they may assert jurisdiction and public right-of way on the road, but that is uncommon, even on roads that have been maintained by the County under cooperative agreement.

As population increases, recreation and commercial use of the road system is also expected to increase. These roads and others are important to and used by smaller communities around the Forest. Many people in these communities rely on access to the Forest for their livelihood as well as for recreation.

GT(2): How does the road system connect large blocks of land in other ownership to public roads (ad hoc communities, subdivisions, inholdings, and so on)?

Magdalena Ranger District lands are bordered by land of the Alamo Chapter of the Navajo Nation in the Bear/Gallinas Mountain Range. Many of the private land in-holdings are being sold and divided for development, consequently impacting the National Forest. Recreation use has increased in the last ten years. User conflicts have become a management challenge. Uses include grazing, firewood, recreation, herb gathering, and scenery in the watersheds that feed the surrounding communities.

Much of the private or tribal lands are accessed by arterial and collector public roads. However, some are accessed by lower standard local Forest Service roads. Access needs to inholdings are addressed on an individual basis as requests are received. Forest Service policy is that access will be provided to a level that is reasonable and suitable for the uses occurring on the land. When landowners desire access, they are asked to apply for a special use or road use permit. The application is then analyzed through the NEPA process to determine possible environmental effects and the level of reasonable access required. When subdivision occurs on larger private parcels, the Forest policy is to request the landowners to create an association or some type of consolidated organization to represent all of the landowner interests. This eliminates the need for the Forest to enter into road use or special use permits with each individual landowner.

Responsibilities for improvements and maintenance should be determined through a commensurate share process. If access is being provided by a public road agency such as the county or state, then the Forest Service may not be obligated to provide any additional access over federal lands. When larger developments or subdivisions occur and inholding traffic is expected to exceed that generated by the users of the National Forest, agency policy is to pursue turning jurisdiction of the Forest road over to a public road authority such as the county or state.

GT(3): How does the road system affect managing roads with shared ownership or with limited jurisdiction? (RS 2477, cost-share, prescriptive rights, FLPMA easements, FRTA easements, DOT easements)

The amount of private land inside or bordering the Magdalena Ranger District and pattern of population growth indicate a need to increase road management cooperation and refine road jurisdictions and maintenance responsibilities.

When desirable, cooperative agreements should be established to share road improvement and maintenance responsibilities when all partners can benefit.

The Forest Service, Federal Highway Administration, and the New Mexico State Department of Transportation have a Memorandum of Understanding (MOU). This document sets forth general procedures for planning, programming, environmental studies, design, construction and maintenance of highways.

Rights of access by law, reciprocal rights, or easements are recorded in Forest files and county courthouse documents. The Forest recognizes these rights and works with the owners to preserve access while protecting the natural resources and facilities on adjacent National Forest Lands. There is also an understanding by the Forest Service that individuals or entities may have established valid rights, unknown to the Forest Service at this time, to occupy and use National Forest lands and roads. The courts have established that such valid outstanding rights may be subject to some federal regulation (*Sierra Club v. Hodel* 1988). This analysis recognizes that such valid outstanding rights may exist and the Forest Service will certainly honor such rights when it is subsequently determined that the specific facts surrounding any claim to such rights meet the criteria set forth in any respective statute granting such occupancy and use (*Washington County v. The United States* 1955).

GT(4): How does the road and trail system address the safety of road users?

Road System: In 1975, the Forest Service developed a Memorandum of Understanding with the Federal Highway Administration that required the Forest Service to apply the requirements of the National Highway safety program, established by the Highway Safety Act, to all roads open to public travel. In 1982, this agreement was modified to define “open to public travel” as “those roads passable by four-wheeled standard passenger cars and open to general public use without restrictive gates, prohibitive signs…” Most roads maintained at level 3 and 4 meet this definition. Design, maintenance, and traffic

control on these roads emphasize user safety.

The largest proportions of road maintenance and improvement funds allocated to the Forest are spent on reporting and general health for these higher standard roads. Safety work such as surface maintenance, roadside clearing and installation and maintenance of warning and regulatory signs are performed on an annual basis. Traffic control signing follows standards set forth in the Manual on Uniform Traffic Control Devices (MUTCD). Funding for road maintenance is not adequate to address safety needs on all roads. Road condition surveys conducted in 2006 reveal a total maintenance backlog (deferred maintenance) of $22,954,302. The condition surveys document a need of about $3,306,807 annually to maintain all roads in the CNF system. Road operation and maintenance funding on the Cibola for fiscal year 2006 was $950,000 and is expected to stay in that range in the foreseeable future.

When accidents occur on Forest roads, often the Forest Service may not be immediately informed. Accidents are usually reported to the local sheriff or state patrol, if reported at all. When the Forest becomes aware of an accident, an investigation is initiated to attempt to identify the cause. If a feature of the road is found to be unsafe, addressing the condition becomes a high priority. Presently, the Cibola National Forest is working on a program for identifying or tracking accident locations and for maintaining surveillance of those locations having high accident rates or losses as is required by Highway Safety Act.

Administrative Use (AU)

AU(1): How does the road system affect access needed for research, inventory, and monitoring?

The road system appears to provide adequate access needed for research, inventory, and monitoring.

AU(2): How does the road and trail system affect investigative or enforcement activities?

The road system on the Magdalena Ranger District generally provides good access to developed and dispersed recreation sites where many common violations occur. These roads also provide access to the many developed trailhead-parking areas for the trail system that provides backcountry access to hunters and hikers. While the road system provides access to perform investigative and enforcement activities, it also provides access for increasing public use of the National Forest System lands.

Protection (PT)

PT(1): How does the road system affect fuels management?

The maintenance level 1, 2, and 3 roads in this analysis are roads utilized for access and needed as containment lines on most fuels projects on the Magdalena Ranger District. Maintenance Level 1 roads are identified on separate NEPA documentation, if needed. Most fuels management project activities need only maintenance level 2 access. To access areas for efficient fuels management, sometimes closed roads are opened. Many of the most critical fuels management project areas are in the Wildland Urban Interface (WUI) and access to them is gained through the bordering private lands. Road use agreement with private lands owners are negotiated in these cases.

PT(2): How does the road system affect the capacity of the Forest Service and cooperators to suppress wildfires?

In current drought conditions, minimizing response time to suppress wildfires is very important to keeping the size of the burned area down. Road condition affects the response time to wildfires.

There are some roads on the Magdalena Ranger District that have one main access route (ex. Hop Canyon Road in the Magdalena Mountains). It is possible that a wildfire burning close to these single access routes could delay response to the area or prevent a more aggressive response, allowing the fire

to burn longer.

PT(3): How does the road system affect risk to firefighters and to public safety?
The road system affects risk by its ability to provide evacuation routes and by its level of safety for the vehicles using the road. Road condition is also a factor on timeliness of access to safety zones for firefighters and public.

Forest Service jurisdiction roads on the Magdalena Ranger District provide the main access to many occupied private lands within the forest boundary. Location, rate, and direction of travel of a fire and inadequate road conditions could combine to create a dangerous situation for the life safety of occupants of these private lands and the firefighters responding to suppress the wildfire or protect the structures in its path.

PT(4): How does the road and trail system contribute to airborne dust emissions resulting in reduced visibility and human health concerns?
Unpaved roads whether native soil or graveled can contribute airborne dust during times of dry weather conditions, especially during extended drought periods. Dust emissions also increase with traffic, speed and vehicle weight. Winds can pick up fine dust from unpaved roads and release them whenever winds die out. Winds can also transport fine dust at appreciable distances close to active road use areas such as nearby resident houses or campgrounds affecting those who are particularly sensitive to the fine dust. Reduced visibility may result from unpaved roads, especially graveled roads, during windy periods. Higher road density values of graveled roads have the potential to reduce visibility and, in some cases, increase health concerns in localized areas.

Some Forest Service jurisdiction roads on the Magdalena Ranger District also provide primary access to many private land in-holdings. With subdivision of these lands, traffic may increase significantly on these Forest roads, increasing the dust emissions. Dust emissions can be reduced with dust abatement, or paving unpaved roads.

Recreation

Non Motorized Recreation (NMR)

NMR(1): Is there now or will there be in the future excess supply or excess demand for unroaded recreation where there are opportunities for non-motorized recreation.
As the Albuquerque Metro Area and surrounding communities continue to grow, it is possible that the demand for unroaded recreation opportunities will exceed supply. Non-motorized recreation opportunities are generally related to trail use along the Magdalena and San Mateo Mountains: hiking, and horseback riding, on the Magdalena Ranger District. Hunting on the Magdalena Ranger District is prevalent on all four of the mountain ranges.

Viewing scenery, birds, wildlife and hiking/walking has been found to be the recreation activities with the most frequent participation on the Cibola National Forest. While this survey is not specific to the Magdalena Ranger District, it does demonstrate the frequency of this activity. See Table 3.

Table 5: Recreation activities based on 2001 National Visitor Use Monitoring Survey (NVUM)

Activity	Percent participation 2001 Final report*	Percent participation 2006 Draft report**
**Viewing natural features such as scenery, flowers, etc	62	78.2
Viewing wildlife, birds, fish, etc	56	62.7
Hiking or walking	52	58.3

*The 2001 NVUM report included the four mountain districts on the Cibola National Forest, and the Kiowa/Rita Blanca and Black Kettle/McClellan Creek National Grasslands

**The 2006 Draft NVUM report included the four mountain districts of the Cibola National Forest, the grasslands were analyzed separately.

The Apache Kid Wilderness and the Withington Wilderness are the two largest contiguous areas of unroaded non-motorized recreation opportunities. The Wilderness areas are open to hiking and horseback riding. Mechanized recreation including mountain biking is prohibited. The supply of unroaded recreation opportunities in the Apache Kid Wilderness and the Withington Wilderness will remain unchanged, but it is anticipated that an increase in use will continue in the Wilderness areas. As future demands continue to increase, it may be necessary to review the access management to the wilderness areas.

NMR(2): Is developing new roads and motorized trails into unroaded areas, decommissioning of existing roads, or changing the maintenance of existing roads causing substantial changes in the quantity, quality, or type of unroaded recreation opportunities?
Some roads provide important access to unroaded areas, such as access roads to trailheads. The development of unauthorized roads and trails on the Magdalena Ranger District has reduced the quality of non-motorized recreational opportunities in the area.

NMR(3): What are the adverse effects of noise and other disturbances caused by developing, using, and maintaining roads, on the quantity, quality, and type of unroaded recreation opportunities?
There are few roads that conflict with the quality of recreation use in the Apache Kid and Withington Wilderness. In other parts of the district, there are two separate issues in unroaded recreation, the impacts of motorized vehicle use on non motorized recreation, and the impacts of roads on general unroaded recreation trail use.

In the first issue, noise can reduce the quality of the recreation experience for non motorized users. This is especially true for equestrian trail users, where the noise of motor vehicles can disturb the horses. Noise can also impact bird and wildlife watching, both in terms of the quality of the experience and possibly impacting the number of birds or wildlife seen.

Wider vehicles can reduce the quality of the experience for mountain bikers, by widening trail tread and changing the profile of the trail. This makes it more difficult for mountain bikers to travel trails, and can reduce the quality of their experience.

There is a desire by single track (motorcycle) and ATV users to have trails that are designed for their vehicle type without having to share routes with full size vehicles. Again, it is a desire for the sense of immersion in the natural environment and a trail that is designed for the width and tread of these vehicles.

NMR(4): Who participates in non motorized recreation in unroaded recreation in the areas affected by constructing, maintaining, and decommissioning roads or motorized trails?
The Magdalena District has a fairly extensive road inventory compared to other districts managed by the Cibola National Forest. There have been limited changes to the road system. Non-motorized trail users are the primary participants in unroaded areas, including hikers, mountain bikers, and equestrians.

Road-Related and Motorized Recreation (RR)

RR-MR(1): Is there now or will there be in the future excess supply or excess demand for motorized and roaded recreation opportunities?
As the Albuquerque Metro Area and surrounding communities continue to grow, it is possible that the

demand for motorized recreation opportunities will exceed supply. There are 1,317.5 miles of National Forest System Roads currently open to public use. Road related recreation on the Magdalena Ranger District also relies on county roads that cross the District. The roads system is integral to accessing all types of recreation on the Magdalena Ranger District, including dispersed and developed recreation sites, trailheads, and scenic overlooks. There are no National Forest System Trails in the Bear/Gallinas and Datil Mountains area where motorized use has been accepted. The road and trail system both function as a transportation system to provide access to the District recreation opportunities but also as a recreation resource. It is important to users to have a variety of opportunities that provide a range of challenges for different user experience levels. Users may desire to experience a variety of landscapes and views and a chance to "get away from the crowd". As more users discover the District as a recreation resource, the more difficult it will become to provide for the range of opportunities that users desire.

There is no designated OHV area within the Magdalena Ranger District. If development pressures reduce the OHV use in the Albuquerque metro area, increased demand on the Magdalena Ranger District is anticipated.

Driving for pleasure was a frequent recreation activity identified by respondents in the NVUM surveys. In 2001, 10% indicated that driving for pleasure on roads was one of the activities they participated in while visiting the Cibola National Forest and Grasslands. In 2006, when the mountain districts of the Cibola National Forest were analyzed separately from the grasslands, 19.9% participated in driving for pleasure.

Table 6: Motorized recreation activities that were identified in the NVUM surveys.

Activity	Percent participation 2001 Final report*	Percent participation 2006 Draft report
Driving for pleasure	10	19.9
Other Motorized Activity	*	3.1
OHV Use	2	1.4
Motorized Trail Activity	*	0.9

*These categories were not used in 2001

RR-MR (2): Is developing new roads and motorized trails into unroaded areas, decommissioning of existing roads, or changing maintenance of existing roads causing substantial changes in the quantity, quality, or type of roaded or other motorized recreation opportunities?

Decommissioning some of the existing roads and changing the maintenance level on existing roads could cause short-term changes to the quantity and quality of roaded recreation opportunities, but there are other recreation opportunities in the general area.

RR-MR (3): What are the adverse effects of noise and other disturbances caused by constructing, using, and maintaining roads on the quantity, quality, or type of roaded and other motorized recreation opportunities?

Constructing or maintaining roads has a short-term effect on noise and traffic disruption. New roads or increased maintenance on existing roads may change the roaded recreation experience. On level 3-5 roads, larger capacity may make the roads safer and more accessible for the traveling public. On level 2 roads, some users desire the challenge of a more rugged road. For these users improving the road may reduce the quality of their experience or motivate them to find other routes. Improving maintenance on a level 2 road to level 3 standards would likely change the vehicles that would be permitted on the road. ATVs or dirt bikes not licensed for highway travel may no longer be permitted.

Where individuals are seeking solitude, increased use is likely to reduce the quality of their experience. Public comments receive indicate that more conflicts between different types of motorized use occur when there is increased use.

RR-MR (4): Who participates in roaded and other motorized recreation in the areas affected by road construction, changes in road maintenance, or road decommissioning?
Forest users visiting developed recreation sites, motorized trail users, and potentially anyone traveling in motor vehicles on the Magdalena Ranger District.

RR-MR (5): What are these participants' attachments to the area, how strong are their feelings, and are alternative opportunities and locations available?
The Magdalena Ranger District is within a two hour's drive of metro Albuquerque. There is strong place attachment by many of the Districts long time users. Especially the members of the Alamo Chapter who will want to maintain the existing road and trails system for their traditional uses. People have purchased residences near the Forest boundary and throughout private inholdings within the boundary because of their appreciation for the landscape and the opportunities the forest provides. Some nearby residents value the close proximity for motorized recreation; others value the sense of solitude and getting away from the urban environment and close proximity for non-motorized recreation opportunities. Since they have made a large personal investment to live near the Magdalena Ranger District, a strong place attachment and sense of ownership exists.

Equestrian use has also been focused in the area. Many nearby residents have horses, and value the ability to ride from their homes onto the National Forest. While the Apache Kid Wilderness and the WithingtonWilderness are open to horse use, there is very limited parking that accommodates horse trailers to access Wilderness trails.

There are alternative opportunities available on the Santa Fe National Forest, and other districts of the Cibola National Forest, including Sandia, Mount Taylor, and Mountainair. There are also non-motorized biking and equestrian opportunities available on Albuquerque and Bernalillo County Open Space lands. However to recreate in a forest environment in less than a 2 hour drive from Albuquerque, there are few similar opportunities on public lands.

Passive-Use Value (PV)

PV(1): Do areas planned for road constructing, closure, or decommissioning have unique physical or biological characteristics, such as unique features and threatened or endangered species?
The areas being assessed for this road analysis have potential habitat for sensitive and Threatened and Endangered (TE) species. The species considered in this analysis for the development of the risk assessment include: Mexican spotted owl (Threatened); Northern Aplomado Falcon (Endangered), Chiricahua Leopard Frog, Mexican Gray Wolf (Endangered), Zuni fleabane (Threatened), Bald Eagle (winter transient), Northern Leopard frog, American peregrine falcon, Northern goshawk, loggerhead shrike, gray vireo, Baird's sparrow, Bleached skimmer dragonfly, Nitocris Fritillary, spotted bat, Gunnisons's prairie dog, Botta's pocket gopher, New Mexico banner-tailed kangaroo rat, Magdalena mountainsnail, Subalpine mountainsnail, Allen's lappet-browed bat, pale Townsend's big-eared bat, Villous groundcover milkvetch, Arizona leatherflower clustered leatherflower, Tall bitterwood, and San Mateo penstemon (plants), (all USFS Region 3 Sensitive Species). A list of species not considered (due to lack of habitat) can be found in the Biological Assessment & Evaluation for the Magdalena District Travel Management Plan.

Managing for productive habitat is important for maintaining species diversity. Species diversity and productive habitat is an important concept to the public, even if they may never visit the Magdalena Ranger District. For many, the idea that there are wild places so close to an urban area is especially important.

Unique features for passive-use of wildlife: found along NFSR 235 from Water Canyon to South Baldy, along NFSR 138, and along NFSR 225.

PV(2): Do areas planned for road construction, closure, or decommissioning have unique cultural, traditional, symbolic, sacred, spiritual, or religious significance?

There are at least 5 American Indian tribes that have strong traditional and cultural ties to the lands managed by the Magdalena Ranger District. These include: the Pueblos of Acoma, Zuni, the Navajo Nation, the Mescalero Apache, and the Ft. Sill Chiricahua-Warm Springs Apache. Rural communities such as the communities of Magdalena, Datil, Reserve, Dusty, Winston, Monticello, and Placitas value their historic ties to the land and their traditional land-based lifestyle.

PV(3): What, if any, groups of people (ethnic groups, subcultures, and so on) hold cultural, symbolic, spiritual, sacred, traditional, or religious values for area planned for road entry or road closure?

There are numerous American Indian tribes that have used the Magdalena Ranger District lands historically and continue to use them for traditional cultural or religious activities. The areas accessed by the current system of roads are of significant cultural value to the tribes. Local communities also used the land historically for grazing, farming, and procurement of forest products. Many of these activities continue today; these communities value their traditional land-based lifestyle. Both groups have a long history of use of National Forest lands.

Social Issues (SI)

SI(1): What are people's perceived needs and values for roads and trails? How does road and trail management affect people's dependence on, need for, and desire for roads and trails?

Roads: The transportation function of roads is highly valued. Several National Forest System roads on the Magdalena Ranger District are secondary, or in some cases primary access to homes and businesses. They also serve as an emergency escape route in case of fire or other event that requires evacuation. Access is also needed to facilities under special use permit, such as electronic towers, pipelines, and electric transmission lines. The roads system provides access for gathering of forest products. Forest products are the basis for traditional tribal uses and local cottage industries. The road system provides access to recreation settings and developed recreation sites. The roads through the picnic grounds and other developed recreation facilities are included in the Forest transportation system.

Roads are also a recreation resource for Forest visitors. Residents as well as visitors in the area have expressed that driving for pleasure was one of their recreation activities while visiting the Forest. Uses include sight-seeing, watching for wildlife, and viewing natural features. On the more primitive roads (Maintenance Level 2), many people also seek the adventure and challenge of navigating these roads.

Recreation Use of Roads and Trails: The recreational use of roads has very similar needs and values. Some travelers are seeking challenge and lower maintenance roads and trails meet this need. A variety of experiences is important, where there is sufficient mileage in diverse landscapes to return to the same location and experience a different trail or road. Improving a road or trail is not considered to be a benefit to many when they are seeking a challenging riding experience.

The type of vehicle influences the distance needed for a quality motorized recreation experience. A motorcycle will cover 25 to 100 trail miles per day. An ATV may cover 15 to 80 miles per day. For a full size 4 X 4, 4 or 5 miles on a challenging road or trail is sufficient (Crimmins 2006). Stacked loops help to respond to the diversity and distance needs in limited terrain.

While destination and access can be important for the recreation use of roads and trails, the use of the route is an important aspect of the experience. Many motorized recreationists through public involvement have indicated that they prefer a route where they feel immersed in the forest setting, with trails just wide enough to accommodate their vehicles. This accounts for some of the conflicts between motorized users, when a trail is widened either by use or maintenance. This widening changes the quality of the experience for riders with narrower vehicles.

SI(2): What are people's perceived needs and values for access? How does road and motorized trail management affect people's dependence on, need for, and desire for access?

People's needs and values for access are diverse. It ranges from people who want to be able to access all areas of the National Forest on motorized vehicles to people who want limited access due to a desire for solitude or concerns about environmental impacts as well as those who are dependent on forest access for their livelihoods. Access to developed sites, residences, and commercial sites is important to many who use the forest transportation system.

Recreation access has been a controversial issue. While nearly all people use a motor vehicle to access the National Forest, the extent of the access can be an emotional issue. For people who want a non-motorized experience while immersed in the environment for hiking, mountain biking, or birding, motor vehicles can be an intrusion. For people who choose to experience the forest through motorized recreation, increased access improves their experience by providing a range of opportunities and

challenges.

SI(3): How does the road system affect access to paleontological, archaeological, and historical sites?

The existing Magdalena Ranger District road system increases access to identified and unidentified historic properties, archaeological sites and paleontological sites. Increased or improved access has the potential to result in vandalism, illegal collection activities, and possibly the illegal excavation of historic properties or paleontological resources.

SI(4): How does the road system affect cultural and traditional uses (such as plant gathering, and access to traditional and cultural sites) and American Indian treaty rights?

The current road system neither prohibits nor encourages access to or use of traditional cultural use areas. In some cases, tribes will express the need for continued vehicular access to areas where they conduct traditional cultural and religious activities. Many of these activities must be done in privacy, and practitioners will travel on foot as needed to ensure privacy. To date, no tribe has requested greater vehicular access on the District than currently exists.

SI(5): How are roads that constitute historic sites affected by road management?

There are several historic roads on the Magdalena Ranger District. The historic roads could benefit from regular maintenance to decrease erosion and stabilize the road bed; maintenance of the road may serve as a form of preservation by ensuring that the road remains in its original location. Lack of road maintenance may cause increased erosion or other problems and lead people to drive off-road creating new tracks and resulting in the loss of the historic roadway.

SI(6): How is community social and economic health affected by road and motorized trail management (for example, lifestyles, businesses, tourism industry, infrastructure maintenance)?

Road management is necessary to forest management. Use of the Magdalena Ranger District is dependent on proper, timely road management. Recreation, Forest users, and permittees' traffic are the dominant uses on roads on the District.

In addition to increasing uses, the demographics in the U.S. indicate an ever-increasing urban population (Betz el al. 2005). These travelers expect to go long distances in short amounts of time and to be able to get through the Forest in comfort. There is only one paved road on the Magdalena Ranger District.

Roads are also important for maintaining commercial and government facilities located on the Magdalena Ranger District. Light duty, single use roads are important for maintaining recreation facilities. Roads also access a major electronics sites at the top South Baldy Peak and Davenport Lookout, which provides television, telephone, and other communications infrastructure to the central New Mexico.

Recreation and visitor spending is the largest contribution of the Cibola National Forest to the economic region (UNM-BBER 2007). Even though Sandia Ranger District is the largest contributor to this impact, Magdalena is already seeing the shift of some recreational visitors coming to the District to avoid the crowded recreation experience of Sandia. Even though there is some residential growth in Catron, Sierra, and Socorro, Counties, it is not anticipated to impact the Magdalena Ranger District in the foreseeable future.

Another important economic contribution of the District is the support of communities through fuelwood and other materials gathering. The collection of pinyon nuts is a very important economic

resource for the residents of the local rural communities. Even though permits are not issued for all of these services, the local communities benefit significantly from them. Wood cutters will generally not travel very far from a road because of the difficulty in hauling fuelwood. Other gatherers may travel farther depending on the material being collected.

SI(7): What is the perceived social and economic dependency of a community on an unroaded area versus the value of that unroaded area for its intrinsic existence and symbolic values?

Unroaded areas within the Cibola National Forest have a variety of social values. Some people value natural resources existing in unroaded areas for the economic contribution that could be afforded by their extraction such as timber, minerals, and roaded access. Other people value roadless areas for the contributions they provide in an undeveloped state such as increased solitude, quiet, and refuge for plants and animals.

The largest unroaded areas on the Magdalena Ranger District are the Wilderness areas which encompasses most of the central part of the San Mateo Mountains. There are no wilderness areas in the Bear/Gallinas, Datil or Magdalena Mountains. The Apache Kid and Withington Wilderness areas have been valued for their intrinsic and symbolic value for thousands of years. Local Indian tribes still express symbolic value for the four mountain ranges.

For the community residences, the Wilderness is often valued for preserving an area in its natural condition.

SI(8): How does road management affect wilderness attributes, including natural integrity, natural appearance, opportunities for solitude, and opportunities for primitive recreation?

There are two wilderness areas on the Magdalena Ranger District. The Apache Kid and Withington Wilderness areas are visited regularly but not in as high a frequency as the Sandia Wilderness or the Manzano Mountain Wilderness due to their distance from any metropolitan area. The roads that are in closest proximity to the Apache Kid Wilderness are National Forest System Roads # 76, #140, #225, #331, #332, #478A, and #478B. The roads that are in close proximity to the Withington Wilderness are National Forest System Toads #56, #330, #138,and #549. None of the roads except for #56, #138, and #330 are located within ½ mile of the wilderness boundary so noise from these roads should not reduce the sense of solitude for trail users while they are near the Wilderness boundary. All of these roads provide access to wilderness trailheads.

SI(9): What are traditional uses of animal and plant species in the area of analysis?

The lands managed by the Magdalena Ranger District have been used for thousands of years by the area tribes who have strong historical ties to their aboriginal lands and continue to use the lands for traditional cultural activities including, but not limited to: hunting, collection of plants, minerals, boughs, and piñon nuts.

SI(10): How does road and trail management affect people's sense of place?

People's sense of place is directly tied to the aspects of an area, including the viewshed that defines a road corridor, invoking a special feeling or attachment to the area. Factors include the area's vegetation, the amount of sunlight available, the views, the solitude, the opportunities that make it a destination, and the overall familiarity. The road itself facilitates a person's enjoyment of the area by providing for driving comfort, the amount and type of use, and any number of aesthetic attributes visible alongside the road. These attributes are directly related to road management. Memories of experiences contribute to a place attachment. For example, if a person has been making regular drives to the top of South Baldy or

Mt. Withington, they connect the drive with memories of the experiences they had, who they were with, and what activities they participated in. Over time these memories become integral with their identity of the place. Any change in road management of the development of a road without taking these things into consideration can leave a sense of loss when people have developed an attachment to a place.

Examples of these effects include those used in the discussion in recreation. If a road is managed as a Level 3 and the decision is made to upgrade it, different users or more users might begin to use the area. This will change the character for users who consider the area to be special; it will change their experience and may displace current users to other areas for their recreation. Likewise, if a road is currently managed as a Level 4 and the decision is made to downgrade maintenance to a level 2, the road will not be drivable by low clearance passenger car, and the area becomes inaccessible for some current users. This problem is especially evident for the elderly, a group that may have used the area for years, making the area inaccessible to them.

Many frequent users of the District have indicated that they prefer an area to stay at the point that they developed an attachment to it. If they have a long term relationship with District locations, and have experienced change, they desire to return to the point that they first "discovered" the place.

Where road management enhances the relationship with the place, the management is valued. When road management changes the experience with the place, the change is considered to detract from the experience. For example, if improved management helps someone to reach a valued trail or recreational location sooner it may be valued. The management level is decreased and the road deteriorates, a user may be displaced because of difficult access.

SI(11): How does road location and road maintenance affect historic sites?

Forest roads often pass through or near cultural resources resulting in direct impacts to both prehistoric and historic sites. Road maintenance within the boundary of cultural sites has the potential to directly affect these resources by disturbing in-situ archaeological deposits. Additionally, road maintenance may have the potential to impact sites near, but not within, the road bed through the creation of wing ditches or other improvements (e.g. culverts).

Conversely, the lack of maintenance within site boundaries can also result in site damage due to water erosion. Vehicles will rut the roads by driving through muddy areas and may create areas that are impassible by vehicles. This may lead people to drive off road around impassible areas, which has the potential to cause additional impacts to sites (either on or near the road). Road maintenance may encourage people to remain on the road and reduce the impacts to cultural resources outside of the roadway.

Civil Rights and Environmental Justice (CR)

CR(1): How does the road and motorized trail system, or its management, affect certain groups of people (minority, ethnic, cultural, racial, disabled, and low-income groups)?

Even though the counties surrounding the Magdalena Ranger District (Datil, Sierra and Socorro, NM) have experienced growth in the number of minority residents from 1990 to 2000, the proportion of minority residents has declined, primarily due to in-migration. The largest minority groups in these counties are Hispanics followed by Native Americans. In-migration has also resulted in increased per capita income and decreases in the percentage of residents living below the poverty line. However, the number of people living below the poverty line has increased. Data also shows a correlation between ethnicity and poverty. Across the Cibola National Forest counties, 20% of Hispanics live below the poverty line and only 15% of non-Hispanics live below the poverty line (UNM-BBER 2007). Because of these changes in the local demographic make-up of the communities, it is expected that rising

incomes will result in increased demand for recreation. Traditional gathering and wood cutting will continue to be an important activity to traditional minority communities within Catron, Sierra, and Socorro Counties in terms of supplementing income and maintaining traditional lifestyles (UNM-BBER 2007).

There is a lack of known data to document effects of different groups of people. It is possible that closing a road, if it is then used (legally or illegally) as a motorized trail, provides forest access to people with more disposable income. Low-income groups who cannot afford to have and use recreational motorized all-terrain vehicles (ATVs) will not enjoy this same level of access to the Forest. We also have numerous tribal and land grant communities who use forest roads for spiritual, cultural, and fuel wood gathering purposes. A motorized trail system may provide additional access for persons with disabilities to participate in more remote areas with opportunities for solitude and challenge.

Literature Cited:

Baker, W.L. and R.L. Knight. 2000. Cited in Gucinski, H., M.J. Furness, R.R. Ziemer, and M.H. Brookes. 2001. Forest Roads: A Synthesis of Scientific Information. General Technical Report PNW-GTR-509. USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon. 103pp.

Beecham, J., and J. Rohlman. 1994. A shadow in the forest. Northwest Naturalist Books. Moscow, Idaho, USA.

Betz, Carter J.; Cordell H. Ken; Green, Gary; Owen, Matt. 2005. Off-Highway Vehicle Recreation in the United States, Regions and States; A National Report from the National Survey on Recreation and the Environment (NSRE). Southern Research Station USDA Forest Service.

Boyle, S.A, and F.B. Samson. 1985. Effects of Nonconsumptive Recreation on Wildlife: a Review. Wildlife Society Bulletin 13:110-116.

Burroughs, E. R., Jr., F. J. Watts, J. G. King, D. F. Haber, D. Hansen, and G. Flerchinger. 1985. Relative effectiveness of rocked roads and ditches in reducing surface erosion. In. Proceedings of the 21st annual engineering geology and soils engineering symposium; 1984 April 5-6; Moscow, ID. Moscow ID: University of Idaho, Department of Civil Engineering: 251-263.

Burroughs E. R., Jr. and J. G. King. 1989. Reduction of Soil Erosion on Forest Roads. USDA Forest Service, Intermountain Research Station, GTR-INT-264. 21 pp.

Canfield, J. E., L. J. Lyon, J. M. Hillis, and M. J. Thompson. 1999. Ungulates. Pages 6.1-6.25 in G. Joslin and H. Youmans, coordinators. Effects of Recreation on Rocky Mountain Wildlife: A Review for Montana. The Wildlife Society, Helena, Montana, USA.

Carter, Jimmy. 1977. Protection of Wetlands. Executive Order 11990. May 24, 1977.

Cassier, E. F., and E. D. Ables. 1990. Effects of disturbance by cross-country skiers on elk in northern Yellowstone National Park. Final report to the National Park Service. 103pp.

Crimmins, Tom. 1999. Colorado Off-Highway Vehicle User Survey; Summary of Results. State of Colorado. Colorado State Parks OHV Program. pp. 1-10.

Dunne, Thomas and Luna B. Leopold. 1978. Water in Environmental Planning. W. H. Freeman and

Company, New York. 818 pp.

Dyrness, C. T. 1967. Mass-soil movements in the H. J. Andrews Experimental Forest; U.S. Forest Service Pacific Northwest Forest Experimental Station Research Paper PNW-42.

Elliot, W. J., R. B. Foltz, C. H. Luce, T. E. Koler. 1996. Computer-aided risk analysis in road decommissioning. In. McDonnell, J. J., J. B. Stribling, L. R. Neville, D. J. Leopold, (eds.). Proceedings of the AWRA annual symposium on watershed restoration management: physical, chemical, and biological considerations; 1996 July 14-17; Syracuse, NY. Herndon, VA: American Water Resources Association: 341-350.

Elliot, W. J. and L. M. Tysdal. 1999. Understanding and reducing erosion from insloping roads. Journal of Forestry. 97(8):30-34.

Elliot, W. J. 2000. Roads and Other Corridors. In. G. Dissmeyer (ed.). Drinking Water from Forests and Grasslands – A synthesis of the scientific literature. USDA Forest Service, Southern Research Station GTR-SRS-39: 85-100.

Flerchinger, G. N. and F. J. Watts. 1987. Predicting infiltration parameters for a road sediment model. Transactions of the ASAE. 30(6):1700-1705.

Fletcher, J.L. and R.G Busnel (eds.). 1978. Effects of Noise on Wildlife. Academic Press Inc., New York, NY.

Foltz, R. B. and M. A. Truebe. 1995. Effect of aggregate quality on sediment production from a forest road. In Conference proceedings of the sixth international conference on low-volume roads. (1):57.

Froehlich, Henry A. 1975. Research and Observations on Forest Soil Compaction in the Pacific Northwest. In: Earth Science Symposium, USDA Forest Service Pacific Southwest Region.

Forman, R.T. and L.E. Alexander. 1998. Roads and Their Major Ecological Effects. Annual Review of Ecology and Systematics. Nov. 1998. 29:207-231.

Gaines, William L.; Singleton, Peter H.; Ross, Roger C. 2003. Assessing the cumulative effects of linear recreation routes on wildlife habitats on the Okanogan and Wenatchee National Forests. Gen. Tech. Rep. PNW-GTR-586. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 79 p.

Gucinski, H., M. J. Furniss, R. R. Ziemer, and M. H. Brookes, eds. 2000. Forest Roads: A synthesis of scientific information. USDA Forest Service. 117 pp.

Gurule, Michael. 2003. Cibola National Forest, Forest Level Roads Analysis Report. Albuquerque, NM: U.S. Dept. of Agriculture Forest Service.

Havlick, David G. 2002. No Place Distant: Roads and Motorized Recreation on America's Public Lands. Washington, D.C.: Island Press. 297 pp.

Hutchins, M. and V. Geist. 1987. Behavioral Considerations in the Management of Mountain-dwelling

Ungulates. Mountain Research and Development 7(2):135-144.

King, J. G. 1979. Fillslope erosion from forest roads. In. Proceedings, 34th meeting, 1979 October 3-5; Boise, ID. Pap. 79-404. St. Joseph, MI: American Society of Agricultural Engineers. 11p.

King, M.M. and Workman, G.W., 1986. Response of Desert Bighorn Sheep to Human Harassment: Management Implications. North American Wildlife and Natural Resources Conference, pp. 74–85.

Kochenderfer, J. N. and J. D. Helvey. 1987. Using gravel to reduce soil losses from minimum-standard forest roads. Journal of Soil and Water Conservation. 42:46-50.

Luce, C. H. and T. A. Black. 1999. Sediment production from forest roads in western Oregon. Water Resources Research. 35(8):2561-2570.

MacArthur, R. A., V. Geist, and R. H. Johnson. 1982. Cardiac and behavioral responses of mountain sheep to human disturbance. Journal of Wildlife Management 46:351-358.

Megahan, W. F. and W. J. Kidd. 1972. Effect of logging roads on sediment production rates in the Idaho Batholith. USDA Forest Service. Intermountain Forest and Range Exp. Stn., Ogden Utah, Research Paper INT-123. 14 pp.

New Mexico Department of Game & Fish (2003). Wildlife Parameters for Timber Sales. Conservation Services Division, Santa Fe, NM.

New Mexico Water Quality Control Commission. 2002. State of New Mexico Standards for Interstate and Intrastate Surface Water. Filed with state records center September 12, 2000. 39 pp.

Novotny, Vladimir and Olem, Harvey. 1994. Water Quality: Prevention, identification and management of diffuse pollution. John Wiley and Sons, Inc., New York. 1054 pp.

Perry, C., and R. Overly. 1977. Impact of roads on big game distribution in portions of the Blue Mountains of Washington 1972-1973. On file, Washington Game Department Environmental Management Division, Bulletin No. 11, Washington, USA

Reid, L. M. and T. Dunne. 1984. Sediment production from road surfaces. Water Resources Research. 20(11):1753-1761.

Reynolds-Hogland, M. J. and M.S. Mitchell. 2007. Effects of Roads on Habitat Quality for Bears in the Southern Appalachians: A Long-Term Study. United States Geological Survey, Alabama Cooperative Fish and Wildlife Research Unit, Auburn University.

Robinson , C. S., F. T. Lee, R. W. Moore, R. D. Carroll, H. Scott, J. D. Post, and R. A. Bohman. 1972. Geological, geophysical and engineering investigations of the Loveland Basin landslide, Clear Creek County, Colorado; U.S. Geological Survey Professional Paper 673.

Rost, G.R. and Bailey, J.A. 1979. Distribution of mule deer and elk in relation to roads. J. Wildl. Manage. 43: 634– 41.

Ruediger, B. 1996. The relationship between rare carnivores and highways. Proceedings of the

Florida Department of Transportation/Federal Highway Administration Transportation-related Wildlife Mortality Seminar, April 30-May 2, 1996. U.S. Department of Transportation. Federal Highway Administration. FHWA-PD-96-041, Washington, DC.

Schultz R.D. and J.A. Bailey. 1979. Responses of National Park elk to human activity. J. Wildl. Manage. 42:91–100.

Sierra Club v. Hodel, 848 F 2d. 1068 (10th Circuit, 1988).

Soil Survey Staff. 1999. Soil Taxonomy: A basic system of soil classification for making and interpreting soil surveys. USDA, Nat. Res. Cons. Serv., Agric. Handbook No. 436. 869 pp.

Spellerberg, I.F. 1998. Ecological Effects of Roads and Traffic: A Literature Review. Global Ecology and Biogeography Letters, 7 (5) pp. 317-333.

Stalling, D. 1994. Hide and seek: balancing the needs of elk and hunters. Bugle. Vol. 12, no. 2.

Strenger, S., S. Sebring, W. Robbie, F. Escobedo, C. Vaandrager, V. Andrew, E. Brooks, C. Krasine, B. Nielsen, and R. Fletcher. 2007. Terrestrial Ecosystems Survey of the Cibola National Forest and National Grasslands. USDA Forest Service, Southwestern Region. 696 pp.

Sullivan, K. O. and S. H. Duncan. 1981. Sediment yield from road surface in response to truck traffic and rainfall. Weyerhaeuser Research Report. Centralia, WA: Weyerhaeuser, Western Forestry Research Center. 46 pp.

Swift, L. W., Jr. 1984. Gravel and grass surfacing reduces soil loss from mountain roads. Forest Science. 30(3):657-670.

Toweill, D. E., and J. W. Thomas. 2002. The Future of Elk and Elk Management. Pages 793-841 in D. E. Toweill and J. W. Thomas, editors. North American Elk: Ecology and Management. Smithsonian Institution Press, Washington D.C., USA.

University of New Mexico - Bureau of Business and Economics Research (UNM-BBER). 2007. Socioeconomic Assessment of the Cibola National Forest. Published: June 2007.

USDA-FS. 1994. Forest Service Handbook. FSH 7709.56b – Transportation Structures Handbook. Amendment No. 7709.56b-94-1, July 27, 1994. Washington, D.C.

USDA-FS. 1999. Roads Analysis: Informing decisions about managing the National Forest Transportation System. Misc. Rep. FS-643. Washington, D.C.: U.S. Dept. of Agriculture Forest Service. 222 p.

Van Dyke, F.G.; Brocke, RH.; Shaw, H.G.; Ackerman, B.A.; Hemker, T.H.; Lindzey, F.G. Reactions of mountain lions to logging and human activity. Journal of Wildlife Management 5095-102; 1986.

Vaughan, D. M. 2002. Potential Impact of Road-Stream Crossings (Culverts) on the Upstream Passage of Aquatic Macroinvertebrates. The Xerces Society, Portland, OR. Report submitted to the U.S. Forest Service, San Dimas Technology and Development Center.

Washington County v. The United States, 903 F. Supp. 40 [D. Utah, 1955]

Weaver, W. E., D. K. Hagans, and J. H. Popenoe. 1995. Magnitude and causes of gully erosion in the lower Redwood Creek basin, northwestern California. In. Nolan, K. M., H. M. Kelsey, and D. C. Marron (eds.). Geomorphic processes and aquatic habitat in the Redwood Creek basin, northwestern California. U.S. Geological Survey Professional Paper 1454. Washington DC: U.S. Government Printing Office: I1-I21.

Weinstein, M. 1978. Impacts of off road vehicles on the avifauna of Afton Canyon, California. Contract CA-060-CT7-2734. USDI, Bureau of Land Management, CA Desert Program, Riverside, CA, USA

Wemple, B. C., J. A. Jones, G. E. Grant. 1996. Channel network extension by logging roads in two basins, western Cascades, Oregon. Water Resources Bulletin. 32(6)1195-1207.

Wisdom, M. J., A. A. Ager, H. K. Preisler, N. Cimon, and B. K. Johnson. 2004. Effects of off-road recreation on mule deer and elk. *Transactions of the North American Wildlife and Natural Resources Conference 69*:531-550.

Wisdom, M.J., R.S. Holthausen, and B.K. Wales. 2000. Cited in Gucinski, H., M.J. Furness, R.R. Ziemer, and M.H. Brookes. 2001. Forest Roads: A Synthesis of Scientific Information. General Technical Report PNW-GTR-509. USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon. 103pp.

Yarmoloy, C., M. Bayer, and V. Geist. 1988. Behavior responses and reproduction of mule deer, Odocoileus hemionus, does following experimental harassment with an all-terrain vehicle. *Canadian Field-naturalist* 102(3): 425-429.

Young, D. D. and J. J. Beecham. 1986. Black bear habitat use at Priest Lake, Idaho. Int. Conf. Bear Res. Manage. 6:73-80.

Appendix B and Issue Identification

The Interdisciplinary Team (IDT) answered the above resource questions and cross-walked the information provided there to determine which issues should be carried forward into the Travel Analysis Process (TAP) along with rationale as to why or why not. Each Forest Service System road was then evaluated against the identified risks and benefits (see Appendix A). The crosswalk is below:

Resource Question Subject Matter	Issues Identified from IDT Responses	Carry Forward or omit?	Why Omit? - or - Carry Forward into Which Criteria?
EF1 – Roads in unroaded areas.	Risk: Habitat fragmentation, runoff, erosion, invasive plants, fire regime alteration. Benefit: Greater number of fuelbreaks, burn extent reduced.	Omit	No plans to build roads in currently unroaded areas.

Resource Question Subject Matter	Issues Identified from IDT Responses	Carry Forward or omit?	Why Omit? - or - Carry Forward into Which Criteria?
EF2 – Road contribution to spread of invasives.	Risk: Increase in spread. Potential displacement of native species. Ecosystem function altered. Soil disturbance is exacerbated	Carry forward	Invasive Plants Risk Criteria
EF3 – Road contribution to control of insects, parasites, etc.	Benefit: May help in treatment administration.	Omit	Further action for treatment would be considered under separate NEPA.
EF4 – Road contribution to ecological disturbance.	Risk: Unroaded areas may result in higher severity fires. Roads contribute to increase of human-caused fire. Densities reduce habitat. Benefit: Creation of fuelbreaks.	Carry forward	Human-Caused Fire and Wildlife Risk Criteria
EF5 – Effects of road noise.	Risk: Effects to people and wildlife. Wildlife – displacement and avoidance, reduced foraging, etc.	Carry forward	Wildlife Criteria
AQ1 – Road modification of surface and subsurface hydrology.	Risk: Increases in peak flows through the loss of vegetation, compaction of the soil, and modification of the slope.	Carry forward	Sediment Delivery criteria
AQ2 – Road surface and erosion.	Risk: Dependent upon road surface type. Erosion can occur on road or on slopes adjacent to road	Carry forward	Sediment Delivery criteria
AQ3 – Road system and mass wasting.	Risk: Mass wasting through changes in soil and hillslope.	Carry forward	Conditions for potential mass wasting are present on the District.
AQ4 – Road stream crossings effects to stream channels.	Risk: Fillslope failure, flow diversion, erosion, and sedimentation	Carry forward	Sediment Delivery Criteria
AQ5 – Roads and potential for pollution.	Risk: Roads also become contaminated by material from vehicles, including accumulation of small spills or from accidental spills of hazardous or harmful materials being transported over roads.	Carry forward	Sediment Delivery Criteria
AQ6 – Road system effects to water quality and quantity.	Risk: Alteration to drainage patterns, increased runoff, sediment and pollution delivery.	Carry forward	Sediment Delivery Criteria
AQ7 – Downstream uses and pollution.	Risk: Aquatic species impacts where connectivity exists between the road and stream channel.	Carry forward	Sediment Delivery Criteria
AQ8 – Road system affect to wetlands.	Risk: Increase direct sedimentation, impede hydrologic function, wetland fill-in, etc., affects to wildlife, spread of invasives into wetlands.	Omit	Wetlands are rare on the District. There are a couple of wet areas, but effects here can be sufficiently mitigated.

Resource Question Subject Matter	Issues Identified from IDT Responses	Carry Forward or omit?	Why Omit? - or - Carry Forward into Which Criteria?
AQ9 – Road System and physical channel dynamics.	Risk: Movement of large debris and fine organic material may be impeded. Roads can isolate floodplains, constrict and modify channels and their migration, and simplify riparian and aquatic habitat. Road encroachment on drainages and floodplains.	Carry forward	Sediment Delivery and Soil Productivity Criteria
AQ10 – Road System and affects to aquatic life.	Risk: Aquatic species – trout and insects may be affected.	Omit	There are no perennial streams on the District.
AQ11 – Road System affects to riparian areas.	Risk: Shading and plant communities along wet areas.	Omit	Riparian areas are rare on the District. See Water Resource Criteria.
AQ12 – Road effects to fishing, poaching, etc.	Risk: At-risk species could be impacted by habitat loss.	Omit	No, or minimal, effects to direct or indirect habitat loss to at-risk species.
AQ13 – Road contribution to invasive aquatic species.	Risk: Introduction of invasive aquatic species through human interference.	Omit	There are no invasive aquatic species on the District.
AQ14 – Road system and aquatic species.	Risk: Habitat loss	Omit	There are no non-native aquatic species on the District.
TW1 – Road affects to terrestrial species habitat.	Risk: Loss of habitat, fragmentation of habitats due to road system development, interruption in migratory patterns of wildlife to reach breeding habitat or winter range habitat, and lack of habitat use by wildlife due to disturbance caused by use of the road system.	Carry forward	Some of this is captured in the species specific occurrence criteria as part of the 'Wildlife/Rare Plants' criteria.
TW2 – Road system and human activities that affect habitat.	Risk: Trampling of vegetation, displacement of wildlife, forage, nesting, and thermal cover habitat can be affected.	Carry forward	Access affects are dealt with in 'Wildlife/Rare Plants' Criteria.
TW3 – Road system and legal and illegal activities.	Risk: Roads facilitate both legal and illegal activities such as hunting/poaching. Wildlife can experience displacement, harassment, and vulnerability.	Carry forward	Addressed in Wildlife Criteria.
TW4 – Road system and unique forest communities.	Risks: Potential impacts to Northern goshawks and Mexican spotted owls.	Carry forward	Addressed in Wildlife Criteria.
EC1 – Road system's affects to agency costs and revenues.	Risk: Maintaining road system with allotted budget. Benefit: Opportunity for increased cooperative agreements and partnerships.	Omit	Budgets are administrative and the possibility of partnerships and cooperative agreements to ease funding burdens exists.
TM1 – Road spacing and location effects to timber production.	Risk: Higher yarding costs. Benefit: Roads located at a "break".	Carry forward	Resource Access Criteria

Resource Question Subject Matter	Issues Identified from IDT Responses	Carry Forward or omit?	Why Omit? - or - Carry Forward into Which Criteria?
TM2 – Roads effects to suitable timber base and other lands.	Benefit: Roads provide access for resource inventory data collection, monitoring activities and conditions, law enforcement, fire suppression, watershed restoration, site preparation and tree planting, treating invasives, thinning operations, and numerous other forest management activities.	Carry forward	Resource Access Criteria
TM3 – Road system access for silvicultural treatment.	Benefit: Road access is needed for more frequent treatments.	Carry forward	Resource Access Criteria
MM1 – Road systems affects to minerals.	Benefit: Roads provide access to minerals	Omit	Use is administrative to "foster and encourage" the development and use of mineral resources.
RM 1 – Road system affects to grazing allotments.	Benefit: Roads provide access to grazing allotments. Risk: Roads open to permittees encourage public use, deterioration, and illegal activities. Some roads cross private lands.	Omit	Administrative range management duties require vehicle access for inspections, repair and maintenance of range improvements, control of invasives, seeding projects, and the need to attend to sick or injured livestock.
WP1 – Road system's effects to water developments.	Benefit: Adequate access provided	Omit	No major advantages to or concerns from water developments.
WP2 – Road development affects to water quality.	No risk or benefit	Omit	No municipal watersheds
SP1 – Road system affects to collection of forest products.	Benefit: Roads provide adequate access to forest product retrieval.	Carry forward	Resource Access Criteria
SU1 – Road systems affects to special use permits.	No risk or benefit	Omit	Administrative – roads will be managed as special use permit dictates.
GT1 – Road system connections to public roads.	Risk: Traditional road access being lost by lack of legal right of way through private lands within the Forest. Benefit: Many people in these communities rely on access to the Forest for their livelihood as well as for recreation.	Omit	Administrative – ROWs will be obtained as opportunities and needs arise.
GT2 – Road system and connection to other jurisdictions.	Risk: Selling of private inholdings, recreational use increase, user conflicts increasing. Benefits: Access to residences and other user needs.	Carry forward	User conflicts are considered on a unit scale rather than by road. Resource Access and Recreation Access Criteria.

Resource Question Subject Matter	Issues Identified from IDT Responses	Carry Forward or omit?	Why Omit? - or - Carry Forward into Which Criteria?
GT3 – Roads systems and other jurisdiction roads.	Risk: Private land in or near the Forest Service boundary leads to maintenance concerns and a need for increased cooperation.	Omit	Administrative - creation/maintenance of cooperative agreements.
GT4 – Road system addressing safety.	Risk: Monitoring being done to determine of Forest is in compliance with Highway Safety Act	Omit	Administrative – monitoring can be carried out by permit if necessary.
AU1 - Road system's effects to access needed for research, inventory, and monitoring.	Benefit: Adequate access provided	Omit	Administrative use – permits can be obtained for access if necessary
AU2 - Road and trail system's effects to investigative or enforcement activities.	Risk: Access provides opportunities for criminal activity. Benefit: Road system provides access to perform investigative and enforcement activities	Omit	Administrative – the implementation of law enforcement is exempt from Travel Analysis.
PT1 – Road System affects to fuel mgmt.	Benefit: ML 1, 2, and 3 roads act as containment lines for firefighting	Carry forward	Emergency Access Criteria
PT2 – Road System affects to capacity to fight fires.	Benefit: Roads increase access to fight fire. Risk: Some roads only have one main access route	Carry forward	Emergency Access Criteria
PT3 – Road systems affects to safety.	Benefit: Provide access in and out of private lands	Carry forward	Emergency Access Criteria
PT4 – Road contribution to airborne dust emissions.	Risk: Unpaved roads can contribute to dust emissions. Visibility may be reduced and health concerns may be increased.	Omit	Will work with state dust emission standards.
NMR1 – Excess supply or excess demand for non-motorized recreation.	Risk: Demand for unroaded recreation opportunities may eventually exceed supply.	Omit	Non-motorized recreation will be considered during future public involvement on road projects, such as NEPA projects, including Travel Management.
NMR2 – Effects of developing new roads on unroaded recreation.	Risk: Reduction in the quality of the unroaded experience. Benefit: Access to west side trailheads to the Withington and Apache Kid Wilderness.	Carry forward	Non-motorized recreation will be considered during future public involvement on road projects, such as NEPA projects, including Travel Management. Recreation Access Criteria
NMR3 – Effects of noise on unroaded areas.	Risk: Noise can reduce the quality of recreational experiences that require peace and solitude.	Carry forward	Non-motorized recreation will be considered during future public involvement on road projects, such as NEPA projects, including Travel Management. Recreation Access Criteria

Resource Question Subject Matter	Issues Identified from IDT Responses	Carry Forward or omit?	Why Omit? - or - Carry Forward into Which Criteria?
RRMR1 - Excess supply or excess demand for motorized recreation.	Risk: Demand may exceed supply and the ability to provide opportunities is limited. Benefit: Road system acts allows for access to recreation sites and provides recreation on its own. Driving for pleasure.	Carry forward	Motorized Recreation and Recreation Access Criteria
RRMR2 – Changes in road system and its effects to motorized recreation.	Benefit: Decommissioning some of existing roads and changing the maintenance level on existing roads causes changes to motorized recreation.	Carry forward	Motorized Recreation and Recreation Access Criteria
RRMR3 – Adverse effects of noise due to road system maintenance.	Risk: Short-term disturbance from construction/maintenance, some improvements to roads make the experience less enjoyable to some. Improvements may also change the types of users using specific roads. Those seeking solitude will be impacted by improvements or other construction. Benefit: Some improvements to roads result in better access.	Carry forward	Motorized Recreation and Recreation Access Criteria
RRMR4 – Participation in motorized recreation activities that may be affected by construction.	No risk or benefit	Omit	Users and uses will be identified during Travel Management
RRMR5 – Participant's values for area and availability of other alternatives.	Benefit: Strong attachments to the area by local communities.	Carry forward	Recreation Access Criteria
PV1 – Unique physical or biological characteristics affected by changes in road system.	Risk: Potential impact to TES species and migratory birds.	Carry forward	Wildlife Risk Criteria
PV2 – Unique cultural, traditional, etc attributes affected by road system.	Risk/Benefit: At least 5 American Indian tribes have close cultural and/or religious connections to the District area and local communities have also historically used the land and continue to do so today.	Carry forward	Tribal Use/Tribal Access Criteria
PV3 – Which groups of people hold value for the District lands.	See Risk/Benefit above.	Carry forward	Tribal Use/Tribal Access Criteria

Resource Question Subject Matter	Issues Identified from IDT Responses	Carry Forward or omit?	Why Omit? - or - Carry Forward into Which Criteria?
SI1 – People's perceived needs and values for road system.	Benefit: Transportation function highly valued. Road system serves as access to houses and businesses and provides evacuation routes. Access is also provided for gathering forest products and visiting recreation sites. Use of the roads as a recreation resource and driving for pleasure is also valued. Risk: Improvements to roads may reduce the challenge that some users are looking for.	Carry forward	Motorized Recreation, Recreation Access, and Resource Access Criteria
SI2 - People's perceived needs and values for access.	Benefit: Road system provides access to developed sites, residences, etc. Access provides opportunities for motorized recreation users. Risk: Users looking for solitude may be impacted by motorized recreation and available access provided.	Carry forward	Motorized Recreation and Recreation Access Criteria
SI3 – Access to archaeological, paleontological, and historical sites.	Risk: Access to these sites may result in vandalism, illegal collection, or possibly, illegal excavation.	Carry forward	Cultural Resources Criteria
SI4 – Road system affects to cultural and traditional uses?	Benefit: Road system provides access for traditional and cultural uses.	Carry forward	Tribal Access Criteria
SI5 – Historic sites affected by road management.	Benefit: Historic roads could benefit from regular maintenance to decrease erosion and stabilize the road in place. Risk: Lack of road maintenance may cause increased erosion and lead people to create new tracks, resulting in loss of historic roadway.	Carry forward	Cultural Resources Criteria
SI6 – Road system effects to community and social health.	Benefit: Road system provides opportunities for local communities to benefit economically from forest products.	Carry forward	Resource Access Criteria
SI7 – Perceived social and economic dependency on unroaded areas.	Benefit: Unroaded areas provide solitude and refuge for humans and animals. Also may have potential for resource extraction.	Carry forward	Resource Access Criteria
SI8 – Road management affects to wilderness attributes.	Risk: A couple of roads are located within a ½ mile of the wilderness boundary but are not likely to impact wilderness attributes. Benefit: Roads provide access to wilderness hiking trails.	Carry forward	Recreation Access Criteria
SI9 – Traditional uses of plant and animal species.	Use has occurred and continues to occur among area tribes and local communities.	Omit	No issue identified.
SI10 – Road management affects to people's sense of place.	Risk: Road management could mean changes to a preferred experience. Benefit: Road management could enhance experience by allowing users to access their preferred recreational spots.	Carry forward	Recreation Access Criteria

Resource Question Subject Matter	Issues Identified from IDT Responses	Carry Forward or omit?	Why Omit? - or - Carry Forward into Which Criteria?
SI11 – Road system effects to historical sites.	Risk: Road systems and maintenance on them often pass through or near historic sites which can cause impacts to them. Benefit: Road system maintenance can help prevent erosion and off-road travel.	Carry forward	Cultural Resources Criteria
CR1 – Road system effects to certain groups of people.	Risk: Increase in population may mean an increased demand for recreational services. Benefit: Forest product gathering will continue to help supplement incomes and traditional lifestyles among surrounding communities.	Carry forward	Recreation and Resource Access Criteria

PAGE INTENTIONALLY LEFT BLANK