Technical and Physical Feasibility Fact Sheet

Alternative 66: Watershed Plans

Acknowledgements: This fact sheet was written by Joanne Hilton of Daniel B. Stephens & Associates, Inc. as part of the "Evaluation of Alternative Actions for Technical, Physical, Hydrological, Environmental, Economic, Social, Cultural, and Legal Feasibility and Water Quality Issues and Legal Overview" contracted to Daniel B. Stephens & Associates, Inc. The format and organization of the fact sheet and the definition of the alternative were developed by the Water Assembly.

1. Definition of Alternative

A-66: Implement local and regional watershed management plans through all land and water agencies in the planning area.

The Water Assembly further clarified this definition with the following text: "once a water plan is agreed upon, coordinate the implementation among the numerous agencies at the local, state, Tribal, and federal level that have some jurisdiction in the matter."

2. Summary of the Alternative Analysis

Watershed management consists of a variety of activities that can contribute to the health of a watershed, including those that protect or improve water quality, enhance water supply, and/or enhance the ecosystems of the area. Another important benefit of watershed management can be reduction of fuel loads, which in turn minimizes the potential for catastrophic forest fires. Ideally, watershed management proceeds in a manner that will optimize the benefits in all of these areas.

Because one of the primary purposes of these fact sheets is to develop an understanding of how various alternatives could affect the water supply and demand in the Middle Rio Grande (MRG) planning region, much of the following discussion focuses on the potential for watershed management activities to affect the regional water supply. However, water quality protection, ecosystem restoration, and/or forest fire protection are equally valid reasons for proceeding with watershed management planning and implementation, and lack of watershed restoration could result in negative effects such as fire risk and ecosystem deterioration.

Two other alternatives defined by the Water Assembly—A-1, Bosque Management, and A-33, Erosion Prevention (A-33 was not analyzed as part of the DBS&A contract)—should be linked to this alternative during the implementation stage so that all aspects of watershed management can be addressed with a comprehensive plan. However, to prevent duplication, this fact sheet does not discuss watershed issues relevant to A-1 and A-33.

3. Alternative Evaluation

3.1 Technical Feasibility

Enabling New Technologies and Status

The first step in developing watershed management plans is to bring together entities and individuals with interests in the watershed, including local, state, Tribal, and federal agencies that have some jurisdiction in the watershed, along with private landowners. Many groups of this type have been formed throughout the western U.S., including a group that is currently considering watershed management activities in the Rio Puerco Watershed. The key to maintaining this type of group is to make sure it is well coordinated and facilitated, which can be accomplished by hiring professionals who specialize in facilitation or involving employees of land management agencies, if they are available. Numerous resources for watershed groups are available from the U.S. Environmental Protection Agency (EPA) and through the Internet.

Once a watershed group has been formed and plans have been developed, strategies that benefit the watershed can be implemented. Examples of such strategies include:

- Management practices for roads, culverts, or other construction projects that minimize erosion and protect water quality from increased sedimentation

- Projects that address water quality issues such as elevated stream temperatures, suspended sediment loads, and impacts from septic systems, mining, or potential contaminant sources

- Grazing practices that minimize water quality degradation, riparian impacts, and impacts to upland watersheds

- Thinning and/or prescribed burns to reduce the risk of catastrophic forest fire and to potentially increase water supplies at higher elevations

In general, the technology for these types of watershed projects is available and well understood, and watershed management activities are already being implemented in the planning region. In particular, the national forests in the area routinely conduct watershed projects, including erosion control, thinning, and prescribed burns (Santa Fe National Forest, 2002b, 2002c; USFS, 1985, 2002). To proceed with watershed management at a regional level, these efforts may need to be updated to incorporate current understandings of fuel loads, fire risks, grazing practices, and ecosystem management, and U.S. Forest Service planning would need to be coordinated with other state, federal, Tribal, and private interests in the region. In addition, the Rio Puerco Watershed group, with participation from state, federal, and Tribal agencies, has been evaluating and seeking funding to address water quality issues along the Rio Puerco.

An important consideration of this alternative is to estimate the potential impacts of watershed management on water supply. Since increased infiltration from watershed projects is more relevant to Alternative 33 (Erosion Prevention), the key focus of this fact sheet is the potential increase in supply due to forest thinning activities. Although the technology for thinning is well developed, most of the research on the impacts of thinning has been conducted outside New Mexico. Additional monitoring programs to evaluate the effect of thinning projects on water supply within the state or the region would be valuable. To optimize the thinning program, reseeding of thinned areas may be considered. Such reseeding may prevent or curtail regrowth of understory and restore forests to a more natural condition for mature ponderosa and piñon forests and may also reduce the risk of wildfires. However, reseeding is expensive and would only be useful if land is managed in a manner that prevents grazing on re-established grasses.

Infrastructure Development Requirements

Specific infrastructure required for this alternative would be identified through the watershed planning process with participation of landowners and land managers within the watershed. Those involved in the watershed planning process should consider specific water quality, ecosystem, and fire prevention concerns within each watershed and should seek funding to implement projects to address those concerns. Typical infrastructure development requirements related to this alternative include:

- *Road construction to create access for forest thinning activities*. Ideally, existing roads would be used, as building of new roads can have environmental, water quality, and fiscal impacts. However, some new roads may be required for watershed thinning.

- *Removal of septic tanks and replacement with centralized wastewater treatment* is sometimes addressed through watershed management, because septic tanks represent nonpoint sources that can be addressed through the Clean Water Act, Section 319, which supports many watershed efforts. Infrastructure issues for wastewater treatment are discussed in Alternative 26, Domestic Wastewater.

- *Small scale infrastructure projects* such as replacement of culverts or construction of check dams or fencing (to restrict grazing) may be beneficial watershed improvements.

Total Time to Implement

As mentioned above, some watershed efforts within the region are already underway. Once funding and/or the commitment of an organizer is secured, the formation of new watershed groups can proceed relatively quickly, generally within a few months. Though completion of specific watershed projects would be an ongoing process and timing is dependent on acquisition of funding, the development of watershed plans and initiation of watershed projects would normally be accomplished in a one- to three-year timeframe. In particular, thinning projects could be initiated in priority areas and proceed to other areas over time. Due to regrowth issues, periodic (20- to 50-year) thinning will be required in all targeted areas.

3.1.1 Physical and Hydrological Impacts

Effect on Water Demand

This alternative will not affect water demand.

Effect on Water Supply (surface and groundwater)

The key consideration in this alternative is potential increases in water supply, or yield, due to forest thinning activities. An important aspect in considering potential yield increases, however, is that the entity conducting the watershed activity does not necessarily have the right to use the water. Any additional water contributed to the stream system would augment streamflows that are legally apportioned based on water rights priority dates. This limitation is further discussed in the legal feasibility fact sheet (*Evaluation of Alternative Actions for Legal Implications, Issues and Solutions).*

In general, water yield increases are proportional to annual precipitation and the amount of vegetation that is removed (MacDonald, 2002a, 2002b; Bosch and Hewlett, 1982; Troendle and Kaufmann, 1987). Small or no water yield increases can be expected in areas where annual precipitation is less than 18 to 20 inches (MacDonald 2002a, 2002b; Ffolliott and Thorud, 1975; Bosch and Hewlett, 1982; Stednick, 1996).

As water yield increases are directly proportional to precipitation and precipitation within the region varies significantly over time, the annual yield increases achieved through forest thinning in the region are expected to be highly variable. Data from the Fool Creek study in central Colorado show that water yield increases in dry years, when they are most needed, were only about one-quarter of the increases in wet years, when they are least needed (MacDonald 2002a, 2002b). The availability of storage reservoirs with sufficient capacity to carry over excess water from wet years is therefore an important factor in determining whether forest management is a feasible option for increasing water supply long-term.

In addition, in snow-dominated areas, most of the increase in water yield comes during months with the highest level of snowmelt. At Fool Creek in Colorado, for instance, May was the only month with a statistically significant increase in monthly water yields (MacDonald, 2002a, 2002b). Paired watershed experiments in areas with more substantial amounts of summer rainfall have sometimes yielded large percentage increases in summer runoff, but the absolute amounts are very small (e.g., less than 0.1 cubic foot per second [cfs] per square mile) (MacDonald 2002a, 2002b). Again this suggests that some storage will be required if most of the harvest-generated increases in runoff are to be used between the beginning of July and approximately mid-April.

Areas with precipitation of 20 inches per year or greater, which cover approximately 300,000 acres of the region, were used to estimate the potential yield increases in the MRG planning region. Maps of contoured precipitation showing this area are provided in Exhibit 66A. The estimated potential yield increases are based on two primary assumptions:

- Based on previous studies in the Rocky Mountains (MacDonald, 2002a), it was assumed that yield increases from thinning would be on the order of 0.7 to 0.9 inch over the land treated.

- Because it is probably not realistic to assume that the entire area could be thinned, it was assumed that 30 to 70 percent of the area with precipitation above 20 inches would be thinned.

Table 66-1 illustrates the potential water supply increases in the region. As shown in this table, for the assumed 30 to 70 percent of the high-precipitation area that would be thinned, yield would increase by approximately 5,000 to 15,000 acre-feet per year. However, as discussed above, this amount would vary from year to year, with lesser yield increases occurring in the dry years.

Table 66-1. Potential Water Supply Increases in Middle Rio Grande Planning Region

Fraction of Total Area Thinned [a]	Area Thinned [b] (acres)	Low-End Water Yield Increase [c] (acre-feet)	High-End Water Yield Increase [d] (acre-feet)
0.00	0	0	0
0.10	30,800	1,800	2,300
0.20	61,700	3,600	4,600
0.30	92,500	5,400	6,900
0.40	123,400	7,200	9,300
0.50	154,200	9,000	11,600
0.60	185,000	10,800	13,900
0.70	215,900	12,600	16,200
0.80	246,700	14,400	18,500
0.90	277,600	16,200	20,800
1.00	308,400	18,000	23,100

[a] Within each incremental fraction, at least 25 percent of the basal area (i.e., 25 percent of the vegetation) must be removed to achieve indicated yield
[b] Total area where precipitation is above 20 inches per year = 308,398 acres
[c] Calculations assume that thinning results in 0.7 inch of additional water yield over area thinned
[d] Calculations assume that thinning results in 0.9 inch of additional water yield over area thinned

Although much of the research on this topic has been conducted outside of New Mexico, the Mescalero Apache Tribe has been conducting extensive forest management, including thinning projects. At this time anecdotal evidence indicates increases in streamflows due to the forestry projects; however, data reflecting these changes have not yet been collected in the streamflow monitoring program currently being implemented (Hornsby, 2002; Walsh-Padilla, 2003). Additional research on the effects of thinning programs within New Mexico could help to improve confidence in the estimates of potential yield increases.

Water supply impacts in piñon-juniper woodlands. Piñon-pine and juniper woodlands are widespread on the Colorado Plateau, including the MRG planning region, between about 5,000 and 7,000 feet in elevation. Annual precipitation is typically from 10 to about 15 inches in piñon-juniper woodlands, and tree species in these communities have evolved both drought and cold resistance. Though the research discussed above indicates potential for increases only at higher elevations, potential water supply impacts in piñon-juniper woodlands is discussed here because they constitute a significant portion of the MRG planning region.

Though some improvements in the ecological health of the area and the timing of runoff events can be expected, the opportunities for management actions to affect water yields in the piñon-juniper zone are generally much more limited than in the forested areas. Research in this area has produced variable results, as indicated by the following examples:

- In 1956, research conducted in Arizona on the removal of piñon and juniper estimated a per-acre yield between 0.5 and 1.0 acre-inch, and in the next decade, a considerable number of acres were cleared using mechanical methods. Almost 20 years later, continued research and field results found that chaparral-infested lands, which had been dismissed by the first study, exhibited significantly more potential for water yield, while the piñon-juniper acres provided disappointing results (Hays, 1998).

- A summary of research into the effects of piñon-juniper management on hydrology was provided by Roundy and Vernon (1999). The results of the studies they surveyed were variable depending on watershed conditions, soil types, removal practices (i.e., whether vegetation is left on-site after cutting), and the scale of the projects, and they cannot necessarily be generalized to cover broader conditions. However, several of the investigations indicated that little usable water would result from piñon-juniper management. Conversely, studies in Oregon and Utah reported some benefits to springflow and/or increased infiltration.

- In reviewing piñon-juniper management, Gottfried and Severson (1994) indicated that many control programs failed to produce more water and better wildlife habitat, as had originally been expected.

Research conducted by Wood and Javed (2001) compared runoff from untreated piñon-juniper stands to runoff from stands where the piñon-juniper were clear-cut and the land was either cleared, burned, or covered with slash. The test plots were monitored from the time of treatment in 1989 until 1999. The findings of this study suggest that treatment of slash following thinning can be used to effect short-term changes in runoff, but that long-term changes are more difficult to achieve. The reestablishment of understory growth may be beneficial for certain land use practices (cattle grazing, fire suppression), but does not appear to achieve greater water yields.

Water Saved/Lost (consumption and depletions)

This alternative will not have an impact on consumption. The alternative could affect water supply as described above and by reducing depletions due to evapotranspiration.

Impacts to Water Quality (and mitigations)

In general, watershed management should have a positive impact on water quality. Watershed groups and public lands managers can work to identify and remediate sources of water quality degradation and to address water quality issues associated with grazing, erosion, septic tanks, or other concerns.

Conversely, thinning activities can have a negative impact on water quality if they are not conducted properly. The primary water quality concern from thinning is increased erosion and sedimentation. This type of impact can be minimized, however, by using best management practices for road installation (if needed) and logging activities.

Watershed/Geologic Impacts

The objective of this alternative is to provide positive impacts to watersheds, as described in Section 2.

3.1.2 Environmental Impacts

Impact to Ecosystems

Environmental impacts from watershed management activities are generally positive, though some environmental damage could occur if activities are not carefully planned and executed. Watershed management can help identify point and nonpoint sources of water quality degradation, secure funding, and implement best management practices that result in overall environmental improvements. Because thinning projects can have either positive or negative environmental impacts, depending on how they are executed, careful planning and execution of thinning projects is required. Best management practices for logging activities, road construction and maintenance, and timing of projects (in relation to species needs) should be used to minimize environmental disturbances. To achieve optimal ecosystem benefit, watershed management programs should integrate grazing management with efforts to reduce fire risk, such as thinning or prescribed burns (Horning, 2003).

Implications to Endangered Species

State or federal threatened or endangered species in the MRG planning region include the Jemez Mountain Salamander, Neotropic Cormorant, Bald Eagle, Whooping Crane, Mexican Spotted Owl, Bell's Vireo, Southwestern Willow Flycatcher, New Mexican Meadow Jumping Mouse, and Rio Grande Silvery Minnow (NMNHP, 2002). With the exception of the Whooping Crane, Bell's Vireo, and the Rio Grande Silvery Minnow, these species may be present in the upland watersheds where management activities would be concentrated. The potential for watershed projects to affect these species is dependent on the nature of the activity and the location of the project in relation to species habitat. Careful planning and timing of projects can help to ensure that they do not impact endangered species.

Additions to the water supply, if any, will be in late spring as snowmelt is occurring. Unless this water is stored and later released, it would not be expected to have an impact on the silvery minnow. Water quality improvements resulting from watershed management would generally have a positive impact on aquatic species, particularly if severe ash flows from catastrophic fires are prevented. It is not known whether water quality improvements would have a positive impact on the silvery minnow, specifically, but no negative impact is anticipated.

3.2 Financial Feasibility

3.2.1 Initial Cost to Implement

The formation of watershed groups could be accomplished relatively inexpensively if the group is coordinated by state, Tribal or federal employees or volunteers. The cost for initiating a watershed group and designing watershed projects using professional facilitation and technical expertise on watershed planning issues could range from approximately $20,000 to $100,000.

Costs for conducting watershed projects that affect water quality are highly variable. A general approach is to identify needed projects in the planning stage, and implement those projects as funding becomes available.

Costs for conducting thinning projects are also variable depending on the ease of access, thickness of vegetation, amount of thinning to be done, treatment of slash (i.e., it can be, in order of increasing cost, scattered, piled, burned, or removed), and techniques used (in order of increasing cost, hand pruning, chainsawing, bulldozing). Example cost ranges are:

- In areas with road access, costs for non-commercial thinning are approximately $80 to $140 per acre for ponderosa forest vegetation.

- The piñon-juniper forest is more expensive because there are more small branches and more slash; costs vary from $160 to $280 per acre (Alter, 2003).

- Costs for steeper or more inaccessible terrain could be considerable higher. For example, recent costs for thinning relatively steep terrain within the Santa Fe watershed were approximately $1,000 per acre (MacDonald, 2002a).

- Reseeding is generally not performed as part of forest thinning programs (Alter, 2003). Costs for areal reseeding can be in the range of $600 to $2,000 per acre (Lewis, 2000).

These costs do not include expenses for necessary planning or environmental studies, which may be significant.

Assuming a cost of $200 per acre, and assuming that 50 percent of the area with precipitation above 20 inches is thinned, resulting in a yield increase of 10,000 acre-feet per year (Table

66-1) that recurs every year for 20 years, the cost for this option, spread over the 20-year time frame, is approximately $150 per acre-foot of increased water supply. The actual period of increased yields (and therefore the annual cost) is dependent on the rate of regrowth.

3.2.2 Potential Funding Sources

Funding for watershed activities can be derived from a variety of sources. U.S. EPA Section 319 nonpoint source grants can potentially be used to form watershed groups, to identify nonpoint source issues, and to implement projects that use best management practices. The focus of these grants is to improve water quality conditions.

In 2002, the New Mexico Water Trust Fund issued a request for funding applications in four categories, one of which was watershed management. Depending on legislative appropriations, this may be a continuing source of funding. Other potential funding sources include Natural Resources Conservation Service (NRCS) grants (e.g., Conservation Technical Assistance, Small Watershed Program, Environmental Quality Incentives Program, Conservation Reserve Program, Emergency Watershed Protection).

Costs for watershed improvements as a result of improved grazing practices could potentially be covered by ranchers. Changes in stocking rates and rotation schedules may provide a benefit to the rancher as well as to the watershed, providing the rancher with an incentive to make these changes (Quivira Coalition, 2000; Goodloe, 2002).

3.2.3 Ongoing Cost for Operation and Maintenance

The primary ongoing cost of forest thinning projects is the need to address regrowth through periodic thinning. In general, a ponderosa forest must be thinned at least every 30 to 40 years to prevent fires and to maintain increased water yield. Costs for repeat thinning would be similar to the initial costs (excluding inflation).

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