8. Analysis of Strategies for Meeting Future Demand

The goal of regional water planning is to ensure that the region is prepared to meet future water supply needs. Accordingly, after a region has assessed its available water supply and projected future demand for water, the next step in regional water planning is to develop strategies for meeting the projected water demand. Strategies (also sometimes referred to as alternatives) developed for regional water plans are actions that the region can take to increase supply, reduce demand, protect or improve water quality, or better manage water resources so that the water supply of the region continues to be viable.

The Taos Region is growing, and additional water supplies will be required. As discussed in Sections 4 through 7, while large groundwater reserves are present within the region, use of those groundwater supplies is limited legally by the availability of water rights. The large dependence on surface water in the region makes it vulnerable to drought.

This section provides information on the process used to identify and screen strategies for meeting future demand (Section 8.1), analyzes the feasibility of priority strategies selected by the steering committee (Sections 8.2 through 8.8), and provides recommendations and a schedule for implementation of the priority strategies (Section 8.9).

8.1 Identification and Selection of Strategies

An initial list of potential strategies was developed at steering committee meetings, which were open to the public. This initial list was revised and expanded at a series of community meetings held in Red River, Taos, and Peñasco in October 2005. Citizens added to the list of strategies, and each group, through a voting process, identified strategies that they considered to be most important for the region.

To assist the steering committee in prioritizing strategies, DBS&A prepared a table listing all potential strategies that had been discussed for the region along with the number of votes received by each strategy at each meeting. At subsequent steering committee meetings, this

short list of strategies was discussed with the purpose of selecting strategies to be analyzed in this regional water plan.

Through this process the steering committee selected the following seven priority strategies:

- *Infrastructure improvements:* Address old, leaking pipes, inadequate treatment facilities and other infrastructure issues and consider a collaborative approach to help multiple communities develop better water system management.

- *Water quality protection:* Identify and implement programs to protect water resources such as wellhead protection programs and regional wastewater management to address impacts from septic systems.

- *Public education:* Disseminate information on water-related topics such as current regulations, the importance of water conservation, actions that individuals can take to save water, and ongoing water rights transfers.

- *Protection of agriculture:* Keep agriculture viable in the region by managing water transfers through bylaws, establishing acéquia water banking procedures, maintaining and repairing acéquias, implementing inter-acéquia water management processes, encouraging economic agriculture, and implementing agricultural water conservation.

- *Keep water rights in the region:* Develop mechanisms to ensure that the water right needs of the Taos Region are considered in proceedings regarding transfers of water rights to other purposes or places of use outside the region.

- *Growth management:* Manage growth in relation to the water supply; possible actions include land use planning, subdivision regulations that maximize water efficiency, evaluation of the cumulative impacts of growth on water supply, and requiring water conservation in all new development.

- *Watershed management:* Improve watersheds for long-term health through measures such as thinning forests to reduce the risk of catastrophic fires and in some cases potentially increase water yield, and implementing management practices to protect water quality.

In determining the final list of priority strategies, the steering committee discussed many different ways to approach potential water management actions that could be beneficial to the region. In some cases it was decided that some actions that could be beneficial would best be addressed if grouped with other strategies. Some of these include:

- The steering committee discussed the importance of conservation to the region. Rather than address conservation as a separate strategy, it was determined that conservation in the public water supply sector would be addressed as part of the growth management strategy and agricultural conservation would be addressed as part of the protect agriculture strategy.

- Additionally, drought vulnerability is a key issue in the agricultural sector, the largest water user in the region, but isn't as great an issue for the public water supply sector, which relies largely on groundwater. Consequently, drought contingency planning is discussed as part of the protect agriculture sector.

- Water banking is also of potential interest to the region; a discussion of water banking was included in Section 4 and options for implementation are included in the protect agriculture strategy.

- The steering committee identified ongoing monitoring and data collection as important for many of the strategies. Data collection recommendations are included in Section 8.9.

In accordance with the ISC template, the priority strategies were evaluated with regard to their technical, financial, and political feasibility as well as anticipated hydrological, environmental, social, and cultural impacts. The results of these evaluations are described in Sections 8.2

through 8.8, and summary recommendations and an implementation schedule are provided in Section 8.9.

In addition to the priority strategies that were identified through the public process defined above, other potential strategies may become feasible or desirable for entities within the region to pursue in the future. In particular, although the Draft Abeyta Settlement Agreement is now complete, all work on the settlement was confidential at the time that the priority strategy list was developed. Hence, strategies on the priority list do not specifically outline settlement provisions such as deep well drilling. However, the regional water planning steering committee expressed general support for the Abeyta Settlement, and recommendations regarding settlement provisions have been added to Section 8.9.

8.2 Infrastructure Development

Currently, 52 public water supply systems serve communities in the Taos Region (Figure 6-3). Many of these systems are experiencing challenges due to inadequate infrastructure, managerial aspects of compliance with regulations, and insufficient water rights. While each system has a unique set of needs, efficiencies in improving infrastructure and management can be realized by using a regional approach, in which two or more systems combine efforts in some manner. The development of infrastructure through regionalization of water systems may help address some of the issues facing small systems in the region, including:

- Old and leaking pipes need replacing.

- Pipes and water and wastewater treatment facilities may be inadequate to serve current or additional residents.

- SDWA regulations are increasingly complex, requiring increased costs for new technology and a higher level of operational skill and certification (which translates into higher salary demands for technical staff).

- Water rights are inadequate for current customers and difficult and expensive to acquire for new residents of the area (25 percent of the water systems listed in the Draft Abeyta Settlement Agreement [Section 4.5.3.1] do not have adequate water rights to meet current demands).

- Small systems generally have limited capacity to raise adequate funds through user fees for infrastructure improvements

- Small systems cannot take advantage of economies of scale as larger systems would be able to do.

This section discusses the approach to addressing these issues for public water supply systems in the Taos Region.

8.2.1 Technical Feasibility

Potential avenues to developing regional infrastructure range from coordinating among water systems during emergencies to sharing equipment to creating new water systems. A Strategic Planning Initiative by the OSE (Watkins, 2006) identifies the following levels of regionalization that can help address many of the problems facing community systems:

- Develop emergency-only working relationships.
- Share inventory/equipment.
- Share operator.
- Share administrative tasks (e.g., billing).
- Share management.
- Interconnect physical systems for backup.
- Share water rights and resources without system connection.
- Interconnect systems but operate individually.
- Dissolve current systems and form new entity.

Determining the most appropriate infrastructure system requires a detailed planning effort. Stakeholders with shared concerns can work together to develop infrastructure plans. The planning effort should include the following phases (modified from New Mexico Tech, 2004):

- Phase 1: Define partners, purpose (e.g., develop wastewater treatment infrastructure), process (for public involvement and decision making), and planning area.
- Phase 2: Compile data on each water system, domestic wells, demand, and supply.
- Phase 3: Develop solutions based on input from the public.
- Phase 4: Develop a funding plan and rate structure for each water system.

A collaborative effort is already underway within the North and Central subregions, having been initiated in November 2004 with funding from the OSE and technical assistance from the New Mexico Environmental Finance Center of New Mexico Tech. The water systems in the Cerro/Questa area (Figure 6-3) were invited to participate in the collaborative effort. After meeting monthly for seven months, the Sangre de Cristo Collaborative Water Group was created that included:

- Cerro East Mutual Domestic Water Consumers Association (MDWCA)
- Cerro West MDWCA
- El Rito MDWCA
- Molycorp
- Village of Questa
- Latir Neighborhood Association
- Cabresto Lake Irrigation District
- Taos SWCD
- Cerro Acéquia Association
- Taos County Planning Department

The issues defined in the final report (Sangre de Cristo Collaborative Water Group, 2005) include:

- Well capacity for the Village of Questa is inadequate. However, the Village has independently reviewed the adequacy of available data regarding hydrogeologic conditions in the alluvial aquifer under the Village. From this review, the Village has determined that there are significant data deficiencies in existing groundwater levels that preclude any conclusions regarding the adequacy of the Village's well capacity.

- One of the Cerro East MDWCA wells is defective.

- The El Rito wells exceed water quality standards due to high iron content.

- The Village of Questa needs to secure additional water rights in the Red River, where the water rights have been adjudicated. However, the data deficiencies regarding the hydrogeologic conditions in the alluvial aquifer near the Village hinder accurate assessment of the quantity of water rights needed, if any. The Village also needs to address old leaking pipes, inadequate treatment facilities, and other infrastructure issues, and to consider collaborative approaches in dealing with these. Considerable funding is needed to increase the capacity of the wastewater system and address the other infrastructure issues.

- Some MDWCAs have inadequate water supply infrastructure at times, and wastewater for all systems is treated with septic tanks.

The group did not have similar enough problems to formulate a strong collaborative agreement, largely because the participants are very different types of institutions. "The only issue that linked them was a lack of money to accomplish their goals, such as sinking new wells, building pipes, installing meters and buying water rights" (Sangre de Cristo Collaborative Water Group, 2005, p. 2). The group did, however agree to continue meeting and discussing issues of mutual concern. Signers to the agreement included local MDWCAs and acéquias and the Taos County Planning Department.

A corollary effort that grew out of the Sangre de Cristo Collaborative Water Group is the decision by the Cerro East and Cerro West MDWCAs to combine systems; the combined system was implemented in 2005.

Other collaborative efforts in the planning region include:

- The West Rim Mutual Domestic Water Users' Association, formed in June of 2002 (NM PRC, 2006), is an example of regionalization. A group of homeowners west of the Rio Grande near Tres Piedras in Taos County were hauling water from Klaver Spring, in a campground on BLM land in Pilar. The water was not a suitable potable supply and the homeowners formed an MDWCA that gave them status as a government entity. They were then able to obtain a grant from the New Mexico legislature to drill a well that now provides a potable supply from which residents can haul water to their homes.

- The La Jicarita Wastewater Study Committee, which includes Vadito, Chamisal, Rodarte, Llano, Peñasco, and Rio Lucio, recently developed a joint powers agreement (JPA) to proceed with designing and building a regional wastewater system.

The Taos Regional Water Planning Steering Committee identified the Taos Valley surrounding the Town of Taos as an area that might benefit from collaboration. The service area for the Town of Taos is of limited extent, and the growth around the town is served by a number of small water supply systems (Figure 6-3). With some level of regionalization, the community would be in a better position to develop the managerial, technical, and financial aspects necessary to borrow money. Potential partners include Taos Pueblo, the Town of Taos, El Prado Water and Sanitation District, Arroyo Seco MDWCA, Cañon MDWCA, El Salto MDWCA, Llano Quemado MDWCA, Lower Arroyo Hondo MDWCA, Lower Des Montes, Rancho de Taos MDWCA, Talpa, Upper Des Montes, Upper Arroyo Hondo MDWCA, Upper Ranchitos MDWCA, and Valdez MDWCA.

All of the MDWCAs and small mobile home park systems shown on Figure 6-3 have some degree of infrastructure or management needs. As they address these needs, it is recommended that these systems continue to look for opportunities to collaborate.

8.2.2 Hydrologic Impacts

The hydrologic impacts for improving infrastructure depend on the improvements that are implemented. For example, developing a centralized wastewater treatment facility may improve water quality, but it may locally diminish return flows from septic tanks. Improving water delivery systems may reduce leaks from pipes and reduce the amount of water pumped from wells. Overall, however, the hydrologic impacts to the region resulting from improving infrastructure would be relatively small. Despite the small quantitative hydrologic impact, this strategy will be very important in making sure that drinking water of a reliably safe quality is supplied to the communities in the region.

8.2.3 Financial Feasibility

As part of their planning process, individual systems will need to develop specific cost estimates for infrastructure improvements and compare a series of options. Funding for water and wastewater infrastructure is available from state and federal agencies, including the U.S. EPA, U.S. Department of Housing and Urban Development (HUD), USDA, U.S. Department of Commerce, USBR, USACE, and BIA.

Funding from the State of New Mexico and EPA for infrastructure improvements is available through NMED's Construction Program Bureau for municipalities, counties, special districts, Indian tribes, and water and/or wastewater mutual domestic associations. The Construction Program Bureau administers several funds:

- The Clean Water State Revolving Fund (CWSRF) program (http://www.nmenv.state.nm.us/cpb/cwsrf.html) is a revolving loan fund set up by EPA to provide a source of low-cost financing for a wide range of wastewater or storm drainage projects that protect surface water and ground water. The CWSRF program was established in 1986 pursuant to the Wastewater Facility Construction Loan Act and the federal CWA (Section 4.4.1) and provides very attractive low-interest loans that spread projects costs over a repayment period of up to 20 years. Repayments are cycled back into the fund and used to pay for additional clean water projects.

- The Rural Infrastructure Act (Chapter 75, Article 1 NMSA) created the Rural Infrastructure Program (RIP) (http://www.nmenv.state.nm.us/cpb/rip.html) in 1988. The purpose of the RIP is to provide financial assistance to local authorities for the construction or modification of water supply facilities and construction or modification of wastewater facilities.

- The Special Appropriations Program (http://www.nmenv.state.nm.us/cpb/sap.html) consists of state grants for special projects issued annually when authorized by the New Mexico Legislature during the legislative session and approved by the Governor.

Funding provided by other agencies includes (GAO, 2001):

- HUD provides Community Development Block Grants that benefit low- or moderately low-income persons and communities where conditions pose an immediate threat to the public health or welfare.

- The USDA Rural Utility Service Program provides direct loans and grants to construct or improve drinking water and sanitary sewer systems in rural communities with populations less than 10,000.

- Under its Public Works Program, the Department of Commerce's Economic Development Administration provides grants to communities in economic decline to expand and upgrade their water and wastewater infrastructure. Grants can cover up to 50 percent of the project costs.

- The USBR provides grants of up to 50 percent of the total cost of studies or demonstration projects for reuse or reclamation of wastewater and up to 25 percent of project costs for design and construction of reclamation and reuse facilities for municipal, industrial, and domestic wastewater.

- The USACE provides grants of up to 25 percent of project costs for water and wastewater infrastructure.

8.2.4 Environmental Impacts

As with hydrologic impacts, environmental impacts will vary depending on the implemented infrastructure improvement; while in some cases impacts may be negligible, in other cases, land disturbance or erosion runoff during construction could be significant. Thus impacts should be evaluated on a case by case basis. Water quality should be better protected with a collaborative effort that includes certified operators who are more qualified to ensure that wells are adequately constructed to prevent contamination and that wastewater treatment plants are operating properly.

8.2.5 Political Feasibility and Social/Cultural Impacts

The political feasibility of implementing infrastructure improvements will also vary depending on the type of improvement implemented, and a public education process will be necessary to garner support. For example, many people may resist connection to a regional water or wastewater system unless they can be convinced of the benefits to them, such as improved water quality and a more reliable water supply.

8.3 Water Quality Protection

Protecting water resources from potential water quality degradation can help to ensure that viable water supplies are available to meet the future needs of the region. Accordingly, this section discusses potential sources of contamination and susceptible areas in the Taos Water Planning Region and suggests programs that can be implemented to protect water quality.

Both point and nonpoint sources can contribute significantly to water quality degradation. As discussed in Section 5.4, many potential contamination sources, such as underground storage tanks, landfills, mines, and facilities with discharge permits (point sources), can be specifically identified and therefore attract more attention and funding. These sources are already monitored and characterized by NMED. Other potential threats to water quality are spread over large areas (nonpoint sources) and include agriculture, livestock, erosion, road construction, and—of particular interest in this region—septic tanks. The impacts from these nonpoint

sources are often more chronic and difficult to address and consequently less well characterized and monitored. A successful water quality protection program identifies all potential sources, both point and nonpoint, and promotes shifts in land use and management practices that decrease the threats to local and regional water supplies.

Groundwater quality is especially important in the planning region, as most public water systems are supplied by groundwater sources. Because poorly designed and/or maintained septic systems can contaminate groundwater, this evaluation addresses in particular strategies to mitigate nonpoint contamination from septic tanks.

8.3.1 Technical Feasibility

All the major identified point sources of contamination located within the region are under the jurisdiction of NMED regulatory programs (Section 5.4), and additional efforts to identify and monitor contaminant point sources would be largely redundant. It may, however, be desirable and beneficial for the region to maintain ongoing awareness of the status of the NMED's monitoring, permitting, or remediation activities for regulated sites (e.g., UST sites, landfills, as discussed in Section 5.4) to ensure that regional concerns are being adequately addressed. One potential mechanism for accomplishing this would be to set up a water quality steering committee. Such a group would benefit from the participation of groups who have already been involved in the development of watershed restoration action strategies (WRASs) (Section 8.8) to address water quality concerns on a watershed basis. In the Questa area, however, water quality issues are already being monitored by technical and legal representatives of the Village, due to concerns about water quality impacts from both mining and septic tanks, so a steering committee in this area may be redundant.

The water quality steering committee could keep aware of existing NMED programs, including:

- Monitoring of UST sites, overseen by the NMED Petroleum Storage Tank Bureau
- Monitoring of landfills, overseen by the NMED Solid Waste Bureau

- Monitoring of hazardous waste generators and hazardous waste treatment, storage, and disposal facilities, overseen by the NMED Hazardous Waste Bureau

- Monitoring of mining sites and groundwater discharge plans, overseen by the NMED Groundwater Quality Bureau

- Monitoring of Superfund sites, overseen by the U.S. EPA in conjunction with the NMED Groundwater Quality Bureau; water quality issues related to the Molycorp mine near Questa are of concern to the local community

- Monitoring of NPDES permits, in particular, discharges during low-flow periods, overseen by the U.S. EPA in conjunction with the NMED Surface Water Quality Bureau

In addition to the point source issues, there are also water quality concerns in the region arising from nonpoint source contamination (Section 5.4). Many nonpoint water quality concerns, such as erosion, have been addressed on a watershed basis through the preparation of WRASs, and continued implementation of the WRASs is an important component of water quality protection in the Taos Region. The WRASs completed in the region are summarized in Section 8.8.

Other options for addressing nonpoint sources, such as contamination from septic tanks, include the New Mexico Source Water Assessment and Protection Program (SWAPP). This federally funded program, which is overseen by the U.S. EPA, assists communities in protecting their drinking water supplies and can be used for monitoring and control of potential contamination sources near public water supplies. Specifically, SWAPP can assist local communities in:

- Determining the source water protection area for the water system

- Taking inventory of actual and potential contaminant sources within the source water protection area

- Determining the susceptibility of the source area and water system to contamination

- Reporting the SWAPP findings to the water utility, its customers, and the community

- Working with the community and other stakeholders to implement source water protection measures that safeguard and sustain the water supply into the future

In the Taos Region, 23 water supply systems have already developed SWAPP plans (Table 8-1), and 19 of those plans were available for review for this evaluation. As a part of the SWAPPs, each supply well has been assigned a final source susceptibility ranking (Table 8-1) that depends upon the sensitivity and vulnerability of the source of supply. Sensitivity of a supply well is evaluated based on the depth of the screened interval, adequacy and integrity of well construction, depth to groundwater, net recharge, aquifer and soil media present, topography, impact of vadose zone media, and aquifer hydraulic conductivity. Vulnerability is evaluated depending on the number and proximity of potential sources of contamination to each supply well. The location of any potential source of contamination within 200 feet of a supply well leads to a high vulnerability ranking (NMED, 2000).

The SWAPP can be used to address water quality issues with minimal additional cost to the local community. To participate in this program, communities can contact the NMED (SWAPP contact information is available at <http://www.nmenv.state.nm.us/dwb/swapp.html>).

To characterize the water quality in individual domestic wells, owners can have their wells tested by NMED for pH, TDS, nitrate, electrical conductivity, iron, and fluoride. NMED provides this service upon request at no cost; domestic well owners simply take a water sample to a NMED field office. Instructions for collecting and delivering the samples are provided on the NMED web site (<http://www.nmenv.state.nm.us/fod/LiquidWaste/well.testing.html>).

Because nonpoint source contamination such as septic tanks, agricultural runoff, or livestock waste is often not fully addressed by any of the NMED programs, the region would likely benefit most by focusing on these sources, with SWAPP assistance. The main nonpoint source concern in the region is the prevalence of on-site domestic wastewater treatment systems (i.e., septic tanks). Septic tanks can threaten water quality and public health when there is

Table 8-1. Source Water Assessment and Protection Plans and Susceptibility Rankings for the Taos Water Planning Region
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Subregion	Water System	Well Identification	Final Susceptibility Ranking
North	Cerro East MDWCA	Well 1	High
	Cerro West MDWCA	Well 3	High
	Costilla MDWCA	Well 1	High
		Well 2	Moderately high
	Questa Water System	Well 1	High
		Well 2	Moderately high
	Red River Water System	Well 1	High
		Well 2	Moderately high
		Well 3	High
		Well 4	High
		Well 5	High
Central	Arroyo Seco MDWCA [a]	NA	NA
	Cañon MDWCA	Well 1	High
		Well 2	High
	El Prado Water & Sanitation District	Well 1	High
		Well 2	Moderate
	El Rancho Mobile Home Park	Well 1 (north)	High
		Well 2 (south)	High
	El Valle Escondido MDWCA	South well	High
		Well 1 - Gilliam	High
	Las Colonias Mobile Home Park	Well 1	High
	Lower Des Montes MDWCA	Well 1	High
	Ranchos de Taos MDWCA [a]	NA	NA
	Talpa MDWCA	Well 1	High
		Well 2	High
		Well 2A	High
		Well 3	High
	Taos Pueblo [a]	NA	NA
	Upper Des Montes MDWCA	Well 1	High
		Well 2	High
	Upper Ranchitos MDWCA (Ranchitos)	Well 1	High
	Valdez MDWCA	Well 1	High

Source: NMED DWB, unless otherwise noted
NA = Plan not available for review
[a] Padilla, 2006

Table 8-1. Source Water Assessment and Protection Plans and Susceptibility Rankings for the Taos Water Planning Region
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Subregion	Water System	Well Identification	Final Susceptibility Ranking
South	Dixon MDWCA [a]	NA	NA
	Peñasco MDWCA	Well 1	High
		Well 2	High
	Upper Cañoncito MDWCA	Willie well 1	High
		Katie well 2	High
		Horace well 3	High
	Vadito MDWCA	Well 1	High
West	Ojo Caliente MDWCA	Well 1	High
		Well 2	High

Source: NMED DWB, unless otherwise noted
NA = Plan not available for review
[a] Padilla, 2006

inadequate treatment of wastewater effluent, improper disposal of wastes to septic tanks, and surfacing of sewage where systems are undersized.

Table 8-2 lists the communities in the Taos Region and summarizes the methods used in those communities to treat wastewater effluent. Out of the approximately 49 small systems serving a total of approximately 13,000 people in the region, only 5 (Taos [which also treats El Prado Water & Sanitation District wastewater], Red River, Questa, and Village of Taos Ski Valley) provide central wastewater collection, treatment, and disposal services, and even in those communities, approximately 1,330 people are not connected to the sewer system, relying instead on an estimated 559 septic tanks for wastewater disposal. The remaining 44 communities, none of which have a groundwater discharge plan or an NPDES permit, were assumed to rely completely upon an estimated approximately 4,300 septic tanks/leachfields for wastewater treatment and disposal. Another 5,700 septic tanks serve rural residents who are supplied by domestic wells (Table 8-2). These estimates total an estimated 10,600 septic tanks serving 24,730 people in the region (Table 8-2). NMED reports that a total of 12,471 septic tanks have been permitted in Taos County since septic tank permitting began in 1974 (Vigil, 2006), although not all septic tanks are permitted.

Septic systems are most likely to cause significant impacts to water quality where higher population centers coincide with shallow groundwater or surface water bodies. Shallow groundwater occurs in much of the planning region, particularly on the east side of the Rio Grande. The areas of greatest concern include:

- The area surrounding Taos in the Central subregion, where more than 12 water systems and an estimated 1,868 septic tanks treat approximately 134,000 gallons of wastewater per day (not including Taos Pueblo)

- Questa in the North subregion, where 41 percent of the population is served by septic tanks that treat almost 40,000 gallons per day

- Peñasco in the South subregion, where 100 percent of the population is served by septic systems that treat 40,000 gallons per day.

Table 8-2. Estimate of Population Served by Septic Tanks
Taos Water Planning Region
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Water Supplier	Population Served [a]	Water Use [a] (gpcd)	Water Accounts [b]	Sewer Accounts [b]	Percentage Not on Sewer [c]	Population on Septic Tanks	Number of Septic Tanks [d]	Effluent Currently Treated by Septic Tanks (gpd) [e]
North subregion *Average household size (based on 2000 Census): 2.42*								
Rural self-supplied [f]	1,727	101	NA	NA	100	1,727	714	87,214
Cerro East MDWCA [g]	81	101	21	0	100	81	33	4,091
Cerro West MDWCA [g]	130	101	36	0	100	130	54	6,565
Costilla MDWCA	425	101	85	0	100	425	176	21,463
Eagle Rock Village	120	101	20	0	100	120	50	6,060
Lama MDWCA	80	101	---	0	100	80	33	4,040
Questa Water System	1,800	104	632 [h]	371 [h]	41	743	307	38,636
Red River Water System	350 1,281 [i]	314	590 [h]	492 [h]	17	58 [j]	24 [j]	9,106
San Cristobal MDWCA	139	28	39	0	100	139	57	1,946
Sangre de Cristo MHP	25	113	13	0	100	25	10	1,413
Two Lakes Village	63	101	21	0	100	63	26	3,182

[a] NMED DWB unless updated due to communication with water system
[b] NMED DWB, 2006 unless otherwise noted
[c] Difference between number of sewer accounts and number of water accounts divided by number of water accounts, or 100 percent if no wastewater treatment plant
[d] Population served by septic tanks divided by the average household size
[e] Effluent amount is based on 50 percent of water diverted
[f] Population self-supplied for water and sewer
[g] Cerro East MDWCA and Cerro West MDWCA merged in 2005
[h] Personal communication with water systems
[i] Transient population
[j] Based on year-round population
[k] Wastewater treated by the Taos Wastewater Treatment Plant
[l] El Prado 40-year plan, 2004
[m] Value estimated at 50% of population served, as half of population is on septic
[n] Value estimated by dividing population by average house size for region, and subtracting out the number of sewer accounts

gpcd= Gallons per capita per day
gpd = Gallons per day
MDWCA = Mutual Domestic Water Consumers Association
MHP = Mobile Home Park
--- = No information available

Table 8-2. Estimate of Population Served by Septic Tanks
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Central subregion *Average household size (based on 2000 Census): 2.33*								
Rural self supplied [f]	8,942	113	NA	NA	100	8,942	3,838	505,223
Arroyo Seco MDWCA	280	113	135	0	100	280	120	15,820
BMG Trailer Park	40	113	11	0	100	40	17	2,260
Cañon MDWCA	600	79	151	0	100	600	258	23,700
Enchanted MHP	180	75	32	0	100	180	77	6,750
El Prado Water & Sanitation District [k]	1,008	60	178 [l]	216 [l]	50	504 [m]	217 [n]	15,120
El Rancho MHP	72	113	24	0	100	72	31	4,068
El Salto MDWCA	216	73	54	0	100	216	93	7,884
El Valle Escondito Water System	300	67	108	0	100	300	129	10,050
Hacienda Subdivision Water System	72	113	26	0	100	72	31	4,068
Las Colonias MHP	47	113	20	0	100	47	20	2,656

[a] NMED DWB unless updated due to communication with water system
[b] NMED DWB, 2006 unless otherwise noted
[c] Difference between number of sewer accounts and number of water accounts divided by number of water accounts, or 100 percent if no wastewater treatment plant
[d] Population served by septic tanks divided by the average household size
[e] Effluent amount is based on 50 percent of water diverted
[f] Population self-supplied for water and sewer
[g] Cerro East MDWCA and Cerro West MDWCA merged in 2005
[h] Personal communication with water systems
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[k] Wastewater treated by the Taos Wastewater Treatment Plant
[l] El Prado 40-year plan, 2004
[m] Value estimated at 50% of population served, as half of population is on septic
[n] Value estimated by dividing population by average house size for region, and subtracting out the number of sewer accounts

gpcd= Gallons per capita per day
gpd = Gallons per day
MDWCA = Mutual Domestic Water Consumers Association
MHP = Mobile Home Park
--- = No information available

Table 8-2. Estimate of Population Served by Septic Tanks
Taos Water Planning Region
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Water Supplier	Population Served [a]	Water Use [a] (gpcd)	Water Accounts [b]	Sewer Accounts [b]	Percentage Not on Sewer [c]	Population on Septic Tanks	Number of Septic Tanks [d]	Effluent Currently Treated by Septic Tanks (gpd) [e]
Central subregion (cont.) *Average household size (based on 2000 Census): 2.33*								
La Lomita Trailer Park	100	78	35	0	100	100	43	3,900
Llano Quemado MDWCA	650	54	216	0	100	650	279	17,550
Lower Arroyo Hondo MDWCA	388	33	87	0	100	388	167	6,402
Lower Des Montes MDWCA	300	113	100	0	100	300	129	16,950
Ranchitos (Upper Ranchitos MDWCA)	266	62	76	0	100	266	114	8,246
Ranchos de Taos MDWCA	1,100	40	180	0	100	1,100	472	22,000
St. Bernard Condos Water System	76	113	19	0	100	76	33	4,294
Talpa MDWCA	735	65	210	0	100	735	315	23,888
Taos Municipal Water System	3,516	227	1,560 [h]	1,555 [h]	0.32	11	5	2,497
Taos Pueblo	1,264	---	---	---	---	---	---	---
Upper Arroyo Hondo MDWCA	150	52	44	0	100	150	64	3,900
Upper Des Montes MDWCA	280	205	93	0	100	280	120	28,700

[a] NMED DWB unless updated due to communication with water system
[b] NMED DWB, 2006 unless otherwise noted
[c] Difference between number of sewer accounts and number of water accounts divided by number of water accounts, or 100 percent if no wastewater treatment plant
[d] Population served by septic tanks divided by the average household size
[e] Effluent amount is based on 50 percent of water diverted
[f] Population self-supplied for water and sewer
[g] Cerro East MDWCA and Cerro West MDWCA merged in 2005
[h] Personal communication with water systems
[i] Transient population
[j] Based on year-round population
[k] Wastewater treated by the Taos Wastewater Treatment Plant
[l] El Prado 40-year plan, 2004
[m] Value estimated at 50% of population served, as half of population is on septic
[n] Value estimated by dividing population by average house size for region, and subtracting out the number of sewer accounts

gpcd= Gallons per capita per day
gpd = Gallons per day
MDWCA = Mutual Domestic Water Consumers Association
MHP = Mobile Home Park
--- = No information available

Table 8-2. Estimate of Population Served by Septic Tanks
Taos Water Planning Region
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Water Supplier	Population Served [a]	Water Use [a] (gpcd)	Water Accounts [b]	Sewer Accounts [b]	Percentage Not on Sewer [c]	Population on Septic Tanks	Number of Septic Tanks [d]	Effluent Currently Treated by Septic Tanks (gpd) [e]
Central subregion (cont.) *Average household size (based on 2000 Census): 2.33*								
Valdez MDWCA	120	43	36	0	100	120	52	2,580
Vigils Trailer Park	93	87	40	0	100	93	40	4,046
Village of Taos Ski Valley (Twining)	40 610 [i]	143	126 [h]	82 [h]	35	14 [j]	6 [j]	1,001
South subregion *Average household size (based on 2000 Census): 2.44*								
Rural self supplied [f]	1,847	108	NA	NA	100	1,847	757	99,738
Apodaca MDWCA	107	108	35	0	100	107	44	5,778
Chamisal MDWCA	313	108	90	0	100	313	128	16,902
Cuchilla del Llano MDWCA	181	108	45	0	100	181	74	9,774
Dixon MDWCA	400	83	126	0	100	400	164	16,600
Llano San Juan MDWCA	64	109	17	0	100	64	26	3,488
Montecito MDWCA	60	108	15	0	100	60	25	3,240
Ojo Sarco MDWCA	116	84	46	0	100	116	48	4,872

[a] NMED DWB unless updated due to communication with water system
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[d] Population served by septic tanks divided by the average household size
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South subregion (cont.) *Average household size (based on 2000 Census): 2.44*								
Peñasco MDWCA	437	183	225 [h]	0	100	437	179	39,986
Picuris Pueblo	86	---	---	---	---	---	---	---
Placitas MDWCA	220	54	84	0	100	220	103	5,940
Rio Lucio MDWCA	360	56	102	0	100	360	148	10,080
Rodarte MDWCA	120	108	40	0	100	120	49	6,480
Trampas MDWCA	120	43	25	0	100	120	49	2,580
Upper Cañoncito MDWCA	75	36	23	0	100	75	31	1,350
Vadito MDWCA	180	108	62	0	100	180	74	9,720
West subregion *Average household size (based on 2000 Census): 1.87*								
Rural self supplied	702	108	NA	NA	100	702	375	37,908
Ojo Caliente MDWCA	184	130	112	0	100	184	98	11,960
Tres Piedras MDWCA	117	95	60	0	100	117	63	5,558
Total	31,464					24,730	10,589	1,219,223

[a] NMED DWB unless updated due to communication with water system
[b] NMED DWB, 2006 unless otherwise noted
[c] Difference between number of sewer accounts and number of water accounts divided by number of water accounts, or 100 percent if no wastewater treatment plant
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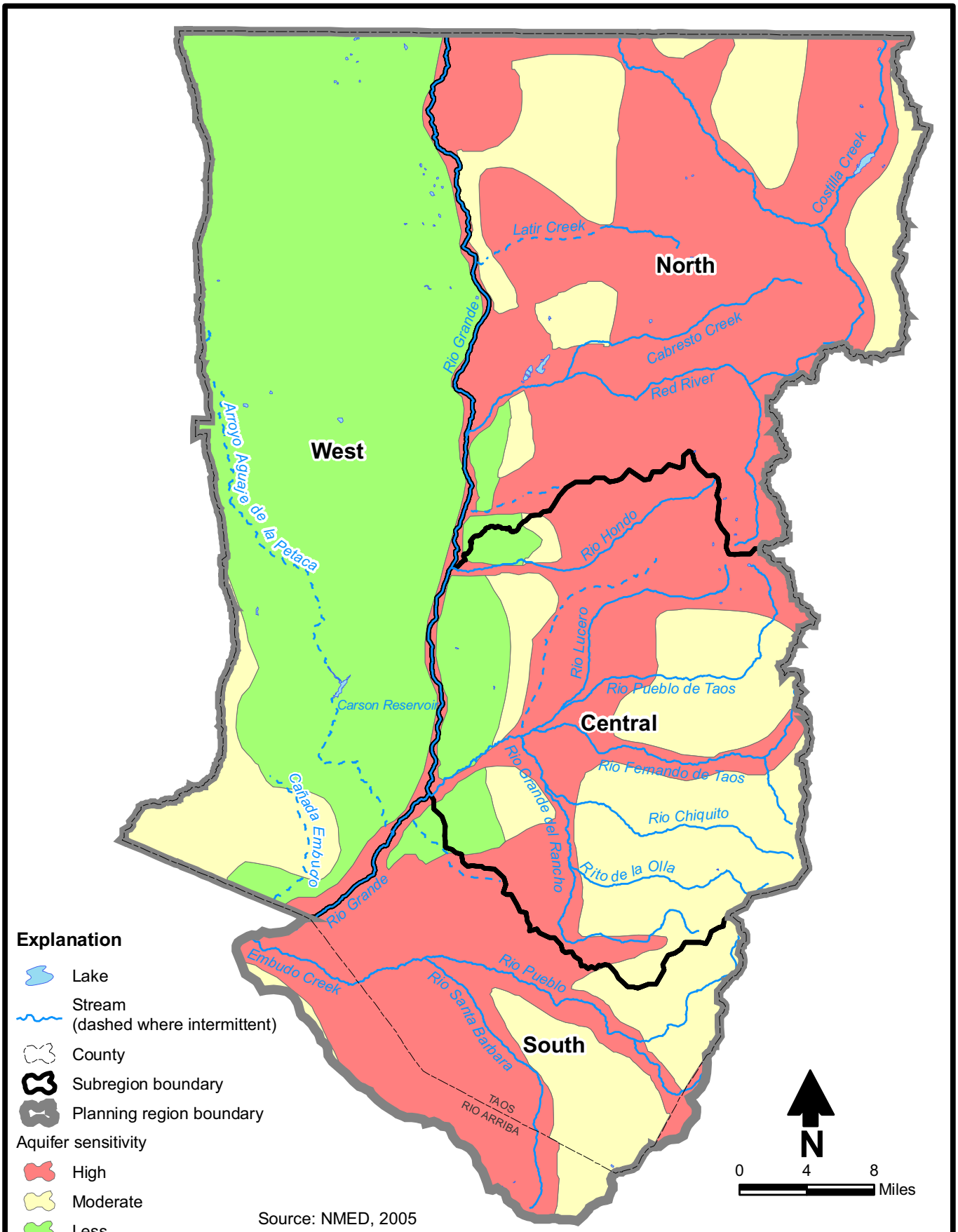
The New Mexico Liquid Waste Disposal Regulations (20.7.3 NMAC) regulate domestic leachfield (septic) systems, and a revised set of these regulations became effective on September 1, 2005 (20.7.3 NMAC). The major features of the revised regulations include provisions for minimum lot sizes on which a septic system can be placed (0.5 to 0.75 acre, depending on depth to groundwater and proximity to wells), drainfield sizing, treatment standards, and permitting of systems that are currently operating without a permit (NMEIB, 2005). NMED, the Professional On-Site Wastewater Re-use Association of New Mexico, and the New Mexico Homebuilders Association submitted petitions to the New Mexico Environmental Improvement Board (EIB) requesting amendments to the new regulations, and a public hearing was held before the EIB on January 3 through 5, 2007 (POWRA, 2006). After considering the petitions of NMED and POWRA (the NMHA petition was withdrawn), the EIB adopted minor revisions to the regulations, which will be codified in 2007.

In NMED-designated "areas of concern," the revised regulations require that new systems on less than ¾ acre install "advanced treatment" systems, defined by NMED as septic systems capable of treating biological oxygen demand (BOD) to less than 30 mg/L and total nitrogen to an average of 20 mg/L or less prior to discharge. The NMED areas of concern are defined locations where groundwater is most vulnerable to contamination, based on depth to water less than 100 feet and TDS less than 2,000 mg/L); Figure 8-1 illustrates the NMED's mapping of aquifer sensitivity for the Taos Region.

By definition, an area of concern has one or more of the following characteristics:

- Overlies an aquifer within 100 feet of ground surface
- Lies within 1 mile of a known groundwater contamination plume that contains anthropogenic anoxic conditions or nitrate contamination
- Lies above an aquifer that is overlain by fractured rock
- Lies above an alluvial aquifer that discharges to a gaining stream located within 200 feet of the proposed septic system



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TAOS REGIONAL WATER PLAN

Aquifer Sensitivity

Daniel B. Stephens & Associates, Inc.

06/07/2007

JN WR05.0235

Figure 8-1

A better understanding of water quality deterioration from septic tanks in the Taos Region is needed, particularly in areas with fractured granite or basalt, shallow depth to groundwater, or other conditions that reduce natural denitrification processes. Once the problem is better characterized, contamination could be addressed through several options:

- *Connect to existing wastewater infrastructure.* The Towns of Taos, Questa, and Red River, Taos Pueblo, and the Village of Taos Ski Valley have central wastewater collection and treatment facilities, and El Prado Water & Sanitation District wastewater is treated by the Taos Municipal Wastewater Treatment facility. Nevertheless, up to 50 percent of the residents in these communities continue to rely on septic tanks for wastewater treatment. This option involves hooking these residents into existing wastewater collection and treatment systems (the treatment capacity of the plants may need to be expanded to accommodate the added effluent).

- *Construct regional wastewater treatment systems for wastewater reuse.* Under this option, communities that currently have a water system but no wastewater system would build central collection, treatment, and disposal facilities. The central collection system could be a single traditional gravity-fed system that serves the entire community or multiple decentralized systems that serve clusters of homes. After treatment, the wastewater could be discharged to surface water under an NPDES permit, discharged underground with a groundwater discharge permit, or reused by a facility currently using potable surface water and/or groundwater to water landscaping.

- *Use alternative on-site wastewater treatment.* Innovative on-site approaches are available as alternatives to conventional septic tank/leach field wastewater disposal and could be used in communities that are not currently served by a water system or where populations are more dispersed. These advanced on-site methods to treat wastewater are intended to produce a higher-quality effluent and thus protect soils, groundwater, and human health. For example, a combination gray/black wastewater system separates individual on-site residential waste streams so that higher-quality wastewater (e.g., from showers) can be stored and used for landscaping or garden watering, while sanitary wastes are segregated and directed to an on-site (or off-site) wastewater

treatment system. This approach greatly reduces the daily volume of residential wastewater that, after treatment, is discharged to surface water or groundwater. Some advanced systems incorporate disposal processes that include evaporation of some effluent.

- *Establish a regular maintenance program for septic tanks.* Under this option, communities could set up a system to service septic tanks on a regular basis. Where home density is less than one house per 2 acres, this may be an effective method of protecting water quality and public health; however, if the density is greater, a centralized system would better protect water quality. Because residents would be assessed an annual fee for this maintenance, education about the benefits of proper septic tank maintenance would be a key component of this program. Homeowner associations, mutual domestic well associations, or county governments could implement this type of program, although programs for homeowner and domestic well associations would have to be voluntary for existing members.

As further discussed in Section 8.3.3, the costs associated with each of these options may make implementation difficult. The technology exists to collect, centrally treat, and dispose of all wastewater now generated by rural residents of the planning area. In the normal course of an area's growth, it is not unusual for housing units to become denser and for wastewater treatment eventually to be centralized. The decision to centralize wastewater treatment is normally made for public safety and health, environmental protection, and economic reasons. In some parts of the planning area, the density of rural housing lends itself to this consideration now, although for areas where density is less than one house per 2 acres, a program of regular maintenance of septic tanks may be more appropriate than replacement.

8.3.2 Hydrologic Impacts

Setting up a water quality steering committee to keep tabs on the status of NMED programs would not have a quantitative hydrological impact. However, encouraging effective execution of these programs, as necessary, will help to protect the existing water resources in the region. Replacing septic tanks with improved wastewater collection and treatment systems would

improve water quality in groundwater and streams that are currently impacted by septic tanks. Nitrate levels in groundwater would not immediately decrease, but would improve over time depending on the depth to water and flow rate in the aquifer.

Another possible benefit of this strategy is conservation of the available water supply. If septic tanks are replaced with a centralized or on-site system that is designed to allow for reuse of treated wastewater, a reduced amount of water would need to be withdrawn for consumptive uses such as landscape, garden, and stock watering. Communities that hook up the approximately 1,330 people who live in areas where wastewater treatment facilities exist could use the added effluent for turf irrigation or other wastewater reuse applications.

8.3.3 Financial Feasibility

Implementing a water quality steering committee would rely largely on volunteer efforts and the costs would therefore be minimal, though some funding to support the committee would be useful. The cost of implementing each option related to septic tanks and source water protection can be significant; the NMED Construction Programs Bureau can assist communities in writing grants and obtaining necessary funds for proposed projects. Sources of funding for community wastewater facilities include the Rural Community Assistance Corporation, the state revolving fund loan, state appropriation, the New Mexico Finance Authority, Community Development Block Grants, the U.S. EPA one-time hardship grant, U.S. EPA demonstration grants, and the New Mexico Environment Department Drinking Water Bureau (Section 8.2.3).

The cost of connecting current septic system users to existing wastewater collection systems will depend on their proximity to the existing system, the number of connections added, and the ability of the existing system to handle the increased volume of wastewater to be treated. Construction of new wastewater treatment facilities would be the most expensive option, and specific project costs depend on the associated sewer/collection system cost, type of treatment, as well as the discharge method for the treated wastewater. Costs range from approximately $10 to $25 per gallon for package plants that treat up to 50,000 gallons per day to $8 to $20 per gallon for municipal treatment plants that treat more than 50,000 gpd. In addition, all discharges need to be permitted, and permit fees will be incurred.

The cost of installing on-site wastewater treatment systems, which can be installed in an existing septic tank to provide secondary treatment of wastewater, is relatively low. Installation of an on-site treatment system costs approximately $4,000 for a single-family home, assuming that access to power is available nearby and the system is installed inside an existing septic tank. Wastewater treated by an on-site system is then either dispersed through the existing leachfield or can be re-used to irrigate landscaping. A basic irrigation re-use system can be installed for an additional $6,000 (including the irrigation tank, pump, controls, and drip irrigation lines). These systems can also be clustered to treat larger volumes of wastewater (Williams, 2006).

A program to provide regular maintenance of septic tanks has been implemented in two areas of New Mexico: the Estancia Basin (implemented by Entranosa Water and Wastewater in 1999) and Peña Blanca (implemented in 1991). The Entranosa program serves about 1,000 homeowners who are charged $5.25 per month and includes pumping each septic tank once every three years. In Peña Blanca, the cost is $10 per month for each homeowner and the tanks are pumped every two years (Rose, 2004).

8.3.4 Environmental Impacts

In general, programs to protect water quality will have a positive environmental impact. Replacement of septic tanks with a regional treatment system would likely have NEPA implications, but these are not expected to be significant enough to prevent implementation of the proposed projects. To comply with NEPA requirements, cultural remains and endangered species habitat would need to be identified and avoided for any project. Some floodway, floodplain, and wetlands issues under Section 404 of the CWA could also be associated with the construction of regional wastewater treatment systems.

Considering that many rural septic systems are faulty and are often located too close to surface water features and domestic and supply wells, septic tank replacement or upgrades/ maintenance would reduce contamination of surface water and groundwater, benefiting public health and the environment. Constructing regional wastewater treatment systems could yield greater streamflow downstream (due to return flow from the treatment plants), but would reduce locally available water by diminishing local groundwater recharge and seepage to surface water.

8.3.5 Political Feasibility and Social/Cultural Impacts

The political feasibility of this alternative varies depending on the combination of options pursued. Hooking residents up to existing centralized wastewater treatment facilities would have the greatest political feasibility and the fewest social or cultural impacts. However, implementing a regular maintenance program for current septic tank users or constructing a centralized wastewater treatment facility in communities without wastewater treatment capabilities would require an initiative by the municipal management utility or by a homeowners association, mutual domestic water consumers association, or county government.

Van Lenten (2003) and Rose (2004) suggest conducting house-to-house surveys to document baseline physical conditions and existing health hazards. Survey information could be presented in public meetings to show the connection between a community's drinking water and wastewater, illustrating how residents could benefit by protecting water quality. A community effort is much more likely to receive funding, lowering costs to the consumer. It is important to provide options and their associated costs for residents to consider, and involving those residents in the discussions and planning can help to minimize any social or cultural impacts.

8.4 Public Education

Public education initiatives can facilitate implementation of all of the priority strategies in this regional water plan. If the general public understands the rationale and benefits of a particular strategy, individuals are likely to alter their behavior as a result of the information (e.g., watering at night to avoid evaporation) or will vote in support of public initiatives (e.g., bonds to fund water projects). Public education efforts can take many forms, including disseminating information (e.g., through flyers, radio and television spots), developing specific library collections, and providing workshops and presentations for the general public. To provide a comprehensive approach to the public education component of the priority strategies, the steering committee decided to evaluate this component as a separate strategy that focuses on the development of a central clearinghouse of information related to water in the Taos Region. Such a clearinghouse will allow easy access to information that will assist the planning region in implementing all of its strategies and protecting its water resources for future generations.

8.4.1 Technical Feasibility

Developing a central clearinghouse for water-related information is technically feasible, since most water-related information that will be useful to the region is easily accessible from a variety of sources. There may be some technical challenges in compiling and distributing some of the information; for example, compiling, organizing, and documenting information on water rights in a manner that is easily accessible to the public can be a complex task that requires significant effort. Conversely, other sources of information, such as how to implement water conservation, are readily available. It is envisioned that the public education clearinghouse would initially supply easily accessible information and integrate more complex information as time and resources allow.

The state system of water resources research institutes is an example of a state-wide clearinghouse with technical information on state water resources (USGS, 2007). These state programs include research, training, and technical assistance and are federally funded with millions of dollars annually allocated to each state. The programs are housed within a state "land grant" university, in the case of New Mexico, at New Mexico State University. The New Mexico Water Resources Research Institute may be able provide technical assistance to the Taos Region in designing and setting up a local clearinghouse.

To implement a public education clearinghouse, the following steps would be undertaken:

- Outline a responsible party to apply for grant funding. It has been suggested at steering committee and public meetings that UNM-Taos may be a potential responsible party to oversee public education efforts. At public welfare conflict resolution meetings held in March 2008, local elected officials confirmed support for a repository of water information and suggested that Taos Soil and Water Conservation District consider housing the repository.

- Form a board of directors or some type of oversight committee to supervise hiring a staff person and setting up an office.

- After funding is obtained, set up a physical office, either within an existing organization or in a separate location.

- Hire one or more staff persons to compile materials, set up the office and website, and work in the office during set hours. The number of staff, type of office, and hours of operation could be set at varying levels depending on the available funding.

- Coordinate with other groups and agencies that provide some level of public education on water related issues, such as the Taos SWCD, Amigos Bravos, Taos Land Trust, and local, state, and federal agencies.

- Compile easily accessible information and set up an in-house library initially, and add more complex information requiring research as time and resources allow.

- Develop a website to make electronic information relevant to Taos regional water planning available through the internet.

- Prepare articles and attend local meetings to inform the public of the existence of the clearinghouse and the specific types of water-related information that are available.

- Conduct outreach in the public schools. Children who learn about conservation or other water resources issues in the classroom often take that information home and educate their own families.

It is anticipated that the types of information that will be provided in the central clearinghouse will include:

- Information on residential and commercial water conservation, including auditing, low water use appliances, xeriscaping, and other information that can help existing residents and businesses reduce their water use.

- Information regarding new building requirements such as subdivision ordinances, requirements for hydrologic or hydrogeologic reporting, and other permitting or approval processes.

- Information and technical resources for installing graywater systems, rainwater harvesting, and xeriscaping, to assist existing residents and businesses, as well as developers of new subdivisions, in making wise use of water.

- Information regarding compliance with state laws or local or acéquia regulations (e.g., recent changes in state law affecting installation of domestic wells and septic tanks).

- Technical information regarding water resources (e.g., geology, depth to groundwater, and water quality) that could affect the ability to obtain water in various areas (the Taos SWCD has been actively compiling groundwater and water quality information).

- Information related to water management and control such as acéquias and water systems.

- Information about water rights and water rights transactions, including materials related to New Mexico water law and water rights issues, as well as information regarding pending litigation and water rights transfers that could be relevant to Taos County.

- Information about ongoing or planned watershed groups and watershed management or restoration projects.

In addition to making information available, a trained staff person working in the clearinghouse can answer questions from citizens and decision-makers or direct them to other resources.

8.4.2 Hydrologic impacts

No direct hydrologic impacts are anticipated to result from implementation of this strategy, as it doesn't involve a change in water diversions or management. However, providing information

regarding water conservation and building techniques that will minimize water use (such as installation of gray water systems for landscaping) can help to reduce water demand in the region, particularly per capita demands associated with new growth (as discussed further in Section 8.7).

8.4.3 Financial Feasibility

Financial requirements for developing a central clearinghouse for water-related information would include a minimum of one staff person, office space, and information materials. It is anticipated that the cost would be in the range of $80,000 to $150,000 per year. If the office could be set up in one of the existing governmental or non-profit organizations in the area, office expenses could potentially be reduced.

Many water-related resources are available for free or for minimum costs. For example:

- Numerous materials for all types of public education and school outreach programs are available on the OSE water conservation website (http://www.ose.state.nm.us/water-info/conservation/index.html).

- Other websites currently offer interactive water calculators to help users understand how much water they use and where they use it (http://www.h2ouse.org and http://www.tampagov.net/dept_water/conservation_education).

- The NMED website (www.nmenv.state.nm.us) provides information on exceedances of drinking water standards (http://eidea.state.nm.us/SDWIS/), source water protection (http://www.nmenv.state.nm.us/dwb/swapp.html), and other water quality issues.

Compiling more complex information and making it available to Taos area citizens and officials will require greater financial resources. For example, it could be useful to develop GIS maps showing existing water rights and proposed or pending transfers (updating those maps as transfers are finalized) or maps showing water quality or updated water level data. Additional expense would be incurred for this type of technical or legal compilation and mapping, but the

level of effort could be set based on available funding. Additional information on funding sources is provided in Section 8.9.

8.4.4 Political Feasibility / Social and Cultural Impacts

Educational activities generally are easier to support politically than programs that regulate or place other requirements on citizens. Consequently, it is anticipated that implementing a clearinghouse for water-related information will have widespread political support. Providing educational resources to Taos Region citizens should have positive social and cultural impacts.

8.4.5 Environmental Impacts

No negative environmental impacts are anticipated as a result of implementing this strategy. Providing educational resources that will assist citizens with water conservation and compliance with regulations such as those pertaining to septic tanks, as well as information on activities such as watershed restoration, should have a positive environmental impact.

8.5 Protect Agriculture

Agriculture has been an important cultural tradition in the Taos Region and is the largest water use sector in the region. The steering committee has identified a goal of protecting this sector by ensuring that water remains available to the agriculture sector. The steering committee understands that pueblos, acéquias, and parciantes have the authority to make decisions regarding potential transfers. However, to protect the region overall, the steering committee supports efforts to preserve a continuing viable agricultural sector in the region. Because the surface water supplies used in agriculture originate in the upland forested watersheds, this strategy is related to the watershed protection strategy (Section 8.8). This strategy includes several different approaches for protecting and sustaining the agricultural activities that are practiced by Taos and Picuris Pueblos and the many acéquias in the region. Taos Pueblo irrigates more than 2,300 acres from 27 ditches, and the nearly 300 acéquias in the Taos Region irrigate at least 43,000 acres (Appendix F1, Table F1-3).

As discussed in Section 4.2, acéquias are local governmental entities, or "political subdivisions," under New Mexico law (NMSA §73-2-28). They provide water to small farms and are vital to the livelihood, environment, and character of the Taos Region. Acéquias have historically provided the strength for communities, and their continuation is vital for the region. Continuation of a vital local agricultural sector will benefit the region by providing local food crops, aesthetic open spaces, and a sense of community.

A number of factors have put pressure on traditional agriculture:

- Economic realities have reduced the number of full-time farmers in New Mexico. In 1945, 73 percent of farmers were full-time as compared to 51 percent in 1987 (Ackerly, 1996). Also from 1945 to 1987 the sizes of farms doubled in New Mexico, without an increase in the total acreage irrigated, and the total number of farmers (full- and part-time) dropped by 50 percent from 1945 to 1987 (Ackerly, 1996). Fewer farmers results in a decrease in the number of parciantes (members of an acéquia) who can help maintain the acéquias and ditch systems that are part of the traditional agriculture.

- Urban population has expanded, requiring more water to meet the growing demand, and some of that water has come from acéquias. Agriculture represents the largest use of water in the Taos Region and would therefore be a potential source of water for new uses as demand increases in urban centers, both inside and outside the region. Farmers experiencing financial difficulties often have few assets other than their land and the associated water rights. In a market where water rights have a high dollar value, it may be very difficult for these farmers to turn down a purchase offer.

- The value of land has increased dramatically, making it difficult to keep land in the family. In the 1960s land sold for $150 per acre, whereas today, the price is about $90,000 per acre (Martinez, 2005). Depending on the inheritance tax, which changes each year, the tax on land, which is appraised at today's prices, may be unaffordable. For instance, in 2005 the $1.5 million exclusion on estate tax could be exceeded with fewer than 20 acres. Given the 2005 tax rate, large portions of inherited land are often sold to pay the inheritance tax (de Stefano, 2005).

This strategy focuses on ways to counterbalance such pressures. Two of the most important tools for the planning region are the laws recently passed giving acéquias and community ditches broader water management authority with respect to water transfers and water banking. These two laws, as well as other potential mechanisms for protecting acéquias and other agricultural users, are discussed in Sections 8.5.1 through 8.5.5.

The Taos Land Trust, whose mission is, in part, to conserve land with agricultural value, has resources to help the farming community remain a vital part of the Taos Region. Their compilation of proceedings from several community forums in 2004, *Ensuring a Land Legacy for Future Generations* (Taos Land Trust, 2005), contains a wealth of information on protecting agriculture. While the strategy discussed here focuses on the actions that acéquia communities can take, the Taos Land Trust also provides information about how individuals can protect their agricultural land through estate planning, conservation easements, and maintaining agricultural exemptions (www.taoslandtrust.org).

8.5.1 Technical Feasibility

Potential avenues to support continuation of the agricultural sector in the Taos Region include the following:

- Enact acéquia bylaws to manage water transfers.
- Implement acéquia water banking (NMSA 73-2-55.1).
- Pursue conservation easements
- Maintain and repair acéquias:
  - Community outreach to solicit volunteers for ditch cleaning
  - State and federal funding
  - Historic preservation

- Implement processes for flow measurement, conflict resolution, and management of water sharing, particularly drought sharing agreements.

- Encourage economic agriculture.

- Improve irrigation efficiencies through water conservation efforts.

These approaches are discussed in the following subsections. The first two mechanisms (acéquia bylaws and water banking) are also relevant to keeping water rights in the region (Section 8.6) and are therefore discussed further there.

8.5.1.1 Enact Acéquia Bylaws to Manage Water Transfers

While acéquias have been required to have bylaws since the late 1800s (NMAA, 2006), the New Mexico legislature created new powers for acéquias in 2003. Acéquias (and community ditches) now have the legal authority to manage transfers of water from land located within acéquia boundaries. Acéquias and community ditches may now pass bylaws requiring that transfers or changes in location of water rights on a ditch or acéquia be subject to approval by the acéquia or ditch commissioners, and the OSE is prohibited from approving applications for changes or transfers of water rights in acéquias and community ditch associations if the applicant has not complied with existing rules of the acéquia or association (NMSA, §72-5-24.1). Without such bylaws, individuals within an acéquia can sell their water rights, which in some cases could cause difficulties for the rest of the community.

The commissioners can deny such transfers if they find that the change would be "detrimental to the acéquia or community ditch or its members" (NMSA §73-3-4.1). The statute provides no definition of "detrimental," and it appears that the commissioners have discretion to determine the meaning of this term on a case-by-case basis.

As shown in Table 8-3, approximately 30 percent of the acéquia associations in Taos County had bylaws in 1987 (OSE is currently working on updating this assessment). Acéquias that do not yet have bylaws should adopt them, and acéquias with existing bylaws should revise them to clarify how the acéquia wants to address transfer issues. For example, many acéquias may

have bylaws that only address organizational issues such as appointment of officers, maintenance of headgates, and annual fees. Amended bylaws could set up the decision-making process for considering the impact of water transfers on the acéquia or could establish water banking procedures.

Table 8-3. Prevalence of Acéquia Bylaws in Taos Region

Subregion	Number of Acéquias Identified in 2006	Number of Acéquias in 1987 [a]			Percentage of Acéquias With Bylaws in 1987
		Total	With Bylaws	Without Bylaws	
Central	84	60	9	51	15
North	47	27	11	16	41
South	64	41	16	25	39
West	3	3	2	1	67
Total	198	131	38	93	29

[a] NM OSE, 1987

In 2005 the New Mexico State Legislature appropriated $200,000 to the New Mexico Department of Finance and Administration (NMDFA) (Chapter 34, Laws 2005) to provide technical assistance to local acéquias to increase their administrative capabilities, such as establishment or updates of acéquia by-laws, board management, and compliance with state rules and regulations. The NMDFA contracted with the New Mexico Acéquia Association (NMAA) to provide this assistance, and the NMAA's website (http://www.acequiaweb.org) is consequently an excellent source of information for acéquias. The NMAA lists the following benefits of having an updated set of acéquia bylaws (NMAA, 2006):

- Consistent set of rules that can be applied to all parciantes fairly and consistently
- Common understanding of the system of governance
- Clarity on the roles, powers, and duties of the Commissioners and Mayordomo
- Clarity on the rights and obligations of parciantes
- Clarity on the voting rights of parciantes, notice of meetings, and quorum
- Written recognition of practices that are unique to each acéquia
- Authorization to exercise certain legal powers such as the ability to regulate water transfers

The NMAA has developed an acéquia bylaws template (http://www.acequiaweb.org/cms/kunde/rts/acequiaweborg/docs/454184156-11-28-2005-14-15-075.doc) that can be useful to acéquias that are interested in adopting bylaws for the first time or in updating their existing bylaws.

8.5.1.2 Acéquia Water Banking

The purpose of a water bank is to promote conservation and beneficial use of acéquia water through a locally managed system of temporarily reallocating water for use within the acéquia. In recently passed legislation, acéquias and community ditches gained the authority to establish a water bank "for the purpose of temporarily reallocating water without change of purpose or use or point of diversion to augment the water supplies available for the places of use served by the acéquias or community ditch" (NMSA §73-2-55.1). Water rights placed in a water bank are not subject to forfeiture for non-use, and State Engineer approval is not required for these temporary transfers.

Although OSE or ISC recognition or approval is not required for acéquia or community ditch water banks, acéquias can only place valid water rights in a water bank. Acéquias must document the water rights that are placed in the bank, and because acéquias are governmental entities, they are subject to public records requests. OSE will want to examine water banking records as part of adjudications, and rights placed in a water bank must be recognized by the OSE. For instance, rights that have not been used for 20 years because a building was built on top of the area previously irrigated cannot be placed in a water bank because OSE would consider those rights as forfeited.

In addition to the NMAA (http://www.acequiaweb.org; 505-995-5644), technical resources to assist acéquias with developing new bylaws regarding transfers and water banking are available from the Northern New Mexico Legal Services (505-982-2504). These organizations jointly prepared model amendments for acéquias to use in implementing a water right transfer approval process and in establishing a water bank. Copies of these documents can be found in Appendix H1.

The NMAA website states that "Nothing in the formation of the Water Bank or its operation will affect the traditional and recognized lawful authority of the Acéquia's Commissioners and

Mayordomos. Issues of daily water use, periodic allocation, water issues between parciantes, and all other matters normally managed by the Acéquia's officers will continue without change. Use of the Water Bank will not affect existing vested water rights, priority dates or any existing lawful use of water by parciantes. No action of the Water Bank will be considered an adjudication of any person's water rights."

Water bank procedures typically involve:

- *Water bank record keeping.* Acéquia bylaws should establish the person in charge of recording deposits and reallocating the water rights.

- *Depositing water rights.* Interested parciantes may deposit water rights for one year, renewable annually. Reallocation of water rights on deposit in any particular year must occur in that year and may not accumulate or carry over to be reallocated in future years.

- *Water right reallocation.* Banked water rights are generally reallocated by the Mayordomo, provided that the reallocation is done without change of purpose of use or point of diversion of the water rights, to augment shortfalls of available water for the existing places of use served by the acéquia. The water rights may also be reallocated in any other lawful manner which, in the judgment of the Commissioners, will benefit the acéquia, subject to all applicable procedures, rules, and laws.

- *Ditch dues and fees.* Ditch dues or fees owed to the acéquia by a water right owner who has deposited water rights in the water bank will continue to be paid by the water right owner.

In addition to acéquia water banking, it may be beneficial in some cases to have a broader water bank that includes water users outside of an acéquia. This type of arrangement could potentially be beneficial during drought years, when not enough water is available to grow an economically viable crop; whatever water is available could be put in a bank for other uses, such as for public supply or landscaping, allowing the parciantes to receive some income during

the drought year while retaining the water rights for future use. Because most of the public supply In the Taos Region is provided by groundwater, the use of banked water for users other than agriculture would need to be carefully considered. Considerable public involvement would be required prior to finalizing a plan for water banking in the Taos Region.

In order to allow for water banking outside of an individual acéquia, specific legislation would likely need to be passed. A limited local water banking initiative was successfully passed in 2002 (NMSA 72-1-2.3) for a specific area (the lower Pecos River Basin below Sumner Lake). Under this statute, the only entities with the authority to create water banks are irrigation districts, conservancy districts, artesian conservancy districts, community ditches, and water users' associations in the targeted area, and the water banks can be set up only for purposes of complying with the Pecos River Compact (NMSA 72-1-2.3A). The legislation allows the specified entities to create (with ISC support) a water bank with expedited transfer procedures that would be submitted to the OSE for approval. Once approved, these procedures would allow for the water bank to "temporarily transfer deposited water to new purposes and places of use and points of diversion without formal proceedings before the State Engineer" (NMSA 72-1-2.3A(4)). If this initiative is successfully implemented, it may encourage lawmakers to consider broader water banking legislation in the state.

Through the AWRM, the State Engineer may also be able to implement the expedited water transfers contemplated in the regulations to assist municipalities and other users with short-term water transfers in times of drought. However, several administrative requirements must first be met, such as creating the water master districts and district-specific regulations as well as developing and approving the hydrologic models to support the expedited transfer process. The State Engineer has identified water banking as an important process to support shortage sharing in times of drought and will continue to work to develop methods for implementing this tool (D'Antonio, 2004). Additional discussion of water banking is included in Section 4.1.2.

8.5.1.3 Pursue Conservation Easements

Under the New Mexico Land Use Easement Act, a conservation easement is defined as "a holder's non-possessory interest in real property imposing any limitation or affirmative obligation, the purpose of which includes retaining or protecting the natural or open space

values of real property, assuring the availability of real property for agricultural, forest, recreational or open space use, or protecting natural resources" (NMSA 47-12-2(B)). This act allows the granting of land use easements to "preserve the availability of real property for agriculture" as well as for "the protection of natural resources" (NMSA 47-12-2(A)).

Conservation easements are useful for farmers who wish to protect the future use of their agricultural lands. If a willing buyer of the easement can be found, the farmer will obtain compensation without having to sell his or her land or water rights. Many non-profit organizations in the western United States are dedicated to the protection of farmland, and these organizations advocate the use of conservation easements to keep agricultural land in production. These regional (e.g., the Taos Land Trust and Rio Grande Agricultural Land Trust), statewide (e.g., New Mexico Land Conservation Collaborative), and national (e.g., American Farmland Trust) land trusts have many resources to assist farmers. Many conservation easements are in place in Taos County to protect unique open space as well as agricultural lands (Taos Land Trust, 2006).

Conservation easements are valid only if an owner willingly grants the easement (NMSA 47-12-3(E)). In many parts of the United States, farmers are compensated for granting these easements through local, state, and federal programs; however, in New Mexico, the only program currently available to compensate farmers for creating conservation easements is the federal Farm and Ranch Lands Protection Program, which offers a 50 percent match for entities or individuals wishing to purchase a conservation easement (NRCS, 2006). Nevertheless, owners may obtain state tax credit through the Land Conservation Incentives Act of New Mexico (NMSA 75-9-1). Federal tax credit is also available and has been increased for 2006 and 2007 from 30 to 50 percent of adjusted gross income (AGI) or, for qualified farmers or ranchers, up to 100 percent of AGI (Public Law No: 109-280 Pension Protection Act of 2006). An alternative to selling conservation easements is to donate them; donation of an easement to a qualifying land trust can also provide the donor with significant tax benefits.

8.5.1.4 Maintain and Repair Acéquias

Acéquias require continual maintenance to remove debris, stabilize the banks and repair or upgrade headgates, and ensuring that acéquias are well maintained is one way to preserve

agriculture in the area. Many acéquias are installing flumes and measuring devices to improve the metering of diversions and ensure that water diversions are equitable. Such maintenance is vital for the protection of acéquias. A number of options are available for acéquia associations to manage the physical aspects of acéquias, including (1) involving the community, (2) seeking funding from the OSE and Army Corps of Engineers, and (3) protecting acéquias as Historic Properties:

- *Community outreach.* Each spring, at the beginning of the irrigation season, acéquias need to be cleaned. With the decrease in the number of parciantes and the increasing age of the active parciantes, this task has become problematic. As Ackerly (1996) recommends, acéquias should expand the notion of the acéquia "community" and seek volunteers from the broader public. Advertisements in local newspapers have been effective for the acéquias in Santa Fe and can be a rewarding and educational activity.

- *Funding.* Several sources of funds are available to assist acéquia associations (NM OSE, 2006c):

  - The *OSE Loan Program* provides low-interest loans from the Irrigation Works Construction Fund for construction and repair of irrigation works. Acéquia associations may use the loans to pay their share of construction program costs. The loans are made at 2.5 percent interest, and the usual repayment period is 10 years.

  - The *OSE Acéquias Construction Program* provides grants from the Irrigation Works Construction Fund, with funds appropriated by the New Mexico State Legislature, for improvement and repair work on specific acéquias. The grant can cover 80 percent of the project cost up to $96,000 per project. Total construction costs under this program are capped at $120,000.

  - The *Army Corps of Engineers Acéquia Construction Program*, created by the federal Water Resource and Development Act of 1986, directs the Secretary of the Army to undertake measures necessary to preserve and restore the diversion structures and

associated canals of acéquias. Under both the Sections 215 and 1113 programs, the federal government funds 75 percent of total project costs. The ISC provides 17.5 percent of the total cost, and the acéquia association provides 7.5 percent of the total cost.

- *Capital outlay* funds are appropriate by the New Mexico Legislature to assist individual acéquias with specific projects. ISC staff review plans, specifications, and ditch eligibility, execute contracts and agreements, and inspect the completed projects. For example, in the second session of 2006, Capital Projects in Taos County included $260,000 to plan, design, and construct improvements to the Acéquia del Monte del Rio Chiquito in Taos County and $65,000 to plan, design, and construct improvements to the Acéquia Madre del Rio Grande in Taos County.

- *Historic preservation/restoration.* The National Historic Preservation Act (HPA) of 1966 was passed by Congress to encourage "the preservation of historic properties as living parts of their communities." Ackerly (1996) points out that while this would appear to be consistent with the goals of acéquia associations, the "the notion of preserving things in their original condition is fundamentally incompatible with preserving properties that have evolved and will continue to evolve into the future." However, as Ackerly states, this may be compatible with some acéquias that wish to preserve their ditches in a more-or-less intact state, for example, not lining them with concrete. Ackerly (1996) gives three examples of how the HPA can be applied toward preserving historic acéquias:

  - Because acéquias with bylaws have a status as a political entity, they are eligible for historic rehabilitation tax credits under the Tax Reform Act (1986).

  - If acéquias can be recognized as "properties" under the New Mexico Prehistoric and Historic Sites Preservation Act (18-6-1 to 18-6-23 NMSA), association members can take advantage of state incentives of as much as $25,000 to promote preservation of their acéquias once they are placed on the State Register of Historic Places.

– If acéquia associations are registered as a non-profit corporation, they could take advantage of the Cultural Properties Preservation Easement Act. This Act allows members to qualify for federal and state tax credits and qualifies them to apply for funds from the Cultural Properties Restoration Fund to promote acéquia preservation.

8.5.1.5 Water Management

Management of the limited water resources on a river system is also vital to protecting traditional agriculture. Mayordomos implement the bylaws and manage the water between parciantes on an acéquia, but resolving disputes between acéquias on a river system also requires management. Four key components are vital to water management on a river system: (1) a sharing agreement or priority administration if the river is adjudicated, (2) a water master or other entity to mange water sharing, (3) measurement of flows, and (4) facilitation for conflict resolution, including training mayordomos in techniques for working with people in difficult situations.

While priority appropriation is the legal system by which water is to be shared, in practice, many acéquias and pueblos have developed agreements to share the water during shortages. Those that have not yet developed shortage sharing agreements or other drought management practices should begin to develop those procedures. A water master is a common method of managing the distribution of water between acéquias, but is generally only implemented in areas where the water rights have been adjudicated, such as on Costilla Creek. The appointment of a water master may not be desired by a community of acéquias, but some alternative management method should be proposed.

Measurement of water flow is essential for trust among parties sharing a short supply. Measurement of the flow should be done by the water master or other entity established to manage flows. Diversions can be measured by using a pigmy meter or other device, or flumes can be installed with a staff gage or recording device.

Even with the first three components in place, disputes can still arise in the community and these should be resolved through a process established by each acéquia community. They

may choose to hire a neutral facilitator or develop skill in working with each other. Mayordomos are continually put in the difficult situation of resolving disputes among parciantes and may benefit by developing skills in resolving conflicts.

A recent effort to resolve disputes among 11 acéquias on the Rio Hondo took several years to develop with the help of a facilitator and technical support, but was successful with the January 2006 signing of an agreement to share the available water proportional to the acreage and efficiencies of the ditches. This agreement included the installation of flumes and recorders to accurately measure the amount of water diverted. To avoid the costs of a water master, three members are tasked with checking the diversions and adjusting the headgates. With the flumes in place, the number of disputes about how much is being diverted is greatly reduced.

8.5.1.6 Encourage Economic Agriculture

Farm income in Taos County is currently not very lucrative, and unless that changes, the pressure to sell acéquia water rights will continue to increase. The USDA reported 453 farms in Taos County in 2002, down 9 percent from 498 in 1997, with about equal average market value of production ($7,558 per year) and expenses ($7,552). Of these farms, 54 percent of the principal operators stated that farming is their primary occupation. More than 88 percent of the farms made less than $10,000 in 2002 (USDA NASS, 2006). Figure 8-2 shows the historical income for non-farm proprietors and farmers from 1969 to 2004.

These numbers do not include the numerous farmers who irrigate to grow crops to feed their families or their animals. For instance, for the Abeyta Adjudication, 7,881 owners of water rights have been identified, 77 percent of which live in Taos County. Based on these data, about 6,000 individuals are irrigating in the Central subregion alone (McCall, 2005), a much greater number than the 453 farms reported in the USDA census and more than a quarter of the population in this subregion, suggesting that a high percentage of residents grow subsistence crops. Even when farms are not reporting significant incomes, the subsistence farming provides food for the farmers and allows them to trade with neighboring farms which, although it does not result in reported income, does provide value to the farmers and can contribute indirectly to the local economy.

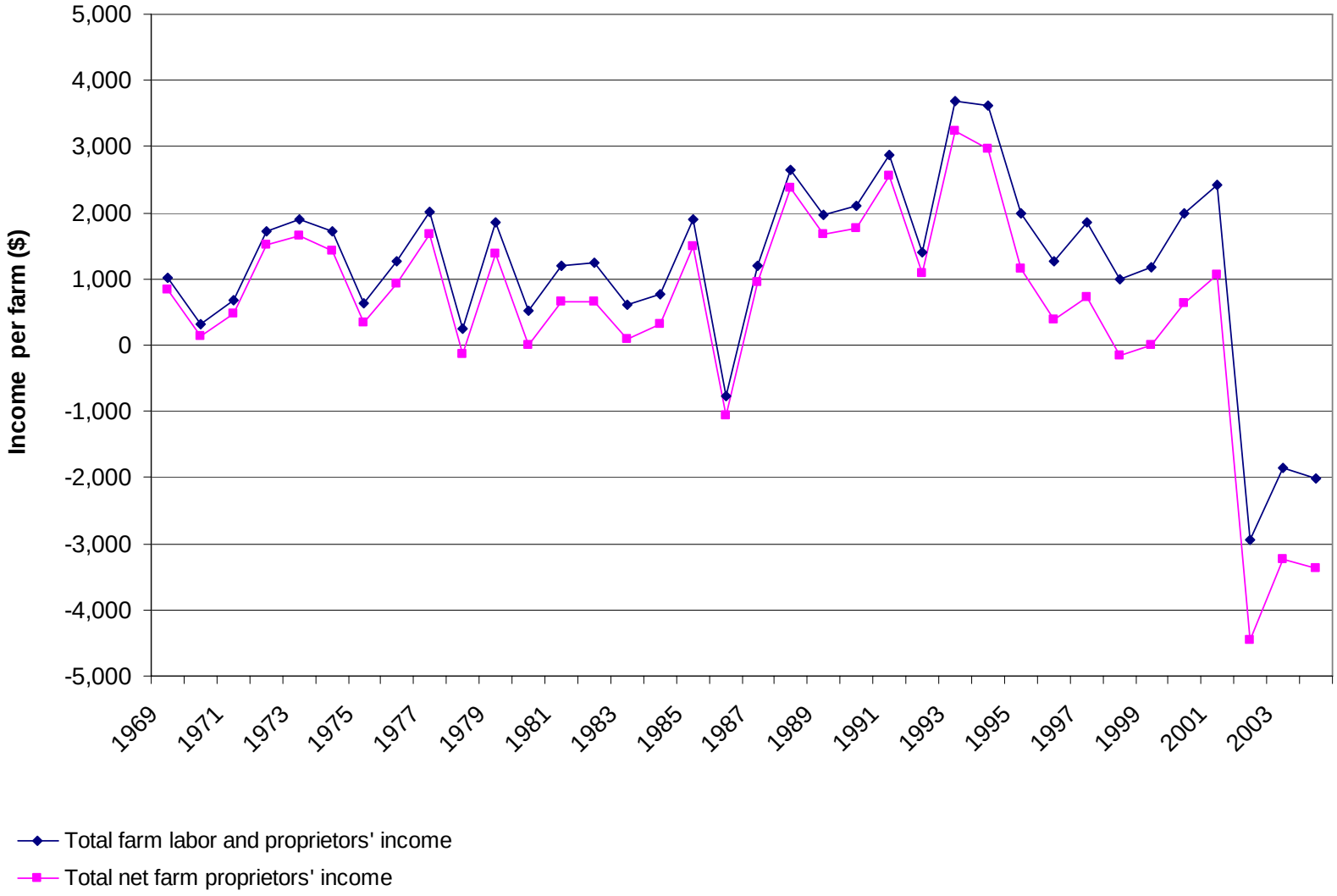

Figure 8-2

TAOS REGIONAL WATER PLAN

Average Annual Farm Income

Daniel B. Stephens & Associates, Inc.

12/7/07

Methods to encourage local agriculture to be more economically attractive (excluding imposing tariffs on imported produce, which is not legally possible) range from expanding participation in local farmers markets to improving the transportation network with appropriate storage and distribution facilities to encouraging farmers to grow high-value crops. These actions require that farmers work with multiple partners and with state and federal governments to make changes.

A project was recently funded by the non-profit organization Sustainable Agriculture Research and Education (SARE) to demonstrate the potential for sustainable agriculture in Taos County. Organic wheat was planted in Costilla, New Mexico, and demonstration plots of cool season vegetables and a wide variety of flowers were grown at Costilla, Questa, Taos, and Taos Pueblo. A market for the wheat was established in Santa Fe with growers receiving $7 per bushel, and funds have been established for a flour mill in Costilla (Western SARE, 2000). Net income from the organic wheat is approximately $230 per acre, which is higher than the returns on alfalfa. Craig Mapel, a marketing specialist from the New Mexico Department of Agriculture (NMDA), indicated that "This year we expect to bring in $100,000 of agricultural income to this part of New Mexico, where there was essentially none a year ago." Mapel's six-figure estimate refers to the market value of a recent harvest of organic wheat made by a farmers cooperative in Costilla, the inaugural crop for the growers after a generation of local people stopped farming in the area (SARE, 1998).

Matt Romero, who farms in Dixon and Alcalde, has said that, with the right plan, farmers can make a good living in agriculture: “It is possible to grow $40,000 to $50,000 worth of vegetables on an acre of land'” (Matlock, 2006b).

The NMSU Alcalde Sustainable Agriculture Science Center (http://alcaldesc.nmsu.edu) is another valuable resource for farmers. They are conducting research on methods of maximizing the growing season and the potential for growing organic medicinal herbs and organic fruit.

Interest in buying local produce is growing nationally. The grocery chain Whole Foods plans give $10 million a year in low-interest loans to help small local farmers and producers of grass-

fed and humanely raised meat, poultry and dairy animals (Ness, 2006). In Santa Fe, Whole Foods buys only from licensed certified organic farmers. Currently they buy organic peaches from Embudo and greenhouse tomatoes from Alcalde. Cid's Food Market in Taos will buy locally grown produce if they are given advance notice. A farmer could contact Cid Backer to determine which crops Cid's Food Market would be interested in selling (Backer, 2006).

John Ikerd, Professor Emeritus at the University of Missouri and author of *Sustainable Capitalism: A Matter of Common Sense* (Ikerd, 2005), gives six strategies for developing a productive farm (Ikerd, 2006):

- Focus on quality, nutrition, and safety. A rapidly growing, environmentally conscious food market is reflected in the growing popularity of organic foods. Related growth in a socially conscious market is reflected in the current explosion in popularity of local foods.

- Focus on ecological, social, and economic sustainability. The new food culture is not just concerned about pesticides, growth hormones, and genetically modified organisms (GMOs). They are concerned about the impacts of their food decisions on the natural environment, on the treatment of farmers and food industry workers, and on who benefits from the process of food production and who pays the costs.

- Focus on their uniqueness. Each family farm is unique, in terms of its natural resources, its location, or the personal abilities and aspirations of the family members. Farm families must focus on the unique advantages they have in producing specific foods to meet the unique needs and preferences of the discriminating consumers of the new sustainable/local food culture.

- Focus on finding like-minded customers. Farmers who break away from the industrial food mainstream have a distinct advantage in finding customers who share similar values in the new sustainable/local food culture. At farmers markets, they could try out a wide variety of products in order to meet a variety of customers and thus find people who value the things they can and want to produce.

- Focus on developing personal relationships with their customers. Finding customers who value what the farmer does and how s/he does it isn't enough; customers must also value who the farmer is.

- Focus on integrity and empathy as the ethical cornerstones of farming and living. If the farmer expects to maintain positive personal relationships, s/he has to treat other people with honesty, fairness, responsibility, respect, and compassion.

8.5.1.7 Improve Irrigation Efficiencies

Another potentially important component to protecting agriculture is to promote conservation of water used for agriculture. Improvements in agricultural efficiency can significantly contribute to optimal water resource management in the planning region, particularly during drought periods. The ability to have enough water to support viable agriculture even during drought periods can help to ensure that agricultural land does not go out of production. When evaluating the relative value and impacts of conservation measures, changes in the local hydrologic system should be considered. For example, while reductions in seepage losses through lining ditches may be valuable when system losses prevent sufficient water from reaching its delivery point, lining ditches will likely reduce the amount of groundwater recharge. Agricultural conservation methods typically focus on changes in farming practices (on-farm improvements) and improvements to delivery systems (off-farm improvements) to increase efficiencies and reduce water losses. Delivery system efficiencies are of most concern when unlined ditches are used to bring water from rivers or streams for irrigation, as is the case for 97 percent of the agricultural irrigation in the Taos Region.

The two general goals of on-farm conservation are to:

- Decrease the amount of diversion required to enable use of an allotted depletion
- Decrease the amount of depletion per amount of crop grown, or per amount of profit gained from the crop

According to Kay (1986), on-farm efficiency is affected by the following factors:

- *Farm layout:* The shape and slope of the farmed areas irrigated by basin (flood) and border irrigation systems affect the farm's ability to promote efficient root zone saturation while diminishing losses to deep percolation.

- *Soil types:* Differing soil types on a farm or in multiple basins can cause uneven watering effectiveness and extremely high losses to deep percolation.

- *Land preparation practices:* Land should be leveled every five to ten years to ensure that water does not pond and that it flows freely in basins.

- *On-farm water management:* Supplying crops with the right amount of water at the right time can minimize water waste and save money.

- *Irrigation scheduling:* Informed scheduling of on-farm water deliveries can help maximize crop yields while minimizing evaporative losses.

- *Methods of irrigation:* The choice of irrigation method (e.g., flood [basin], border, furrow, or drip/micro-irrigation) can optimize water use.

- *Crop type:* Different crops require different amounts of water. Emphasis should be placed on growing crops with high monetary value relative to their water consumption.

Several available on-farm technologies can increase the efficiency of on-farm irrigation. However, while these technologies do save significant quantities of water, they can also be expensive to implement.

A primary method of improving on-farm efficiency is to convert farms from irrigation methods that result in water loss (e.g., through evaporation, as in the flood irrigation method used most commonly in the planning region) to methods that minimize losses, increasing the proportion of irrigation water that reaches plants. Table 8-4 lists the attainable irrigation efficiencies for different systems. Currently, 97 percent of the farms in the planning region use flood irrigation with surface water.

Table 8-4. Attainable On-Farm Irrigation Efficiencies for Various Irrigation Systems

System Type	Efficiency (%)	
	Current Taos Region [a]	Attainable [b]
Gravity irrigation		
Improved gravity [c]	50	75–85
Furrow		55–70
Flood		40–50
Sprinkler systems		
Hand-move or portable	65	60–65
Sideroll		60–80
Traveling gun		60–65
Center pivot		70–85
Solid set or permanent		65–80
Low-energy precision application		90–98
Drip/micro-irrigation	NA	80–95

[a] Wilson et al., 2003 NA = Not applicable (not used in Taos Region)
[b] Vickers, 2001
[c] Includes tailwater recovery, precision land leveling, and surge flow systems

The desired improvements in on-farm efficiencies are those that reduce evaporative losses but do not increase overall depletions of the amount of water diverted. In general, increases in on-farm efficiency may result in greater reductions in return flow than in evaporative loss, which in turn could lead to reductions in recharge. When considering the implementation of any on-farm improvement, its impact on depletions needs to therefore be carefully considered.

Which type of efficiency improvement will be most viable must be determined by each acéquia or individual irrigator on a case-by-case basis. The types of on- and off-farm improvements and their general applicability to the Taos Region are discussed in the following subsections.

8.5.1.7.1 Drip/Micro-Irrigation Systems. In 1999, no acreage in the Taos Region was irrigated with drip/micro systems (Wilson et al., 2003). Drip/micro-irrigation methods can conserve water because they deliver water directly to the root zone through emitters placed along a water delivery line (typically a polyethylene hose). In contrast to most other types of irrigation systems, a properly designed and well operated drip/micro-irrigation system:

- Can be used on steep slopes
- Requires minimal land grading
- Can be installed on land parcels of any size or shape
- Has few, if any, runoff problems and little likelihood of excessive over-irrigation
- Has greater distribution uniformity (especially the newer system designs)
- Provides optimal soil moisture through more frequent irrigation
- Allows direct application of fertilizer to the root zone
- Reduces pest and weed problems and therefore requires fewer chemicals

Systems can be installed permanently (typical for orchards and vineyards) or seasonally (typical for row crops), or they may consist of permanent main lines with removable or disposable lateral lines. Because drip/micro-irrigation system components typically remain in place for the growing season, the systems can be automated; however, they should be monitored and shut off temporarily as appropriate during rainy periods. Drip systems supplied by surface water sources must have a filter to remove sediment, a pressure regulator, and a pump and pump house.

Costs to convert to drip irrigation from flood irrigation are several thousand dollars per acre. Farmers will have to weigh the benefits of the reduced water demand (particularly during droughts) against the cost of implementation.

8.5.1.7.2 Laser Leveling. For fields that are flood irrigated, laser leveling involves grading and earthmoving to eliminate variation in field gradient, that is, smoothing the field surface and often reducing field slope. Laser leveling helps to control water advance and improve uniformity of soil saturation under gravity-flow systems, allowing the grower to apply only the water needed to refill the root zone. For this method to work properly, the volume of water needed for irrigation must be applied as rapidly as possible in order to allow the same time for infiltration throughout the entire field. In 1999 more than 29,500 acres in the Taos Region were flood irrigated; this acreage could benefit from laser leveling (Wilson et al., 2003).

Evidence suggests that laser-level irrigation can increase on-farm efficiency by 25 percent and reduce diversion time to 25 percent of that previously required to irrigate the same acreage.

Irrigation efficiencies for laser-level irrigation can be as high as 75 to 85 percent, as opposed to irrigation efficiencies for normal flood irrigation, which run about 40 to 50 percent (Vickers, 2001).

8.5.1.7.3 Sprinkler Systems. As shown in Table 8-4, sprinkler systems can provide some efficiency improvements if they are used to replace flood or furrow irrigation. Only 40 acres are flood-irrigated with groundwater (Wilson et al., 2003) and could increase efficiency by converting to sprinkler systems. Sprinkler systems are not as viable for surface water systems because of potential clogging problems.

Most crops can be irrigated with some type of sprinkler system, although crop characteristics such as height must be considered in system selection. In 1999, 1,000 acres (about 3 percent of all irrigated land in the Taos Region) were irrigated with sprinkler systems (Wilson et al., 2003). Sprinkler systems are well suited for germinating seed and establishing ground cover for crops like alfalfa and lettuce because they can provide the light, frequent applications that are desirable for this purpose.

Sprinkler systems are particularly useful for irrigating soils that are too shallow to permit surface shaping or too variable for efficient surface irrigation. In general, sprinklers can be used on any topography that can be farmed, and land leveling is not normally required.

There are disadvantages to using sprinkler systems for irrigation. Sprinklers may require more pumping energy than other irrigation methods and can be labor-intensive, especially those systems that must be moved manually. They also require better-quality (or filtered) source water than other surface irrigation methods with the exception of drip/micro-irrigation.

8.5.1.7.4 Surge Valves. Surge valves can be added to increase application efficiencies and reduce deep percolation of irrigation water in some fields that use furrow irrigation. The principle behind surge irrigation is to switch the water back and forth between irrigation sets in an alternating pattern using an automated valve. The valve may be set for different lengths of out-times (times when water is applied to advance water through the length of row). If the out-times and cutback are set correctly, this method of irrigation advances the water more quickly

and efficiently through the field than continuous irrigation, thereby minimizing runoff (tailwater) and deep percolation. Surge valves typically improve furrow irrigation efficiency by an average of 10 to 40 percent, depending on soil type, land slope, and the lengths of the runs; some growers have cut irrigation amounts by as much as 50 percent (Vickers, 2001).

8.5.1.7.5 Gated Piping. Pipeline conveyance systems are often installed to reduce labor and maintenance costs, as well as water losses to seepage, evaporation, spills, and non-crop vegetative consumption. Permanently installed underground piping is constructed of steel, plastic, or concrete, while aboveground piping generally consists of lightweight, portable, aluminum, plastic, or flexible rubber-based hose that can be moved.

Gated pipe, a form of aboveground pipeline, distributes water to gravity-flow systems from individual gates (valves) along the pipe. One irrigation method (commonly called *cablegation*) that uses gated piping employs a moveable plug that passes slowly through a long section of gated pipe, with the rate of movement controlled by a cable and brake. Because the pipe is both oversized and sloped, water will gradually cease flowing into the first rows irrigated as the plug progresses down the pipe. Improved water management is achieved by varying the speed of the plug, which controls of the length of time water flows into each furrow.

8.5.1.7.6 Soil Treatments. The amount of water available to plants depends not only on the amount of rainfall and/or irrigation, but also on the physical, chemical, and biological properties of the soil. Soil acts as an absorbent for water from precipitation and irrigation and serves as a reservoir of water for plants in the interval between water applications.

Soil structure is an important physical parameter to consider when trying to increase on-farm efficiency, as soil sealing and soil crusting decrease the rate of water infiltration into the soil. Structureless soil can severely restrict the downward percolation of water. A common constraint to both water filtration and root penetration in the soil is the degree of soil compactness or density. Other soil characteristics that affect water availability to plants include the extent of organic matter in the soil and the types and density of soil organisms present. In addition, soil characteristics can determine how easily runoff occurs; in situ moisture conservation is a means of conserving all rainfall where it falls and allowing no runoff.

Measures that can be adopted by farmers to optimize the physical, chemical, and biological soil parameters with a view toward increasing the water efficiency include the following:

- Covers or mulches laid down on the surface of the soil and along rows
- Tilling or physically (manually or mechanically) breaking up the plough layer
- Use of soil additives called polyacrylamides that bind the soil together so that water spreads more evenly and percolates less rapidly
- Planting in small depressions, known as planting pits
- Contour cultivation that slows down the movement of water across the soil surface

8.5.1.7.7 Crop Management. Crop management provides an extra means of reducing water losses and optimizing water use in any farming system. Crop management considerations include crop water requirements, timing of irrigation, crop selection, crop configuration (plant density, crop mix), and cropping calendar (planting dates, rotation). When used along with properly programmed automatic irrigation systems, crop management techniques can increase on-farm irrigation efficiencies to 85 to 90 percent (Vickers, 2001).

8.5.1.7.8 Off-Farm Conveyance Systems. The conveyance system is a major component of a surface water diversion system; it is the means by which water is moved from the water source to the farm for irrigation purposes. Typically, water is conveyed in an open or closed conduit such as a channel, tunnel, canal, or pipe, and is moved by some driver, typically gravity and/or an energized pump. Surface water delivery systems that use unlined ditches, such as most of those in the Taos Region, are often inefficient in terms of water use. Improvements to these delivery systems could potentially reduce diversion demands and improve the systems' ability to meet demand during drought years.

When in use, conveyance facilities and systems are often a source of water loss, primarily through evapotranspiration and leakage. To the extent desired or required, leakage and

evapotranspiration can be minimized in man-made or modified natural conveyance structures and systems through appropriate facility planning, design, construction, and operation/maintenance activities. Lining a diversion ditch, for instance, may improve the delivery of water to end users on a ditch, which is particularly crucial during periods of low flow. However, reduced seepage from the diversion ditch does not mean that more water is available for new uses.

Improving the delivery efficiency of unlined ditches often results in a reduced amount of return flow, which can have undesirable consequences such as reducing stream or ditch flow to downstream users or reducing the amount of groundwater recharge. Lining canals and ditches can also cut off the water supply to phreatophytes, such as cottonwood trees, that depend on leakage from ditches.

8.5.2 Hydrologic Impacts

When considering the hydrologic impacts of conservation measures, the broader hydrologic balance in the area in which the measures are implemented needs to be considered. Conservation measures may lead to greater reliability to provide a viable farm, particularly during drought periods, or to improved crop yields. However, implementation of conservation measures does not necessarily mean that water saved will be available for another use. Reductions in diversions and return flows without reductions in depletions do not result in additional water being available for other uses. Hydrologic impacts from agricultural conservation therefore need to be evaluated on a case-by-case basis.

Continuing the use of water within an irrigation system, be it an acéquia or community ditch, will help retain flows and seepage that contribute to local recharge of local aquifers, and local shallow wells and cottonwoods that rely on seepage from these ditches will continue to receive this supply. If, on the other hand, agriculture in the Taos Region declines and water rights are transferred out of the region, the local hydrologic regime could change. More water would likely flow in the streams, which might benefit the stream riparian system, but shallow wells could become dry and the bosque habitat that has developed around acéquias would likely diminish.

If irrigation efficiencies are improved, the local hydrologic impacts may be less return flow from beneath the irrigated field. If conveyance channels are lined, the reduced seepage could impact bosque habitat and downstream irrigators.

8.5.3 Financial Feasibility

The costs for implementing acéquia bylaws to require approval of transfers out of the acéquia and to allow for water banking are relatively low. Since example bylaws are available (Appendix H1), the cost for adopting the bylaws for an individual acéquia is minimal. However, because of the many acéquias in the region, it would be beneficial to conduct an outreach and education program to ensure that all acéquias have the information needed to make an informed decision about bylaw adoption. Funding would be required to support an outreach coordinator, who could work in conjunction with county extension agents or through other programs. The cost for an acéquia outreach and education program could be on the order of $50,000 to $100,000.

Costs for conservation easements are variable. In the private sector, more people are interested in selling conservation easements than in buying them. Buyers for conservation easements usually include private land trusts or organizations like the Nature Conservancy, which use donations to purchase land and easements. These nonprofit organizations have limited resources, and so the feasibility of obtaining financial support for this strategy is limited. However, as noted in Section 8.6.1.3, when a conservation easement has been donated or sold, the landowner can take advantage of fiscal benefits offered through state and federal tax law:

- Donated conservation easements may be treated as a charitable gift under the federal tax code (IRS 170(h)), and most individual donors can deduct an amount equal to 50 percent (or for qualified ranchers, up to 100 percent) of their taxable income the year in which the gift is made. Donations valued in excess of that amount can be carried forward and applied against taxable income for up to six years.

- The New Mexico Land Conservation Incentive Tax Credit Act allows donors of land for conservation easements to qualified nonprofit conservation organizations and government open space programs to deduct up to half of the appraised value of their donation, not to exceed $100,000.

- For estate tax purposes, land with a conservation easement will have a lower property tax value and thus a lower estate tax. Federal legislation passed in 1997 created an estate tax incentive for landowners to grant conservation easements. Executors can exclude 40 percent of the value of land subject to a donated qualified conservation easement from the taxable estate (I.R.C. §2031(c)).

Costs for maintenance and repairs on acéquias can reach several hundred thousand dollars, but funding is available for such repairs (Section 8.5.1.3). Funding is also available for improved water management, including monitoring flows. Installation of fumes and recording devices is about $15,000 per ditch. The monitoring and maintenance of the equipment can be conducted by volunteers within the acéquia or through a water master who may have an annual salary in the range of $75,000.

Promotion of economic agriculture will require initiative by local farmers to tap into the financial and technical resources available. The financial impacts to the region will be positive in the form of an increased tax base and an increase in local income of area farmers.

Costs for improvements in irrigation efficiency can be significant. Costs for on-farm improvements are highly variable, and in many cases, small operations do not generate cash flows sufficient to allow for investment in water delivery system improvements, in which case funding from other sources is therefore likely to be necessary.

Both federal and state funding assistance should be available for the on-farm conservation measures described under this strategy. (Federal funding sources are generally available for capital costs only and do not cover operation and maintenance costs.) Potential funding sources for farm improvements include the following:

- The most applicable federal program for funding on-farm activities is the Natural Resources Conservation Service (NRCS) Environmental Quality Incentives Program. However, this program is understaffed, which could increase the time needed to process applications and disburse funding.

- The Farm Security and Rural Investment Act of 2002 provides for the Conservation Security Program. This is a national incentive program that allows farmers who are implementing conservation technologies in fiscal years 2003 through 2007 to receive reimbursements (SWCS, 2003).

- The New Mexico ISC, through its Agricultural Conservation Funds program, will grant low-interest loans to irrigation entities, who in turn can loan to farmers for various farming improvements, including water conservation-related actions (NM OSE/ISC, 2006).

- The New Mexico State Legislature has considered and may at some point initiate programs to provide funding for agricultural conservation measures.

8.5.4 Environmental Impacts

Retaining land and appurtenant water rights in agriculture could provide the following environmental benefits for the Taos Region:

- Retaining land in agriculture would ensure continued availability of habitat for local and migrating wildlife.

- Groundwater seepage from irrigation canals would continue to recharge the shallow aquifer and help sustain the local riparian habitat.

However, continuing to divert water from streams, particularly in drought periods, puts pressure on the riparian habit. Lower stream flows result in increased water temperature, which can

impact cold-water fisheries. In some reaches, stream flow may stop altogether, with obvious negative impacts on aquatic life.

8.5.5 Political Feasibility and Social/Cultural Impacts

Efforts to retain water in the agricultural sector are designed to benefit the local traditional culture. Retaining water in agriculture means that local businesses supplying that sector will continue to operate. Other agricultural water right holders will benefit from a system-wide continued use of water, especially in small systems where ditch maintenance is often the collective responsibility of the farmers who use it.

In addition to the economic implications, agriculture is a vital component of the planning region, and implementation of this strategy will help preserve agricultural lands and the local character and culture of the region. From an aesthetic perspective, the retention of agricultural lands enhances the quality of life for the surrounding area by creating a greenbelt in an otherwise desert landscape. However, those interested in transferring water outside of the region will likely oppose efforts to keep water in agriculture or other uses within the region.

8.6 Water Rights Protection

Most water rights in the Taos Region are used in the agricultural sector; however, other uses such as municipal, commercial, and industrial are growing throughout New Mexico, and municipal demand outside the Taos Region has created pressure on local water rights holders to transfer water rights out of the region. Protecting existing water rights and limiting out-of-region transfers are important to many stakeholders in the planning region, as expressed at numerous public and steering committee meetings during development of this regional water plan and in the goals and visions outlined in Section 2.2 and in the *Taos County Comprehensive Plan*.

This strategy presents several approaches for protecting water rights and keeping them in the region. The discussions in this section present some options that can be considered as the region moves forward with plan implementation, but do not necessarily represent an approach

that is agreed on amongst all water rights holders in the region. Since most of the water rights in the region are used in the agricultural sector, this strategy is closely related to the protection of agriculture strategy (Section 8.5).

8.6.1 Technical Feasibility

Potential methods for protecting water rights and limiting out-of-region transfers include using statutory and administrative criteria, developing area-of-origin protections, adopting conservation easements, and transferring development rights. These approaches are discussed in the following subsections. Specific protections for preserving water rights within individual acéquias are discussed in Sections 8.6.1.1 and 8.6.1.2.

As discussed in Section 4.1 and Appendix D, the State of New Mexico Water Code governs water right transfers taking place outside an acéquia or community ditch and allows transfers unless the transfer will impair existing water rights or is contrary to conservation or public welfare. These same criteria apply to out-of-state and out-of-region transfers. New Mexico water law provides individuals with the opportunity to protest water rights transactions.

Most water rights transfers take place within the same basin; however, water can be transferred from basin to basin, subject to interstate compacts and federal law (NMSA §§72-5-23, 72-12-7(A)). Transfers are based on the amount of water consumptively used; that is, the amount that can be transferred is limited to the prior consumptive use. Further, out-of-basin transfers cannot make the basin hydrologically worse off than it was (NMSA §§72-12-3, 72-12-7). As with all transfers, the State Engineer can deny an out-of-basin transfer if the transfer would be contrary to the public welfare of the State or to conservation of the State (NMSA §72-5-23, 72-12-7(A)).

8.6.1.1 Develop Public Welfare Criteria

In 1987, the New Mexico legislature amended a number of water statutes to give the State Engineer the authority to deny an application for a new water right or water right transfer if it is contrary to conservation of water or detrimental to the public welfare of the state. The public welfare consideration is intended to protect New Mexico water resources. This Regional Water

Plan recommends that the State Engineer give serious consideration to the Public Welfare criteria and positions of this Plan and of local and regional entities. To further that goal this Regional Water Plan includes a public welfare statement and identifies an implementation framework that will allow local governments to develop a process for informing themselves of water transfer issues in the region

The State of Colorado passed legislation in 2005 creating a process for developing interbasin compacts and permanent basin roundtables to address the issue of impacts from interbasin transfers (C.R.S.37-75-101). The purpose of the Colorado program is to develop agreements (compacts) between basins regarding water transfers and use (C.R.S.37-75-105). Although the legislation does not alter water transfer decision making authority or limit water rights (C.R.S.37-75-102), it creates a process whereby representatives from all the major water use sectors—especially agricultural (which owns the bulk of water rights) and municipal (which needs more water) as well as environmental, local government, and other water stakeholders (C.R.S.37-75-104)—can have input on water transfers. Basin roundtables will also make recommendations regarding the need for water within existing basins for projects that would put that water to use in the region (C.R.S.37-75-104(2)(C)).

Public input is also important in state and regional water planning in New Mexico as well as in certain aspects of the OSE AWRM regulations (Section 4.1.5). However, the degree to which that input will affect or change water policy could be limited, as the OSE and other water management agencies are not required to use the public input. In the OSE AWRM regulations (19.25.13 NMAC), the State Engineer refers to a process of incorporating local interests into the process of administering water rights by supporting the development of shortage sharing agreements and in developing basin-specific criteria. Policies or agreements developed in accordance with these regulations will generally apply when priority administration is necessary due to limited physical water supplies (as opposed to limited water rights).

8.6.1.2 Petition the State Engineer to Develop Administrative Criteria for the Region

Under the New Mexico statutes, the OSE has broad powers to regulate water resources (NMSA 72-2-8). Using these powers, the State Engineer has developed many administrative policies and guidelines to protect hydrologically connected stream systems, prevent excessive

drawdown, and protect critical areas in other parts of the state. In September 2000 the OSE developed the Middle Rio Grande Administrative Area Guidelines for Review of Water Rights Application to protect streamflows of the Rio Grande as well as declining portions of the aquifer in certain areas of the Rio Grande basin. These criteria close the administrative area to new appropriations and "limit groundwater diversions to the amount of valid surface water rights transferred or otherwise held by the permittee, plus the amount of water the permittee returns directly to the river." The guidelines cite public welfare as one rationale for developing the regulations: "The Public welfare of the state is promoted only if there is certainty that permittee will be able to obtain and transfer all necessary valid surface water rights to prevent adverse effects upon the flow of the Rio Grande" (MRGAA Guidelines, p. 3).

The entire Taos Region lies within the Rio Grande underground water basin, which the OSE administers considering the connection to Rio Grande and tributary surface water. The Taos Region could petition the OSE to develop a set of criteria for the upper middle Rio Grande portion of the Rio Grande groundwater basin. Such criteria could be used to limit transfers in specific areas or to prevent transfers that could impair existing water rights and resources.

Another approach would be to use the existing authority of county or other local governmental entities, such as water user associations, to develop ordinances designed to protect groundwater and prevent transfers that would be harmful to the health and welfare of citizens. Acéquias and irrigation and conservancy districts already have specific authority to review and prevent water rights transfers (NMSA 73-3-4.1, 73-13-4, 73-14-47). These types of ordinances could also encourage conservation activities or further define conservation so that the OSE would have more specific criteria to apply when evaluating water rights transfers under the statutory criteria (NMSA §72-5-23, 72-12-7(A)). Other states such as California and Texas are pursuing similar efforts (Hanak and Dyckman, 2003).

The longstanding policy of prohibiting transfers of water rights from above Otowi gage to locations below the gage is an example of how the State Engineer may protect water rights under existing authority. The policy evolved as part of New Mexico's implementation of the Rio Grande Compact (the legislature has petitioned the State Engineer to formalize the policy (House Joint Memorial 14), but that has not yet been done). Since the accounting mechanism

for the compact uses native Rio Grande inflow at the Otowi gage (adjusted for upstream reservoir operations) to determine New Mexico's delivery obligations at Elephant Butte, the State Engineer prohibits movement of consumptive water rights across the gage because such a transfer would affect Compact accounting. Although not the primary objective, this policy essentially protects water rights in the northern part of the state from moving downstream to larger municipalities such as Santa Fe or Albuquerque where diversions occur below the gage. The policy does not protect against diversions in Santa Fe County that occur above the gage.

8.6.1.3 Enact Area of Origin Protections

Out-of-region water transfers can have negative impacts on the local economy, local values, and way of life (CALFED, 2003). Legislation creating area-of-origin protections could be designed to place limitations on transfers that would have serious negative impacts or to create some regional benefits to offset impacts when water is transferred elsewhere. Many states have developed legislation and policies for protecting areas of origin impacted by water rights transfers. For example:

- California passed area of origin legislation as early as 1931 and now has a county of origin statue in place (California Water Code, Section 10505). Later, the legislature passed watershed of origin legislation to protect against similar negative impacts (California Water Code, Section 11460).

- The State of Georgia has been actively developing such legislation due to the fact that the water-rich area of the state is the most economically depressed while the water-poor areas have large cities and economic growth fueling demand for the water (Draper, 2004). In 2002, a study addressing interbasin transfers proposed a set of 22 criteria for consideration by state agencies prior to granting a permit for interbasin transfer (Georgia Water Coalition, 2005). Many of these provisions are applicable to interregional transfers and are relevant in the implementation of a water rights protection strategy.

The following subset from the Georgia proposed criteria would be most appropriate for inclusion in the development of area-of-origin legislation or in administrative criteria for the Taos Region; many of these are included in the public welfare criteria discussed in Section 2.3.1:

- Available water supply
- Protection of present uses
- Assurance that current and projected future water demands are met
- Surface water and groundwater interaction and the impact of a proposed transfer on either source of supply
- Economic feasibility
- Consultation with local governments affected by a proposed transfer

Compensation to third parties is another policy approach under consideration in western states. A recent study that evaluated mechanisms to offset impacts on third parties from water rights transfers concluded that taxing transfers and compensating third parties would be the most likely mechanism to ensure market stability and efficiency while protecting equity (Murphy, 2003).

The State of Colorado, which has water transfer issues similar to those in New Mexico, has also tried to legislate compensation for impacts from water transfers. In 2003, the Colorado General Assembly considered, but did not act upon, legislation to mandate compensation for transfer of agricultural water. The legislation stated "No claim for a water right diverting water decreed for agriculture from one water division to another may be recognized or a decree therefore granted unless the water judge includes in the decree such terms and conditions as are required to address the direct economic effects of the diversion on the basin of origin" (HB03-1113). Economic effects were defined as the difference in value of the land where the agricultural water was used versus the value of the land after the transfer of the water rights off the land (HB03-1113).

Compensation measures may address economic losses to third parties; however, these do not address negative impacts in social and cultural changes resulting from water transfers.

To implement area-of-origin restrictions in New Mexico, new legislation adopting these or similar permit review criteria might be necessary, unless the OSE chooses to develop the criteria under existing authority, which it arguably has under the umbrella of public welfare.

8.6.1.4 Encourage Conservation Easements

As discussed in Section 8.5.1.3, land use easements are permanent restrictions on use or development and are thus a mechanism to keep land in agricultural use. As most of the water used in the Taos Region is for irrigated agriculture, protecting the agricultural sector is one means of keeping water within the region.

Whether a conservation easement can be granted that restricts the transfer of water rights between sectors is unclear. The Land Use Easement Act specifies that "no application or permit for a change in point of diversion, place, or purpose of use of a water right at any time shall be impaired, invalidated or in any way adversely affected by reason of any provision of that act" (NMSA 47-12-6(C)). This provision seems to allow a property owner with a valid land use easement to nevertheless transfer their water rights; attempting to block a water rights transfer by claiming that the transfer will violate an existing conservation easement appears to be contrary to this provision. No New Mexico case law addresses this provision of the Land Use Easement Act.

8.6.1.5 Transfer Development Rights

In 2003 New Mexico enacted legislation to specifically allow transfer of development rights from one parcel of land to another, generally implemented through local zoning ordinances. Development rights can be transferred from agricultural land to other non-agricultural land, preventing any future conversion of agricultural land to residential or commercial developments. The agricultural land owner derives financial gain from selling the development potential of agricultural land, without removing the land from agricultural production. NMSA §5-8-43 provides counties and municipalities with guidelines to regulate the transfer of development rights in accordance with comprehensive land planning and to encourage the conservation of ecological, agricultural, and historical land.

Several municipalities and counties in New Mexico have implemented programs to support development right transfers. Santa Fe County has developed ordinances and a program to protect the La Cienega area (Fleming et al., 2001). The Village of Los Ranchos de Albuquerque has taken similar actions to preserve farmland and promote innovative development along the Village's main street (Lucero, 2003).

8.6.2 Hydrologic Impacts

Keeping water within the region can have several hydrologic benefits. Continuing to use surface water for irrigation can help retain flows and seepage, contributing to local surface flows. Seepage from ditch systems helps maintain shallow groundwater levels, and if it is reduced because of decreased diversion to the ditch system, the domestic wells drawing from this part of the aquifer may be impacted. In addition, maintaining water rights within the region will help to ensure that water uses support the local economy.

In complex hydrologic systems, the movement of one water right generally has a more significant impact in the move-to location (the location where the water right is transferred to), where pumping from a proposed new well or surface diversion is likely to affect existing well owners in that area or a proposed new diversion may affect other surface water users. However, the following impacts can occur at the move-from location:

- If a surface water right, particularly on smaller systems, is transferred from the downstream end to a reach further upstream, the intervening reach (between the old and new points of diversion) will have less water.

- In a ditch system, where participation in ditch maintenance is essential for all users, fallow land can present a problem because owners of this land will no longer participate in ditch maintenance.

- When landowners fallow their land, less water is diverted through the ditch system. This may reduce the hydraulic head to the point where not enough water will reach destinations at the tail end of the ditch.

- Seepage from ditch systems helps maintain shallow groundwater levels. If seepage is reduced because of decreased diversion to the ditch system, the domestic wells drawing from this part of the aquifer may be impacted.

Retaining water rights within the region can minimize these negative impacts.

8.6.3 Financial Feasibility

Costs for evaluating the impacts of out-of-region or subregion transfers would be for legal and technical expertise. These costs would be borne by the entities who protest the application and would vary on a case by case basis.

Although the region could encourage the OSE to develop administrative criteria for regional groundwater basins in the Taos Region, actually developing the criteria would be the responsibility of the OSE. To develop such criteria, the OSE would likely need to further refine existing models to identify specific locations (or cells within the model) where transfers would be limited, and the OSE would bear the cost for these activities, requiring an increase in the OSE's budget. Costs to the region in encouraging the development of such criteria would be negligible.

Several federal programs, many of which are managed by the NRCS, indirectly support the preservation of agricultural land and retention of water rights by providing funding to farmers for a variety of projects, ranging from granting conservation easements to improving and protecting wetlands and wildlife habitat on private land. In many cases, however, demand for these programs outweighs the supply of funds available. These programs generally involve a cost-sharing component, and so farmers must also have private financing in order to take advantage of the federal funding.

Though there are costs associated with protecting water rights in the region, there are also unquantified economic benefits inherent in ensuring viable water supplies for future growth in the region.

8.6.4 Environmental Impacts

Retaining land and water rights in agricultural use will ensure continued availability of habitat for local and migrating wildlife, and in cases where surface water is used for irrigation, groundwater seepage from irrigation canals will continue to recharge the shallow aquifer and help sustain

local riparian habitat. Thus retaining water rights within the Taos Region can provide environmental benefits for the region.

8.6.5 Political Feasibility and Social/Cultural Impacts

The water rights protection strategy was repeatedly identified as a high priority at public and steering committee meetings in the Taos Region. Many residents are interested in maintaining local control over water and do not favor out-of-region transfers. Nevertheless, the Draft Abeyta Settlement Agreement in the adjudication lawsuit in the Taos Valley area calls for water rights transfers, and Taos Pueblo has the right to market the water rights it acquires through the settlement agreement. Thus, the region should continue to work to protect local values while recognizing the rights and views of all water rights holders.

8.7 Planning for Growth

In many areas of the Taos Region, groundwater supplies, which are the primary source of water for municipal, domestic, and commercial uses, are sufficient to support development. Although long-term drought may severely affect surface water supplies and shallow wells, the deep groundwater resources in the Rio Grande rift sediments can potentially sustain pumping for municipal and industrial purposes for the foreseeable future. The Abeyta DSA provides for augmentation wells that if funded will provide a drought relief buffer to acéquias in the Taos Valley. However, access to and use of those supplies for development, which is consistent with the goals of the regional water plan and the Taos County comprehensive plan (Planners Ink/Community ByDesign, 2004), may be limited due to legal constraints. At the same time, loopholes in subdivision law and state water policy foster a type of growth that may be inconsistent with the larger goals of the region and that may potentially impact existing surface water or groundwater uses. Monitoring existing development and planning for growth are essential to ensure that future growth occurs in a manner consistent with regional goals, is supported by adequate water supplies, and does not result in negative impacts to the existing community. Accordingly, Taos County is currently developing a growth management plan to address future growth and development. The Town of Taos also continues to work on growth management planning.

The State of New Mexico Subdivision Act recognizes the need to provide adequate water supplies for new development (NMSA 47-6-11(F)). The responsibility for implementing the statute, by developing ordinances that require proof of available water supply and/or address related issues such as conservation in new development, lies with the counties and municipalities within which the new development occurs. This approach often results in varying degrees of water supply protection related to new development due to the lack of a technical definition of a long-term water supply and insufficient staff, resources, and data to evaluate cumulative impacts of development and to determine if adequate, long-term supplies exist and if use of those supplies will not harm existing users. The purpose of this strategy is to evaluate the potential for improving water resource management by requiring that adequate water supplies are available before development can proceed and ensuring that growth proceeds in a manner that supports wise use of water resources.

8.7.1 Technical Feasibility

Issues related to growth planning in relation to water supply availability are summarized in the following subsections.

8.7.1.1 Regional Growth Management and Land Use Goals

During the regional water planning process, the New Mexico Department of Game and Fish expressed concerns about the effects of urban fragmentation impacts on wildlife habitat in the region and indicated that linking water supply to land use planning is one method to address urban growth issues. The Taos County comprehensive plan (Planners Ink/Community ByDesign, 2004) sets out a detailed list of goals, objectives, and strategies that relate to land and water. The County's goals are stated in general language, while the objectives and implementing strategies to meet the goals are outlined with much detail. For example, the plan includes 29 specific implementation strategies associated with Goal 1. The goals that relate specifically to water are:

- Goal 1: Secure, protect, and maintain safe and sustainable water quality and quantity through effective and coordinated watershed and aquifer management.

- Goal 2: Restore and protect our rivers, arroyos, and streams.

- Goal 3: Enhance wildlife opportunities and protect riparian areas and wildlife habitat and migration corridors.

- Goal 4: Preserve our irrigated lands and acéquias from being diminished in quantity and quality.

- Goal 5: Support, maintain, and preserve the County's rural, cultural, and agricultural land uses and natural environment.

- Goal 11: Direct development away from irrigated agricultural lands.

- Goal 13: Encourage cooperation and partnerships with all local water and sanitation districts, mutual domestics, neighborhood associations, municipalities, state, federal and tribal jurisdictions in determining future land and water uses.

Many of these goals and strategies address negative impacts that can occur from unmanaged growth. For example, "New water demands will be balanced against senior water rights, while water conservation measures and sustainable new water sources will be pursued to minimize conflicts between water uses and avoid overburdening any water resource" (Planners Ink/Community ByDesign, 2004) Several strategies are recommended to implement that objective; examples include (Planners Ink/Community ByDesign, 2004):

- Strategy 19: Monitor and consider limiting the amount of water available to new domestic well users by supporting domestic well legislation that also encourages the expansion and/or creation of community wells or Domestic Water Associations.

- Strategy 20: Consider imposing restrictions on new domestic well use as a condition of approval of any development through amendments to the Subdivision Regulations and Land Use Ordinance, such as shared wells, limiting amount of water and metering to each service connection.

Taos County is implementing the land and water element of the comprehensive plan by developing the *Taos County Growth Management Plan, Phase I: Future Land Use* (Community ByDesign, 2006), which sets out nine different levels of land use and settlement pattern intensities in order to protect sensitive areas and encourage growth in other areas. For example, the Resource Conservation Area designation indicates "areas mapped as high sensitivity such as riparian areas, major arroyos, floodplains/wetlands, and high slopes." Development is not encouraged in these areas. Likewise, Development Reserve areas are those ". . . considered to remain as undeveloped for future growth due to distance from services and infrastructure." Designations for areas where growth is encouraged include rural residential, agricultural sustainable community, traditional village, commercial/employment, and highway corridor (Community ByDesign, 2006).

Implementation of this growth management plan would likely achieve many of the goals of the comprehensive plan and result in better protection of water supplies; however, the growth management plan has not yet addressed an evaluation of water rights availability and impacts in the areas where development is encouraged. One area with development potential (based on the availability of private land, minimal conflicts with acéquias, and relatively flat slopes) is the Taos Plateau area west of the Rio Grande. The possibility of transferring water rights to that area needs to be evaluated.

8.7.1.2 Current Framework for Linking Water Supply Availability to Growth

In light of the regional objectives for protecting land and water and for encouraging future growth planning, it is important to understand the framework under which growth currently occurs. Section 8.7.1.2.1 addresses water right limitations on physically available water supply, and Sections 8.7.1.2.2 through 8.7.1.2.4 discuss current county and municipal subdivision regulations.

8.7.1.2.1 Water Supply Limitations. Groundwater supplies are abundant in certain areas of Taos County, but development of these supplies is dependent on availability of surface water rights where the groundwater in the area is stream connected, because the Rio Grande is already fully appropriated (Section 4).

New Mexico adheres to the prior appropriation doctrine whereby the water user with the most senior water right has priority over a water user whose use came later in time (Section 4.1, Appendix D). Therefore, the law protects those senior users above all others. New growth clearly falls into the category of junior water users.

In New Mexico the State Engineer recognizes the hydrologic connection between surface water and groundwater and manages diversions accordingly. Therefore, even if a groundwater supply is abundant, appropriation and use of this supply will be limited based on whether it impacts senior users who rely on surface water. In Taos County, surface water supplies, which are fully allocated, were generally developed first and have the most senior water rights (except where senior rights have been transferred). This means that any new groundwater appropriation that will draw water from the surface stream systems may potentially impact senior water users and may not be available for appropriation.

The connection between groundwater and surface water is evaluated by OSE on a case-by-case basis when a water rights application is submitted. If there are impacts to surface water rights, the groundwater appropriator may be required to retire sufficient irrigated land to offset the surface water depletion caused by the proposed groundwater pumping. In areas where groundwater appropriations are very remote from surface water, it may be possible to prove through hydrologic models that the groundwater withdrawals will not deplete fully appropriated stream systems.

The Rio Grande and its tributaries are governed by an interstate compact, the Rio Grande Compact (NMSA §72-15-23). This Compact requires the State Engineer to manage the river to meet the Compact's requirements, which are based on an accounting procedure that assumes that depletions in the upper reaches of the Rio Grande have not increased since 1939. Accordingly, the State Engineer manages the Rio Grande Groundwater Basin in a manner to ensure that no new depletions occur, which means that groundwater withdrawals that could affect the river must be offset by retiring an existing (pre-1939) surface water right. For these reasons, groundwater is not readily available to support future growth. However, a major loophole in the Subdivision Act and in state water policy allows for development using domestic

wells without regard to water rights, OSE policies, or interstate compact considerations. The domestic well issue is further discussed in Sections 8.7.1.2.2 and 8.7.1.2.3.

8.7.1.2.2 County Subdivision Regulation. The New Mexico Subdivision Act mandates that counties pass ordinances requiring developers to demonstrate that a proposed subdivision will have water supplies of sufficient quantity and quality to meet demand (NMSA 47-6-11(F)). (NMED generally reviews issues relating to wastewater disposal for new subdivisions.) Counties have the option of requiring that the developer of a subdivision containing 20 or more parcels, any one of which is 2 acres or less in size, obtain a permit from the State Engineer demonstrating that they have sufficient water rights to supply the proposed subdivision (NMSA 47-6-11.2(B)).

The Subdivision Act includes numerous exemptions. For example, the Act excludes 13 types of land divisions from the definition of a subdivision (NMSA 47-6-2). No proof of water availability is required for development on lands that fall under these exemptions. Two examples of exemptions include bequests of land to family members and parcels donated to not-for-profit corporations including schools, universities, and religious organizations. Two other aspects of the Subdivision Act hamper comprehensive planning for water availability: (1) numerous loopholes allow developers to avoid compliance with county subdivision regulations, and (2) domestic wells are exempt from the regulations.

The existence of county regulations does not necessarily mean that subdivisions will be required to comply with the water availability requirements. Cases have occurred in which the OSE has issued a negative opinion about the water supply availability for a proposed subdivision, yet the county commission has nevertheless approved the subdivision (Drennan, 1997). Additionally, developers can take advantage of lax municipal water supply requirements. In cases where the county commission has denied a permit, developers have convinced nearby municipalities to annex the subdivision in order to allow it to move forward (Benjamin et al., 2006).

Domestic wells are exempt from the Subdivision Act, and neither the immediate or cumulative impacts of these wells are considered in determining available water supply. Even when

agricultural water rights are transferred to another location, the land may be developed for housing using domestic wells. This practice allows for increased withdrawals that could impair other water users with no opportunity for protest or evaluation of impairment. New domestic well regulations (Section 4.1.4) may affect future subdivision development using domestic wells in critical management areas.

Given these various opportunities for avoiding proof of water availability requirements, efforts to protect water supplies for future use will require the cooperation of informed county commissions, municipalities, and other planning agencies.

8.7.1.2.3 Taos County Subdivision Regulations. In accordance with the State Subdivision Act, Taos County subdivision regulations govern water supply requirements for new developments. The 2005 ordinance requires that a property owner seeking to subdivide land and obtain a preliminary plat demonstrate the availability of an adequate water supply to meet the needs of the subdivision for at least 50 years (County of Taos, New Mexico, 2005, Section 1(A)(1)). This requirement applies to any type of water system that will supply the subdivision, including domestic wells, new and existing community water systems, and an existing utility (County of Taos, New Mexico, 2005, Section (2)(1-4)). In some cases involving a community water system or water utility, a subdivider is required to have water rights permits in place (County of Taos, New Mexico, 2005, Section (2)(4)(b)).

The Subdivision Act and the Taos County subdivision regulations clearly contemplate that larger subdivisions will develop community infrastructure that includes water systems, which would require the purchase and transfer of water rights to the system. The County regulations state that all Type 1 (500 or more lots where the smallest parcel is less than 10 acres) and Type II (25 to 99 parcels where smallest parcel is 20 acres or less) subdivisions have community water systems, which would require a valid water right (County of Taos, New Mexico, 2005, Section 2, Article 16). Yet, many times developers avoid these requirements and instead rely on domestic wells by classifying their subdivisions as Type III (fewer than 24 lots where the smallest parcel is 10 acres or less), which do not require community systems.

This issue was highlighted in the draft Taos County growth management plan (Section 8.7.1.1), which found that while the existing regulations require community infrastructure such as community wells, wastewater and paved streets for Type II (25 lots or more) subdivisions, "To date, there has not been one Type II Subdivision submitted, yet there have been over twenty Type III (less than 24 lots) subdivisions submitted in the same area and sometimes by the same landowner. The management of these Type III subdivisions has been through legal recourse in trying to demonstrate them as 'Common promotional schemes'; this is not an effective growth management strategy" (Community ByDesign, 2006, p. 16).

Rio Arriba County has similar subdivision requirements, except that the subdividers need to show only a 40-year water supply. Additionally, the County has an ordinance to protect agricultural land.

Other examples of how development using domestic wells can negatively impact existing water users in the Taos Region are illustrated by recent OSE subdivision review memorandums:

- In 2003, the OSE reviewed the water availability studies submitted for the Riverbend subdivision north of Ranchos de Taos and concluded that it complied with the County's subdivision regulations and issued a positive opinion. The OSE staff noted that ". . . nearly all the water pumped from the Riverbend subdivision wells will ultimately come from the Rio Pueblo, which is located adjacent to the proposed subdivision. Thus, the approval of this subdivision may diminish the surface water supply available to downstream users on the Rio Pueblo. There are no requirements in the OSE regulations or in the Taos County Subdivision Regulations that applicants for domestic well permits issued under Section 72-12-1 NMSA obtain water rights to offset effects on streams" (NM OSE, 2003).

- Similarly, the State Engineer found that a Rio Arriba County subdivision using domestic wells would eventually draw all of its water from the Rio Chama, a fully appropriated stream. The OSE did not give a favorable opinion for the subdivision, but this was based on the fact that the subdivision didn't comply with certain provisions of the

County subdivision regulations, not because of the impacts on the Rio Chama (NM OSE, 2004).

Without the domestic well exemption, the developers promoting this type of subdivision would be required to purchase sufficient water rights to meet the subdivision needs and additionally purchase offset rights to ensure that the groundwater pumping does not deplete the surface water supply relied on by senior water rights holders.

To protect existing water rights holders and account for actual impacts on the water supply, the County could amend the subdivision regulations to require the purchase and transfer of valid water rights for subdivisions relying on domestic wells that will directly impact surface water. Another approach would be to require water rights for all subdivisions; this approach has been adopted by the City of Santa Fe (City Code of the City of Santa Fe, New Mexico 14-8.13) and the Town of Taos (Section 8.7.1.2.4).

Despite recently updated subdivision regulations and an active effort to encourage growth that is consistent with other regional goals, without the enactment of more stringent requirements, subdivisions that rely on domestic wells will continue to be approved and impact surface water supplies in a manner that can negatively affect existing users.

8.7.1.2.4 Municipal Water Suppliers. The Subdivision Act does not apply to municipalities; however, the Municipal Code contains provisions and grants authority to cities to adopt city ordinances governing land platting, planning, and zoning (NMSA 3-19-1 through 12; 3-20-1 through 3-20-16). Specifically, municipal subdivision regulations may govern the extent and manner in which water will be provided to the subdivision as a requirement of subdivision approval.

Incorporated municipalities present in the Taos Region include the Town of Red River, the Village of Questa, the Town of Taos, and the Village of Taos Ski Valley. The numerous other communities located throughout the region are not incorporated and thus must rely on County regulations and growth management planning. The Taos Pueblo and Picuris Pueblo are independent sovereign nations and thus will address growth issues as they choose.

New subdivisions within municipalities are typically served by a municipal system, and a municipality could include consideration of system capacity in its land use regulations. For example, a municipality could require, for any proposed development project, a written statement of water and sewer availability as a prerequisite for building permits, site plan, or subdivision approval. A jurisdiction that ties approvals to system capacity should have a sound technical basis for evaluating development and implementing such regulations.

In areas where an existing water system will supply new subdivisions, infrastructure development requirements can be established to tie development approvals to existing or planned system capacity. Local governments could better link capital improvements to the timing of new development by identifying growth areas in advance and providing new publicly funded infrastructure to serve these areas in a timely manner. Alternately, some local governments have established concurrency ordinances, which require that new development is restricted to areas where infrastructure capacity exists or will be available within a specified period of time. This approach may not alter the type or cost of improvements, but would affect the timing of construction.

The Town of Taos has adopted unique water requirements for new development. Applicants for new or increased municipal water services are required to transfer consumptive water rights to the Town in amounts that will meet the new water demand for the new service connection, including anticipated losses (Town of Taos Municipal Code 13.04.040 A) The transfer must be complete before the Town approves the new service connection or increased water use (Town of Taos Municipal Code 13.04.040 B), and applicants bear the purchase and transaction costs associated with the transfer (Town of Taos Municipal Code 13.04.040 D). The Town of Taos will not issue building permits until all water right requirements are completed (Town of Taos Municipal Code 13.04.060.1). The Town also prohibits construction of domestic wells within town limits if the property line is located within 300 feet of a water line in service (Town of Taos Municipal Code 13.04.160).

8.7.1.3 Local Growth Management Initiatives and Approaches

Several public and private initiatives are underway in Taos County to promote growth management and protect unique areas of the County from development, including the following:

- As discussed in Section 8.7.1.1, the County is implementing its comprehensive plan and developing a growth management plan. This growth management plan will also facilitate transfer of development right programs that promote cluster development.

- The Taos Land Trust, a local non-profit organization, is helping to protect sensitive land by purchasing conservation easements or placing land in the trust so that development is either prohibited entirely or must follow certain specific guidelines.

Protection of water rights and agricultural land is further discussed in Sections 8.5 and 8.6.

8.7.1.4 Water Conservation During Development

In addition to assuring that sufficient water supply is available, an important component of new development is the implementation of conservation measures. Both municipal and county subdivision regulations and policies relating to industrial or commercial development should ideally incorporate conservation requirements. Asking existing residents to conserve water can be difficult if they see new development being constructed without conservation measures. Additionally, it is easiest to install low water use appliances, xeriscaping, rain water harvesting, gray water reuse, and other conservation features during construction rather than retrofitting them later. Recommendations for implementing conservation measures include:

- Installing graywater systems
- Harvesting rainwater
- Requiring low-water-use appliances in all new subdivisions and commercial developments.
- Requiring xeriscaping

Multiple studies have estimated the volume of water that can be conserved through the implementation of conservation measures. Methods of reducing outdoor demand include:

- Rainwater harvesting is an effective way to reduce outdoor demand that would otherwise be met through a potable drinking water system or well. For example, a 1,000-square-foot roof can collect 150 gallons of rainwater during a ¼-inch rain (Vickers, 2001).

- Installing graywater systems will also reduce the demand for potable water to be used outdoors. The amount of graywater available for re-use depends upon how much water is used indoors, and this volume decreases as household fixtures and appliances become more efficient (Vickers, 2001).

- Total outdoor demand could be reduced through xeriscaping, by replacing existing high-water-use plants with plants that use less water. Xeriscaping has been shown to reduce outdoor water use by 50 percent or more (OSE, 2001). Rebate programs have proved to be an effective way of encouraging changes in landscaping in multiple New Mexico communities, and requiring low-water use plants as a fraction of new development landscaping would be an effective method to keep outdoor water demand low.

The effectiveness of indoor conservation techniques was estimated on a regional level in a Texas Water Development Board (TWDB) research study (TWDB, 2003). Savings cited by the TWDB come from several studies and include savings of:

- 10.5 gpcd per single family toilet replaced (Mayer et al., 1999)
- 5.5 gpcd for each low-flow showerhead and faucet aerator kit installed (A&N, 2000)
- 5.6 gpcd for each high-efficiency clothes washer installed (DeOreo et al., 2001).

In a study that followed the American Water Works Association (AWWA) Research Foundation's *Residential End Uses of Water* study (Mayer et al., 1999), Seattle Public Utilities used a group of single-family residential homes that were included in the AWWA study to assess the effects of high-efficiency plumbing fixtures and appliances. The project included retrofitting multiple plumbing fixtures and appliances in the participating homes, as relatively few of the homes included in the AWWA study were equipped with water-conserving fixtures and appliances. As a result of these retrofits, indoor water use was reduced from 63.4 gpcd to 39.8 gpcd in the participating homes (DeOreo et al., 2001). More than 20 gallons of the average 23.6 gpcd saved through the retrofit resulted from toilets (10.9 gpcd), clothes washers (5.6 gpcd), and leaks (4.3 gpcd); showers did not show any significant water-use reductions in this study. Toilet leaks (primarily flapper leaks) were found to be the largest contributor to

household leakage. Dual flush toilets were found to reduce the amount of water used by 24 percent more than traditional 1.6-gallon-per-flush toilet replacements (DeOreo et al., 2001).

8.7.2 Hydrological Impacts

No new water would be made available to the region as a result of this strategy, but senior water rights would be better protected. Instituting more protections regarding water supply will protect the region from development that will eventually face water shortages. If new growth that does occur relies on an assured water supply, there will be less conflict with existing users, and if water conservation measures are instituted at the time of development, future demands may be reduced.

If this strategy is not implemented and growth occurs without adequate water supplies, there may be diminished surface water supplies, especially during drought periods.

8.7.3 Financial Feasibility

If wide-scale development is allowed to occur without ensuring that adequate water supplies are available, costly projects will be required to locate alternative water supplies that would potentially need to be imported from great distances. Costs for ensuring water supply availability for new development are low in comparison to the costs of addressing significant water problems later.

The cost of developing new legislation at the state level or regulations at the county level to further refine the technical aspects of proof of water availability vary depending on how much can be accomplished by in-house staff. In general, a county could develop new, more explicit regulations for approximately $20,000 to $100,000.

Should the counties modify their regulations to require the purchase and transfer of valid water rights for all subdivisions, the developers would bear the costs. Water rights in the Taos Region can cost between approximately $4,000 and $8,000 or more an acre-foot, with prices increasing annually. Additional transaction costs would result from protests of the water transfers and the

associated technical and legal fees, which could be as high as $100,000 if a hydrologic model needed to be developed in support of the application.

The greatest expense of requiring a more rigorous proof of adequate water supplies is likely to be the technical evaluations required for a thorough analysis of cumulative impacts of water supply development. Neither Taos nor Rio Arriba Counties has the resources and staff needed to evaluate the adequacies of water supplies. Hiring new staff is a viable option if the amount of work justifies the position; the cost would depend on the expertise and experience of the staff but might be in the range of $75,000 to $100,000 per year. The cost of contracting with a consultant would vary depending on whether existing groundwater models are available. If existing models can be used, evaluations could be in the $20,000 to $30,000 range, though there would be efficiencies if several developments in one area could be considered at the same time.

8.7.4 Environmental Impacts

Ensuring that development proceeds only when adequate water supplies have been secured should protect against potential undesirable impacts to the environment that may result from excessive groundwater withdrawals, especially during drought conditions. Additionally, consideration of measures such as water conservation with new development will contribute to environmental protection by preserving the region's limited water resources.

8.7.5 Political Feasibility and Social/Cultural Impacts

Concerns regarding growth issues have been expressed at many of the Taos regional water planning steering committee and public meetings. Potential diminishment of the water supply due both to exports out of the region and outsiders moving into the region was a common concern expressed at meetings. Those with an interest in protecting the rural agricultural nature of the area, in particular, the acéquias (Section 8.5), are concerned that unplanned growth will cause adverse impacts to the rural agricultural environment.

Many of the proposed approaches in this strategy are likely to have general support because they implement goals and objectives expressed in multiple regional planning documents. However, passing an ordinance requiring all new developments to purchase and retire valid water rights would likely cause significant public debate and strong opposition from certain sectors, particularly developers. Acéquias may see such a change in policy as a means for creating an even more aggressive market for senior water rights and thus increase pressure on water rights holders to sell, which would have a negative impact on initiatives to preserve and maintain the agricultural characteristics of the community.

Ensuring sufficient water supplies for new development while taking into account existing demand would benefit all residents in the region by protecting their water supplies. Conversely, there have also been concerns expressed at several meetings indicating interest in future growth and development, and contending that the mechanisms to prevent growth would not be desirable. There seemed to be more widespread political support for mechanisms that would require that any new development be water efficient and addresses water quality issues such as septic tanks and stormwater.

8.8 Watershed Management

Watershed management involves 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 and biological function of the area. One of the most important management practices for the Taos Region includes the reduction of fuel loads, which can help to minimize the potential for catastrophic forest fires. Restoration of riparian areas is another important component of watershed management and often involves stabilization of river banks. A healthy watershed will provide optimal benefits for water quality and quantity and all aspects of ecosystem health.

Because management of an entire watershed is a large undertaking involving multiple parties, this strategy focuses on two aspects: (1) reducing the risk of catastrophic fire and (2) implementing plans from watershed groups that address local riparian and water quality issues and recommend local restoration activities.

Many of New Mexico's forests are in an unhealthy state as evidenced by overly dense vegetation, lowered biodiversity, and fragmentation and reduction in wildlife habitat. As a result, New Mexico faces greater susceptibility to catastrophic wildfire and drought, compromised watersheds, decreased water supply, and accelerated erosion and sedimentation (New Mexico Forest and Watershed Health Planning Committee, 2004). In the past century, vegetation density at higher elevations has generally increased due to a combination of two factors: timber harvests followed by grazing and fire suppression that resulted in thick stands of small-diameter trees. The high density of small-diameter trees has had two negative effects:

- Decreases in water yields.
- A severe risk of catastrophic fire. Major fires that have occurred in the Taos Region include:
  - In May 1996, the Hondo Fire burned 8,000 acres (Steelman and Kunkel, 2003) in 10 hours and displaced 2000 residents (Stone, 1996).
  - The Encebado Fire in July 2003 burned 5,400 acres on Taos Pueblo (Taos County Historical Society, 2007).
  - In 2002, the Montoya Fire and the Ponil Fire consumed burned 2,850 acres and 92,500 acres, respectively (Carson National Forest, 2003).

In response to these fires and other severe fires in New Mexico, Congress developed the Collaborative Forest Restoration Program (CFRP) through the U.S. Forest Service to provide guidance and funding for projects to reduce fuel loads. Four CFRP projects are located in the Taos Region (Table 8-5).

The impact of a severe fire on the watershed is initially very high loads of sediment and ash, much higher peak runoff, and reduced sustained flows from a precipitation event. The high peak flows (sometimes three orders of magnitude higher than ever recorded) can cause damaging erosion and destruction of irrigation and water supply diversions (Robichaud et al., 2000; Moody and Martin, 2001, as cited by MacDonald et al., 2002; McCord and Winchester, 2001; Burke, 2004).

Table 8-5. Collaborative Forest Restoration Program Projects in the Taos Water Planning Region
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Project Title	Organization	Funding Amount ($)	Description
Fiscal year 2001			
Eight Northern Indian Pueblo Council, Inc. Forest Restoration Program	Eight Northern Indian Pueblo Council	118,800	Forest restoration and thinning activities on the Carson and Santa Fe National Forests and Pueblo land.
Forest Restoration and Economic Sustainability	Rocky Mountain Youth Corps	333,367	Train local youths ages 18-24 in natural resource management, prescription, and thinning techniques. Crews will conduct forest restoration treatments to thin small-diameter trees on the Carson National Forest and will plant trees in deforested areas.
Fiscal year 2002			
Forest Restoration Stewardship within a Diverse and Vigorous Ecosystem	La Lama Neighborhood Assoc.	270,992	Conduct restoration treatments and monitoring of wildland-urban interface acres within a half-mile radius of the community. Use harvested wood to make value-added products. Replant burned areas of the Hondo Fire with species that enhance wildlife habitat. Educate local residents about methods to decrease the fire danger around their community
Taos Canyon Forest Restoration Project	Taos Business Alliance for Economic Development	330,925	Reduce hazardous fuels on Carson National Forest land bordering private property in Taos Canyon through contract thinning, removal of small diameter trees, and elimination of ground and ladder fuels.
Fiscal year 2003			
Forest Thinning For Fire Prevention and Education For Youth	Village of Questa	273,000	Conduct forest restoration treatments on 150 acres in Carson National Forest adjacent to the Village of Questa. Slash mulch and make small-diameter trees available to local residents. Conduct a Forest Ecology Camp for area youth.

Table 8-5. Collaborative Forest Restoration Program Projects in the Taos Water Planning Region
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Project Title	Organization	Funding Amount ($)	Description
Fiscal year 2004			
Forest Restoration Project for Taos Canyon North- Shady Brook	Taos Canyon Neighborhood Association, Inc.	350,208	Remove small-diameter trees, reduce fuel loads and other flammable materials on 200 acres of Forest Service land that abuts private land north of Shady Brook and around campgrounds on the west end of Taos.
Healthy Forest-Happy Potters Pot Creek WUI Reduction Project	Healthy Forests, Happy Potters, Inc.	175,000	Attempt to reduce the threat of large, high-intensity wildfires by removing excessive piñon-juniper biomass to form a defensible space along the Pot Creek area. Demonstrate that traditional pottery firing (TPF) techniques complement forest restoration, as TPF methods are an excellent use of small-diameter wood.
Fiscal year 2005			
Forest Watershed Restoration and Preventative Fuels Treatments on Taos Tribal Lands	Pueblo of Taos	360,000	Continued restoration of areas burned in the Encebado Watershed by introducing native vegetation and natural structures for slope stabilization. Assess and plan restoration fuel reduction projects in the Rio Pueblo and Rio Lucero Watersheds. Implement low-impact fuels reduction/habitat restoration in the priority areas of the watersheds, and use removed small-diameter material to begin a renewable energy program. Develop and implement a multi-party monitoring project, and educate the community on fuels management activities and the important role of natural fire.

Table 8-5. Collaborative Forest Restoration Program Projects in the Taos Water Planning Region
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Project Title	Organization	Funding Amount ($)	Description
Fiscal year 2006			
Largo Canyon Fuels Reduction and Forest Restoration	Rocky Mountain Youth Corps	360,000	Conduct forest restoration treatments on 150 acres of Largo Canyon in the Carson National Forest. Further youth development needs through participation in the RMYC member development program, pursuing GEDs, and learning chainsaw use, workplace safety, life skills, natural resource management, and forest restoration and prescription techniques. Use small-diameter wood products in the Questa community woodlot and in B&E BioFuels' gasification plant.
Fiscal year 2007			
Santa Cruz and Embudo Creek Watershed Multi-jurisdictional Restoration and Protection	Forest Guild	336,302	Implement forest and watershed restoration and community protection treatments on roughly 575 acres of ponderosa pine and piñon-juniper dominated forest in the Santa Cruz River and Embudo Creek watersheds, creating/maintaining seasonal work for an estimated workforce of 8. Generate fuel wood, vigas and latillas for use by local residents and provide treatment residue for use in watershed restoration activities. Partner with the Chimayo Youth Conservation Corps and Northern New Mexico College to provide outreach and education opportunities to area youth.

Source: http://www.fs.fed.us/r3/spf/cfrp/pdf/2001-2004projectsummaries.pdf

Without efforts to reduce forest density, a continued high risk or a gradually increasing risk of high-severity wildfires can be expected in the planning region. Taos County has recently developed a fire management plan that addresses forest fire prevention.

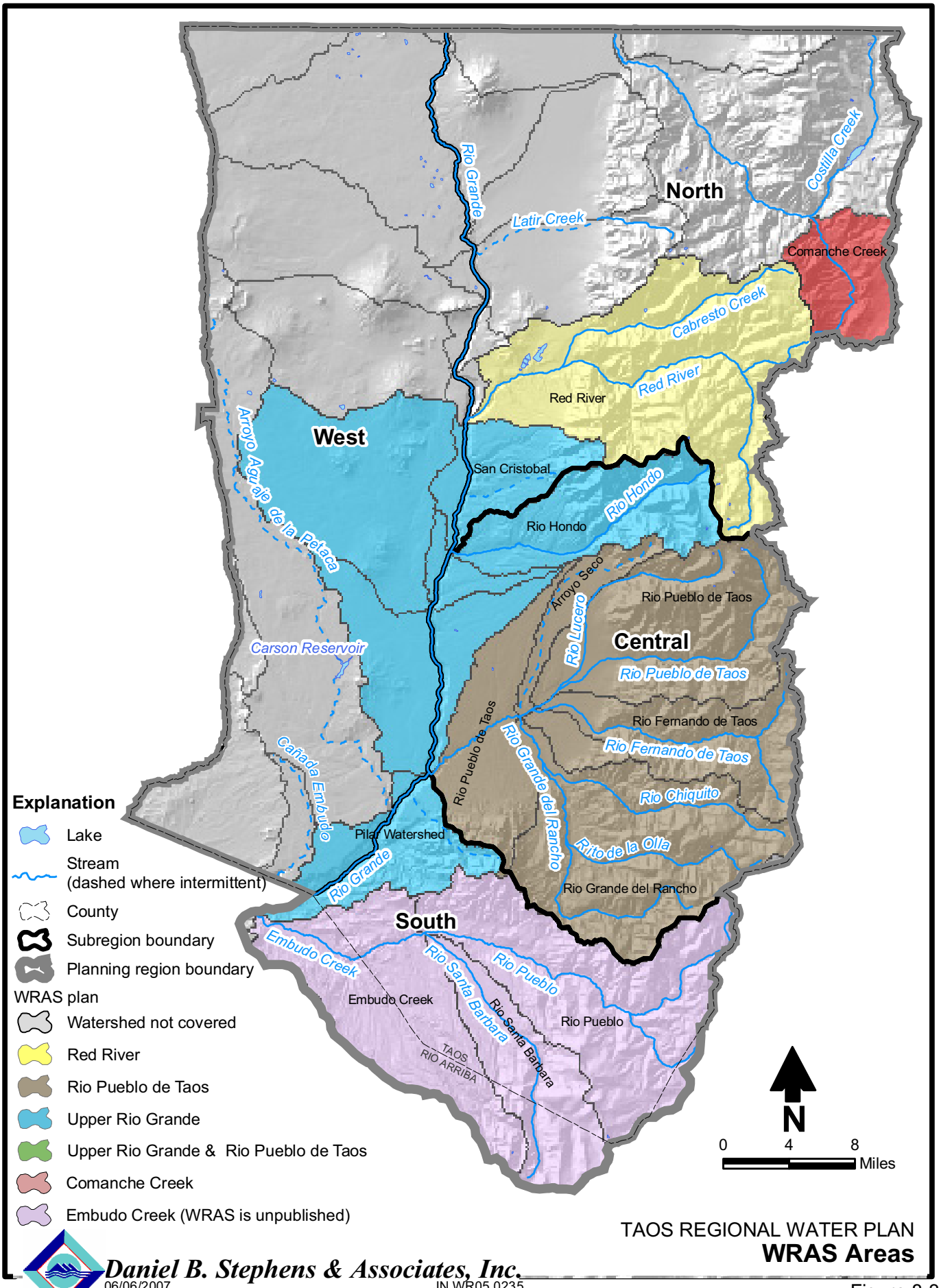
In addition to fuels reduction projects, local issues in watersheds include increased sedimentation from roads, culverts, or other construction projects, elevated stream temperatures, suspended sediment loads, and impacts from septic systems, mining, grazing, off-road vehicles, or other potential contaminant sources. These impacts impair ecosystem function and biodiversity as well as irrigation and public water supplies.

In 1996, EPA initiated an effort for communities to form watershed groups and begin to address impaired reaches of streams (U.S. EPA, 1996). Watershed restoration projects may be identified and implemented through development of a Watershed Restoration Action Strategy (WRAS), which can be developed through the U.S. EPA's 319 program as implemented by NMED.

Watershed efforts often bring together entities and individuals with interests in the watershed, including local, state, and federal agencies that have some jurisdiction in the watershed as well as private landowners and interested citizens. Approximately 60 percent of the region is either state or federal public land (39 percent national forest, 17 percent Bureau of Land Management [BLM] land, and 4 percent New Mexico State land). An additional 8 percent of the land in the region is pueblo, with the remaining 32 percent privately held. The large percentage of national forest and BLM land in the region indicates the importance of working with federal agencies on watershed management issues.

Five current WRAS efforts are well underway in the Taos Region (Figure 8-3), including four that have already been prepared (Red River, Comanche Creek, Rio Pueblo de Taos, and Upper Rio Grande) and one that is in progress (covering the South subregion in addition to areas outside the Taos Water Planning Region). These WRASs are summarized below:

- The Red River WRAS, prepared by the Red River Watershed Group in November 2003, applies to the entire drainage area of Red River and its tributaries.



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TAOS REGIONAL WATER PLAN

WRAS Areas

Daniel B. Stephens & Associates, Inc.

06/06/2007

JN WR05.0235

Figure 8-3

- The Comanche Creek WRAS prepared by the Quivira Coalition, dated September 2005, is entirely located within the Valle Vidal Management Unit of Carson National Forest; thus the entire watershed is managed by the Forest Service.

- The October 2005 Rio Pueblo de Taos WRAS, prepared by the Rio Pueblo de Taos Watershed Group under an CWA Section 319 grant administered by Amigos Bravos, involved hosting field trips and education outreach.

- A draft Upper Rio Grande WRAS, prepared in July 2006 under a CWA Section 319 grant administered by The Meridian Institute covers the large area of the Upper Rio Grande watershed. This WRAS included individual detailed documents for the Rio Don Fernando de Taos, Rio Hondo, and Pilar. Three small overview WRAS documents (for San Cristobal, Ranchos de Taos, and Greater World Community) are also included in this draft WRAS.

- Subwatershed groups have been formed for Peñasco, Embudo Valley, Rio Grande Corridor, and Española. These groups include:

  - Llanos, Truchas, Chamisal, and Ojito, with participation from Picuris Pueblo (Peñasco)

  - Dixon, Rinconada, Apodaca, Cañoncito, Ojo Sarco, Truchas, and Embudo (Embudo Valley)

  - Alcalde and Velarde (Rio Grande Corridor)

Water quality issues identified by individual WRAS documents are discussed in Section 5.4. Projects recommended by the WRAS efforts are summarized in Appendix H2; implementation of these projects is supported by this regional water plan.

In addition to the WRASs, another watershed effort that affects the region is the North-Central New Mexico Forest Ecosystem Restoration Analysis (ForestERA) Project. This project is a

large-scale landscape assessment of north-central New Mexico being performed by a team from Northern Arizona University (NAU). It includes an analysis of the risk of wildfire and identifies treatment alternatives and priority areas for treatment, resulting in spatial data and report deliverables. The project area is larger than the Taos Water Planning Region, extending farther west and south, and includes large portions of the Carson and Santa Fe National Forests, the Cities of Santa Fe and Española, Santa Clara Pueblo, and other areas. The NAU project team held five focus groups (watershed, wildlife, fire, recreation, and economics) during late summer and early fall of 2006 to make contacts and gather information, and a full project workshop was held in Taos in October 2006. The Forest Guild is acting as the NAU project team's community liaison. Further information about this project is available at <http://www.forestera.nau.edu/overview_nnm.htm>.

8.8.1 Technical Feasibility

The watershed management activity with the greatest potential to affect water supplies is reduction of vegetation density. Protection from catastrophic crown fire protects the water quality in the region, and some research indicates that in some cases there may be water yield benefits as well. Numerous ongoing projects to reduce vegetation density are conducted on a regular basis throughout the western U.S., and some projects have been initiated in the Taos Region by the Forest Service and BLM. Many technical issues must be addressed in developing an appropriate prescription for treating a watershed: the method of cutting and removing trees, the limitations presented by steep slopes, determination of the desired densities, conditions for cutting to avoid bark beetle infestations, conditions for prescribed burns to minimize mortality, risk for uncontrolled burns and smoke, and methods for monitoring water quality and impacts to the environment. All of these issues must be developed as appropriate to the terrain, proximity to urban areas, and traffic patterns (if logs are removed).

Community involvement is essential at the outset of developing a prescription for thinning to make sure that the treatment objectives are understood and that community concerns—such as access, traffic control, involvement of community workers, and any other concerns—are integrated into the prescription. One example of community involvement in watershed planning

is the following prescription, which was agreed on by the various stakeholders of the Santa Fe Municipal Watershed (USFS, 2001):

- No trees will be harvested commercially.
- Trees up to 16 inches in diameter will be cut and the trunks laid along slope contours to reduce soil erosion.
- Trees will be cut by feller buncher, except on steep slopes where chainsaws will be used; no new roads will be constructed nor will skidding be allowed.
- Forest canopy cover will be left in a variable density mosaic that mimics natural fire disturbance patterns in a ponderosa pine forest.
- The southern ridge of the watershed will be cut into fuel breaks up to one-quarter mile wide to keep erosion out of the canyon and thinned to 20 to 30 large trees per acre or 20 to 30 percent canopy cover.
- Slash piles will be burned once they have dried, approximately 3 to 12 months after the cutting takes place and when humidity is high to avoid an uncontrolled burn.
- Low intensity broadcast burns will be used to reduce density of small trees and surface fuels.
- Monitoring and evaluation will be used to determine treatment effectiveness and environmental effects.

This is just one example; each community must evaluate its own objectives and concerns regarding potential commercial harvest, methods of treatment, and appropriate mitigation measures.

The CFRP (http://www.fs.fed.us/r3/spf/cfrp/2007program/index.shtml) holds workshops to bring together CFRP grantees, their partners, and other stakeholders to share their experiences and discuss accomplishments, challenges, and strategies to overcome barriers to the implementation of collaborative forest restoration projects. The purpose of the CFRP program is to:

- Promote healthy watersheds and reduce the threat of large, high-intensity wildfires, insect infestation, and disease in the forests in New Mexico.

- Improve the functioning of forest ecosystems and enhance plant and wildlife biodiversity by reducing the unnaturally high number and density of small-diameter trees on federal, tribal, state, county, and municipal forest lands.

- Improve communication and joint problem solving among individuals and groups who are interesting in restoring the diversity and productivity of forested watersheds in New Mexico.

- Improve the use of, or add value to, small-diameter trees.

- Encourage sustainable forests through collaborative partnerships whose objective is forest restoration.

- Develop, demonstrate, and evaluate ecologically sound forest restoration techniques.

In addition to thinning to reduce fuel loads, other watershed projects, such as those identified in the WRASs prepared for the region, are all technically feasible. The projects recommended in the WRASs are summarized Appendix H2. The successful implementation of those projects is dependent on obtaining adequate financing and developing community support for the specific project.

8.8.2 Hydrological Impacts

Thinning the overstory vegetation within a watershed can impact the hydrologic water balance by reducing transpiration, thereby increasing water yield. In addition to potential increases in yield, vegetation thinning may impact the timing of streamflows by increasing infiltration, thus reducing peak flow volumes and increasing base flow volumes. Research on whether thinning can produce a significant increase in water yield has indicated that results are highly variable and it is difficult to quantify or predict whether measurable yield increases will be observed in each case. Additional long-term research on large-scale thinning projects is needed to better understand the relationship between thinning and water yield. Key issues regarding hydrologic impacts are:

- Greater yield increases can be expected in the higher-elevation, higher-precipitation zones.
- Yield increases will generally be greater in wet years than in dry years.
- As the acreage of thinned area increases, total runoff volume will also increase.
- Yield increases are proportional to the amount of basal area removed.
- Unless the treatment is maintained over time, regrowth can diminish any increased water yield.
- The entity conducting the watershed activity does not necessarily have the right to use any new water that results from their activities.

These topics are discussed in the following subsections.

In general, water yield increases from vegetation reduction are proportional to annual precipitation and the proportion of the forest canopy that is removed (Bosch and Hewlett, 1982; Troendle and Kaufmann, 1987, as cited by MacDonald et al., 2002; McCord and Winchester,

2001). Small or no water yield increases can be expected in areas where annual precipitation is less than about 18 to 20 inches (Ffolliott and Thorud, 1975; Bosch and Hewlett, 1982; Stednick, 1996, as cited by MacDonald et al., 2002). Precipitation averaging above 18 inches per year is prevalent along the Sangre de Cristo Mountains along the east side of the region (Figure 5-3).

Large variability in annual precipitation is another important limitation to managing forests for water yield. Data from central Colorado showed that water yield increases from vegetation reduction in dry years were only about one-quarter of the increases in wet years (Troendle and King, 1985, as cited by MacDonald et al., 2002). This means that water yield increases from forest harvest would be least in the dry years, when they are most needed, and greatest in the wet years, when they are least needed. Since the relative variability of annual precipitation increases as annual precipitation decreases, the increase in water yield with forest management becomes increasingly variable and therefore increasingly uncertain with low annual precipitation.

However, a recent study completed in west-central Texas (Upper Colorado River Authority [UCRA] et al., 2006) showed a positive hydrological response to brush thinning, even during drought years. The UCRA study involved treatment of 300,000 acres by removal of phreatophytes (mostly honey mesquite and juniper). Response monitoring included measurement of groundwater levels, base flows, and the timing duration and distribution of flood flows. Even though the monitoring has occurred during a dry period, groundwater levels have increased, and numerous previously dry springs and seeps have begun to flow (UCRA et al., 2006).

Increases in water yield resulting from forest cover reduction have been studied since 1955, when the Hubbard Brook Experimental Forest was established in New England by the USFS Northeastern Research Station as a major center for hydrologic research. A study conducted by Hibbert (1967) at this experimental forest concluded that water yield increases with forest cover reduction. Bosch and Hewlett (1982, as cited by MacDonald et al., 2002) complemented Hibbert's findings by analyzing data from 94 catchment experiments, as reported by Huff et al. (2000). The Bosch and Hewlett study generalized that there is about a 1.5-inch change in annual water yield for every 10 percent change in forest cover in excess of a 20 percent

minimum threshold of forest cover reduction. Therefore, water yield consistently increases when vegetation cover is removed; however, the magnitude varies with both the annual rainfall of the catchment and the proportion of cover removed (Newson, 1997).

For the purpose of this plan, this strategy considers watershed management activities in the following vegetation zones defined by elevation, precipitation, and therefore, plant species:

- *Mixed conifer forests.* Mixed conifer forests occur at elevations above 7,300 feet and receive 12 to 35 inches of rainfall annually, more than half in the form of snow. Douglas fir, blue spruce, limber pine, white fir, ponderosa pine, and aspen are typical species in these mixed conifer forests.

- *Ponderosa pine forests.* Ponderosa pine forests occur between 7,000 and 11,600 feet in elevation. Precipitation ranges from 14 to 25 inches per year, equally divided as summer rain and winter snow.

- *Piñon-juniper woodlands.* Piñon-pine and juniper woodlands are present in the Taos Region in areas between about 5,000 and 7,000 feet in elevation. Annual precipitation typically ranges from 8 to about 14 inches in the piñon-juniper woodlands, and tree species in these communities have evolved both drought and cold resistance.

- *Chaparral shrublands.* Chaparral shrublands are usually found at elevations under 6,000 feet and are dominated by shrub live oak and other shrub species that proliferate following fire or cutting. Annual precipitation varies from 10 to 16 inches.

- *Riparian ecosystems.* Riparian ecosystems occur along river and stream corridors at all elevations. Cottonwood and willow trees form part of the riparian vegetation in these river and canyon bottoms. Many lower-elevation riparian ecosystems have been inundated with salt cedar and other non-native species.

8.8.2.1 Mixed Conifer Forests

Research conducted in mixed conifer forests at Workman Creek in the Sierra Ancha Experimental Forest in central Arizona indicates that increases in streamflow can be obtained by replacing trees with a grass cover on strategically located parts of a watershed or by reducing forest overstory densities (Gottfried et al., 1999a). Research in Colorado has shown that water yield increases in the higher-elevation lodgepole and spruce-fir forests are directly proportional to the amount of basal area that is removed (Troendle and King, 1987, as cited by MacDonald et al., 2002). This research also indicated that, because of limitations in the accuracy of streamflow measurements and the regressions between paired basins, at least 20 to 25 percent of the basal area within a watershed must be removed to detect a statistically significant change in runoff (Troendle and King, 1987; Troendle et al., 2001, as cited by MacDonald et al., 2002). Smaller reductions in basal area should increase streamflow proportionally, but the magnitude of increases from small changes in forest density cannot be predicted with any confidence.

8.8.2.2 Ponderosa Pine Forests

Watershed research on water yield improvement in the low-elevation ponderosa pine forests of the Colorado River Basin was conducted on the Beaver Creek watershed in north-central Arizona (Baker and Ffolliott, 1999), in the high-elevation ponderosa pine forests on the Castle Creek watershed in eastern Arizona (Gottfried et al., 1999b), and in the ponderosa pine forests on the Colorado Front Range (Gary, 1975, as cited by MacDonald et al., 2002). Results of this research include:

- The potential for increasing water yields in ponderosa pine forests is less than in higher-elevation mixed conifer forests because of the drier conditions of the ponderosa pine forests. However, short-term (up to 10-year) increases of 1 to 3 inches were observed on the Beaver Creek watershed as a result of varying intensities of overstory thinning, patterns of overstory removal, and combinations of the two treatments. Increases of 0.2 to 1 inch are likely a more realistic expectation of water yield increases within a multiple use management framework, where water, forage, wood, wildlife, and recreation are all considered in the product mix.

- An average water yield increase of 0.5 inch (30 percent) remained stable for 20 years after an irregular-block timber harvest on a watershed at Castle Creek. The initial increase in water yields was attributed largely to reduced evapotranspiration and increased snow accumulations in the created openings. No increase in water yield occurred after a prescribed burn on a second watershed, because the fire did not significantly affect the forest overstory conditions or consume much of the litter and duff on the forest floor (Gottfried and DeBano, 1990).

- Low to intermediate stocking levels in two-thirds of the ponderosa pine stands on the Colorado Front Range preclude significant water yield increases from these areas, regardless of the management emphasis (with the exception of clear-cutting).

8.8.2.3 Piñon-Juniper Woodlands

The effects of vegetation management practices on water yields in piñon-juniper woodlands have been studied on the Beaver Creek watershed (Baker and Ffolliott, 1999). Conversion of these open overstories to less water-demanding herbaceous covers by cabling, felling, and herbicide treatments had the following results:

- Cabling or felling of piñon-juniper woodlands had a negligible effect on water yields. Any water yield increase that might be expected from these mechanical methods of conversion is thought to be taken up by herbaceous plants, which increased several-fold.

- The aerial application of a herbicide treatment resulted in a small increase in water yields of less than 0.5 inch. In this treatment, the test watershed was sprayed with the herbicide mixture from a helicopter to kill the trees. The dead trees were removed after 8 years of post-herbicide evaluation in a second-stage of the treatment. Streamflow returned to near pre-treatment levels after the dead trees were removed.

- 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. During 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 that were treated, which had been dismissed by the first study, exhibited significantly more potential for water yield than the treated piñon-juniper acres (Hays, 1998).

Roundy and Vernon (1999) summarized research into the effects of piñon-juniper management on hydrology. The studies they surveyed had variable results, 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 found that the results could not necessarily be generalized to cover broader conditions. 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 spring flow and/or increased infiltration in treated piñon-juniper areas.

The timing and quality of streamflow can change substantially after removing piñon-juniper, even though annual water yields remain unchanged. If the removal of the woody vegetation results in a much denser grass and forb cover, runoff processes during high-intensity rainstorms can shift from overland flow with high surface erosion rates to subsurface flow with no surface erosion rates. The increased infiltration reduces stormflow volumes and increases base flow volumes. Sid Goodlow, a rancher in the Capitan area, demonstrated this change by rehabilitating his land, which had become overgrown with piñon and juniper. After he removed the piñon and juniper and established grasses, the once dry arroyos became perennial streams.

Natural widespread loss of piñon trees is currently occurring across New Mexico due to extended drought and impacts of the bark beetle. 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 effect measurable increases in streamflow water yields in the piñon-juniper zone are generally much more limited than in the forested areas.

8.8.2.4 Chaparral Shrublands

A research program initiated in 1956 on the Three Bar Wildlife Area near the Theodore Roosevelt Reservoir in central Arizona represented the first major experimental watershed program in the chaparral shrublands of the Colorado River Basin (DeBano et al., 1999a). This early program was followed by research on the Whitespar, Mingus, and Battle Flat watersheds

in north-central Arizona to further assess the potential for water yield improvement through chaparral conversion practices (DeBano et al., 1999b). Findings from these research efforts include:

- Increasing streamflow by converting chaparral shrubland to other vegetation is possible on favorable sites where annual precipitation averages 19.5 inches or more. The key to increasing water yields on these sites is the replacement of deep-rooted chaparral shrubs with shallow-rooted grasses and forbs, which use less water, by applications of herbicides, prescribed burning, and combinations of these conversion methods. The expected average increase is 3.9 inches in water yields on areas receiving 22 inches of average precipitation.

- Chaparral shrubs surviving the initial conversion treatments have to be re-treated to control re-sprouting. Post-treatment shrub cover should be maintained at about 10 percent to sustain the water yield increases. However, the threats posed to wildlife, concerns about the environmental effects of herbicides, and increased recognition of the other multiple use values in the chaparral shrublands have restricted large-scale applications of the conversion treatments studied.

8.8.2.5 Riparian Areas

A key issue in maintaining healthy riparian areas is removal of invasive species and the reestablishment of native species. While tamarisk (salt cedar) is a problem in many parts of New Mexico, the upper range of its habitat is 6,890 feet, which prevents salt cedar from invading most of the Taos Region (ISSG, 2005). The Rio Petaca near Pilar requires some removal of tamarisk as mentioned in the Pilar portion of the Upper Rio Grande WRAS.

8.8.2.6 Scale Effects

The size of a treated area is an important consideration when planning an effort to reduce vegetation. As the thinned area increases, total runoff volume will also increase. However, Huff et al. (2000) suggest that the change in yield relative to expected annual runoff is on the order of 1 percent for large watersheds, which is generally too small to measure. In their modeling study, a 40,000-square-kilometer (km^2) (9,884,000 acres or 15,444 square miles [mi^2])

watershed in the Sierra Madre Mountains of California was assessed for 1-km^2 areas eligible for thinning. This assessment found that 60 percent of the watershed was ineligible for consideration because the authors' thinning criteria excluded set-aside, protected, and non-forested land. A minimum remaining vegetation criterion of 135 square feet (ft^2) of basal area was imposed for each 1-km^2 treatment area, which further reduced the thinning operations to 15 percent of the entire study area. For each thinned 1-km^2 area, the modeled annual water yield for average climate conditions ranged from 0 to 6.5 inches. Because only 15 percent of the total 40,000 km^2 was thinned, aggregating the individual 1-km^2 thinned areas produced the watershed-scale thinning simulation. The area-weighted watershed increase in water yield from their idealized scenario ranged from 0 to 1.3 inches; at larger hydrologic unit code scales, the water yield ranged from 0 to 0.16 inch. Although the change in water yield per unit area decreases as the size of the area increases, the actual volume of produced water increases.

8.8.2.7 Flow Timing Effects

The timing and quality of streamflow can change substantially after overstory vegetation, which should result in a much denser grass and forb cover. The runoff processes during high-intensity rainstorms can shift from overland flow with high surface erosion rates to subsurface flow with no surface erosion rates. The increased infiltration reduces stormflow volumes and increases base flow volumes. Drastic changes in runoff timing will be highly site-specific and will depend on a variety of factors, such as soil depth, soil texture, slope, bedrock type, changes in percentage of ground cover, and precipitation amounts and intensities.

8.8.2.8 Ownership of Produced Water

The amount of water that can be gained from watershed restoration throughout the region is affected by New Mexico laws and regulations, which specify that any "additional" runoff created by watershed management becomes part of the public water supply and is subject to the prior appropriation system. This effectively means that any appropriator could obtain the increased water generated, regardless of their role (or lack thereof) in the land management activities leading to the increased supply. No mechanism exists whereby the person or entity that increases the amount of runoff can lay a priority claim to the water produced. Furthermore, any permit obtained to use that water would be a new, very junior water right. The more likely scenario is that no new appropriations would be allowed, but that holders of existing water rights would be more like to receive their full supply each year.

8.8.2.9 Summary

In summary, the average long-term increase in water yield depends on the annual precipitation, the species being treated, the proportion of the canopy that is removed, the regrowth rate, and the length of time between treatments. These variables significantly affect the amount of water yield increase that may be expected.

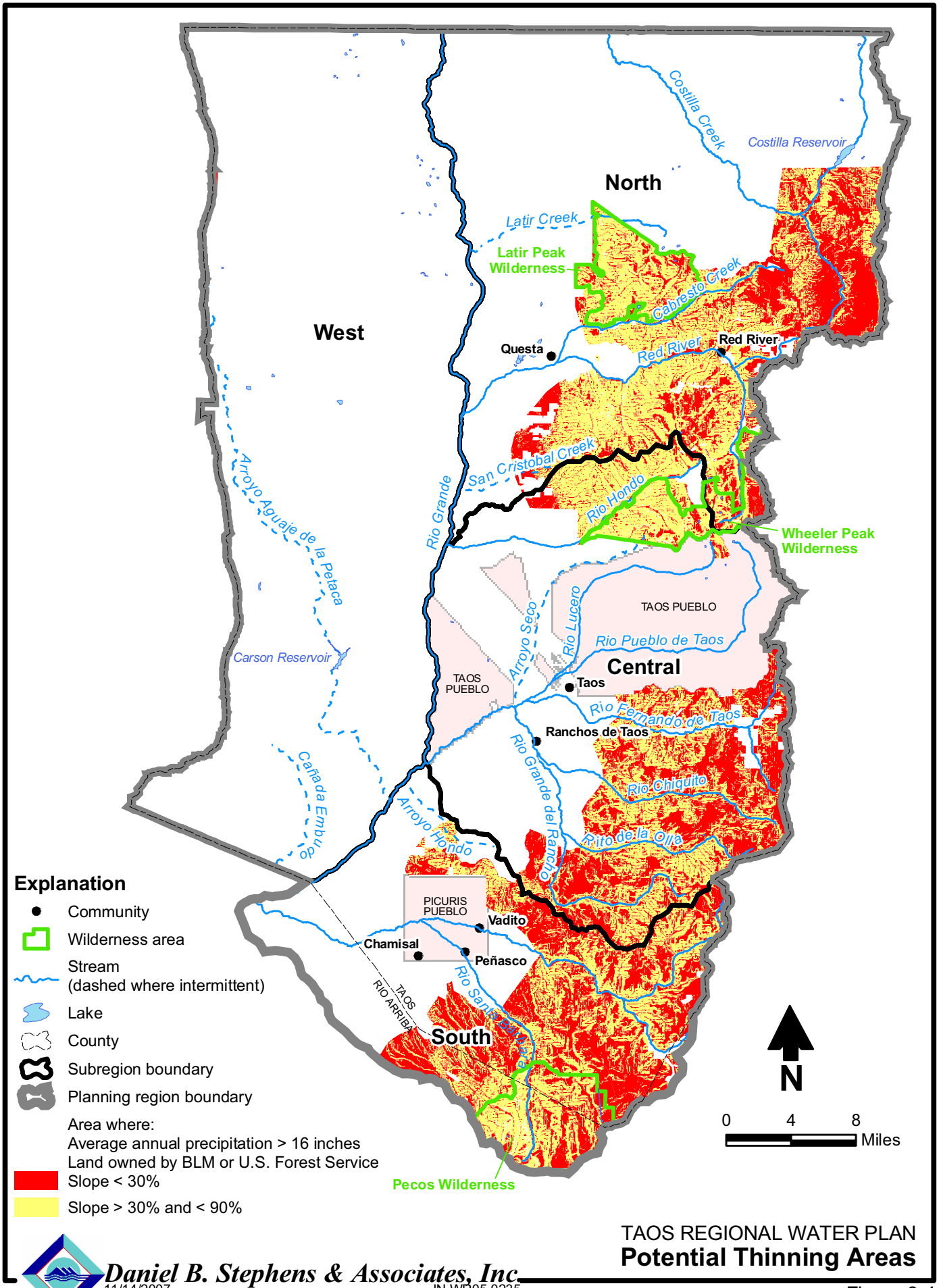
To approximate the expected yield increase from vegetation removal in the Taos Region, a simplified calculation was conducted. Non-wilderness areas with precipitation of 16 inches per year or greater (Figure 8-4), which cover approximately 295,000 acres of the region, were used to estimate the potential yield increases in the planning region, which are based on two primary assumptions:

- Based on the previous studies summarized above, it was assumed that yield increases from thinning would be on the order of 0.2 to 0.5 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 non-wilderness area with precipitation above 16 inches would be thinned.

Table 8-6 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 870 to 5,040 ac-ft/yr. As discussed above, this amount would vary from year to year, with yield likely not being as large in dry years. In addition, unless long-term maintenance of thinned areas occurs, any yield increases will be short-term.

The predicted increases shown in Table 8-6 have considerable uncertainty. To better assess potential water yield, longer-term studies of the relationship between water yield and thinning projects in the Taos region are needed. Studies and modeling to better understand the relationships between basal area reductions, vegetation type, and treatment type to water yield would be valuable for understanding potential yield changes and could be used to develop a strategic approach for evaluating yield potential.



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TAOS REGIONAL WATER PLAN

Potential Thinning Areas

Daniel B. Stephens & Associates, Inc.

11/14/2007 JN WR05.0235

Figure 8-4

Table 8-6. Potential Water Supply Increases in the Taos Water Planning Region

Percentage of Total Area Thinned [a]	Area Thinned [b] (acres)	Water Yield Increase (acre-feet)	
		Low-End [c]	High-End [d]
10	17,290	290	720
20	34,580	580	1440
30	51,870	870	2160
40	69,160	1,150	2,880
50	86,460	1,440	3,600
60	103,750	1,730	4,320
70	121,040	2020	5040
80	138,330	2,305	3,760
90	155,620	2,590	6,480
100	172,910	2,880	7,210

[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 non-wilderness area where precipitation is above 16 inches per year.
[c] Calculations assume that thinning results in 0.2 inch of additional water yield over area thinned.
[d] Calculations assume that thinning results in 0.5 inch of additional water yield over area thinned.

8.8.3 Financial Feasibility

Costs for conducting thinning projects are variable depending on the ease of access, thickness of vegetation, amount of thinning to be done, treatment of slash (i.e., whether it is—in order of increasing cost—scattered, piled, burned, or removed), and techniques used (in order of increasing cost—hand pruning, chainsawing, or bulldozing). Current costs for mechanical thinning programs in New Mexico range from about $800 to $1,000 per acre including planning (Boucher, 2004). In wilderness areas, where no mechanical cutting is allowed, the cost for using wildland fire as a method of restoring forests is about $6 per acre (Boucher, 2004). Recent thinning projects in the Santa Fe Municipal Watershed cost $3 million for 3,200 acres, or about $945 per acre (Van Dorn, 2005). Recent thinning costs on the Raton municipal watershed were approximately $650 to $1,000 per acre for mechanical treatment with a hydroax. Costs for biological and archaeological clearances, development of thinning prescription, public meetings, and oversight can add an additional $150 to $200 per acre.

The primary ongoing cost of forest thinning projects is the need to address regrowth through periodic thinning or prescribed burns. In general, a ponderosa pine forest must be thinned at least every 30 to 40 years or allowed to have low-intensity fires every 5 to 7 years to prevent catastrophic fires and to maintain increased water yield. Costs for repeat thinning would be similar to the initial costs (excluding inflation).

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.

Funding for watershed activities can be obtained 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.

- During the past several years, 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 is likely to be a continuing source of funding.

- The CFRP provides grants for forest restoration projects that reduce the threat of wildfire, improve watershed conditions, improve the use of small trees thinned from restored lands, and provide jobs and training to local communities. These grants are available for state, local, and tribal governments, educational institutions, landowners, conservation organizations, and other interested public and private entities. Restoration projects must be on federal, tribal, state, county, or municipal forest lands (or any combination thereof) in New Mexico. The program does not provide grants for the treatment of private land, but CFRP grants can be used for processing facilities on private land that use small trees from thinning projects on public lands.

Other potential funding sources include NRCS grants (e.g., Conservation Technical Assistance, Small Watershed Program, Environmental Quality Incentives Program, Conservation Reserve Program, Emergency Watershed Protection).

8.8.4 Environmental Impacts

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, off-road vehicles, erosion, septic tanks, or other concerns.

Management actions taken in the national forests to increase water supply emanating from the forests generally must comply with a number of federal laws, including:

- National Forest Management Act, 16 U.S.C. §1600, et seq.
- National Environmental Policy Act, 42 U.S.C. §4321 et seq.
- Clean Water Act, 33 U.S.C. §1251 et seq.
- Endangered Species Act, 16 U.S.C. §1531 et seq.
- National Historic Preservation Act, 16 U.S.C. §470 et seq., where applicable
- American Indian Religious Freedom Act, 42 U.S.C. §1996, where applicable

The National Forest Management Act (NFMA) directs the USFS to manage national forest lands according to forest plans prepared every 10 to 15 years. This planning process must, according to the NFMA and the National Environmental Policy Act (NEPA), provide for public involvement and allow for incorporation of economic, environmental, or other concerns into the process. Implementation of these forest plans, however, is dependent on funding.

The primary environmental advantage of reducing forest density is the reduced risk of high-severity fires. High-severity fires in coniferous forests can increase runoff and erosion rates by one or more orders of magnitude relative to unburned conditions, and these increases can have severe downstream effects such as flooding, reservoir sedimentation, and adverse effects on aquatic habitat. The effects of prescribed fires on runoff and erosion are generally minimal, as the fire severity is mostly low to moderate and will cause less soil water repellency or highly

discontinuous water repellent patches (MacDonald et al., 2002). Areas burned at moderate or low severity also leave less bare ground than high-intensity fires, and according to recent research, a lower percentage of bare ground correlates very strongly with lower erosion rates. An important concern in the case of prescribed fire and broadcast burning is the effect on air quality and the potential for the fire to become uncontrolled. Fires in forested areas produce a large number of particulates that are hazardous to human health. Smoke also has an adverse effect on visibility and visual aesthetics. Another environmental impact that has been identified as a potential concern is the logging of old growth forests under the fuel reduction program (George, 2004).

An extensive program of forest harvest or thinning could increase erosion rates and adversely affect water quality (due to increased turbidity and sediment loads), particularly during the thinning operation. The increase in erosion from harvested areas and the accompanying adverse impacts on water quality can usually be minimized through careful design of treatments that use best management practices (MacDonald et al., 2002). The careful design and construction of the road and skid trail system is critical to minimizing overland flow and reducing erosion, and the use of buffer strips along ephemeral and perennial streams is needed to minimize sediment delivery into the stream network. Maintaining riparian vegetation is the best means to minimize increases in water temperatures.

8.9 Summary Recommendations and Implementation Schedule

As discussed in Section 8.1, a list of potential strategies was developed at steering committee meetings, which were open to the public, and at a series of public meetings held in communities throughout the region. The list of potential strategies was prioritized based on input from the public meetings, and the priority strategies are analyzed in Sections 8.2 through 8.8. A draft implementation schedule that identifies responsible parties and the relative time frame to begin implementing each strategy is included as Table 8-7.

To successfully implement the strategies discussed in Sections 8.2 through 8.8 and to identify other strategies that may be needed as the region develops, ongoing monitoring, data collection, and interpretation will be required. Some of the key data collection efforts that are important include:

Table 8-7. Implementation Schedule and Recommended Actions for Strategies to Meet Future Supply Needs
Page 1 of 3

Strategy	Implementation Priority [a]	Action	Responsible Party [b]
Infrastructure improvements	1	• Define infrastructure needs and apply for funding	Individual water systems
	1	• Phase 1: Define partners, purpose (i.e., develop wastewater treatment infrastructure), process (for public involvement and decision making), and planning area.	Potential regional system partners [c]
	1	• Phase 2: Compile data on each water system, domestic wells, demand, and supply.	
	2	• Phase 3: Develop solutions based on input from the public.	
	2	• Phase 4: Develop a funding plan and rate structure for each water system.	
Water quality protection	1	• Conduct an inventory/assessment of septic locations and identified water quality problems. • Provide technical and financial resources for addressing septic issue. • Require regional wastewater systems or program of pumping septic tanks to improve performance.	Counties, NMED, municipalities, MDWCAs
Public education	1	• Determine lead organization for clearinghouse.	Regional water plan steering committee
		• Apply for grant funding.	County, UNM-Taos, other lead organizations
		• Set up an oversight committee.	Regional water plan steering committee and lead organization
		• Hire staff, set up office.	Oversight committee
		• Compile materials. • Develop website. • Distribute education materials.	Public education clearinghouse staff

[a] 1 = Begin implementing immediately (within 1 to 3 years)
2 = Begin implementing in 4 to 10 years

[b] Primary responsible parties as recommended at regional water planning steering committee meeting; participation is contingent on the wishes of the respective elective body. Others may also be involved.

[c] Potential partners include:
Taos Municipal Water System
El Prado, Cañon, and Ranchos de Taos MDWCAs
Hacienda Subdivision
Talpa
Llano Quemado
BMG Trailer Park
Enchanted, Vigils, La Lomita, Enchanted, and El Rancho mobile home parks

WRAS = Watershed Restoration Actions Strategy
SWCD = Soil and water conservation district
USFS = U.S. Forest Service
BLM = Bureau of Land Management
NMED = New Mexico Environment Department
OSE = Office of the State Engineer
USGS = U.S. Geological Survey
WWTP = Wastewater treatment plant

Table 8-7. Implementation Schedule and Recommended Actions for Strategies to Meet Future Supply Needs
Page 2 of 3

Strategy	Implementation Priority [a]	Action	Responsible Party [b]
Protection of traditional agriculture (acéquia protection)			
Acéquia bylaws to manage water transfers	1	• Adopt or revise bylaws to require that transfers or changes in location of water rights on a ditch or acéquia be subject to approval by the acéquia or ditch commissioners.	Each acéquia, New Mexico Acéquia Association
Acéquia water banking (NMSA 73-2-55.1)	1	• Adopt or modify bylaws to establish water banking procedure.	Each acéquia
Maintain and repair acéquias	1	• Solicit volunteers from the community to help with ditch cleaning. • Seek state and federal funding. [d] • Set up water management methods to establish sharing among acéquias on a river.	Collaborative effort of acéquias on a river, Taos SWCD
Encourage economic agriculture	1	• Expand participation in local farmers markets. • Improve transportation network with appropriate storage and distribution facilities to encourage farmers to grow high-value crops.	Farmers and ranchers working with multiple partners and state and federal governments
Keep water rights in the region			
Support and become involved in the existing OSE process (Section 8.5)	1	• Monitor published notices announcing OSE applications for new appropriations or transfer of existing water rights. • File written protest or objection with the OSE if any applications are contrary to the conservation of water, detrimental to public welfare, and/or will substantially or specifically affect the objector if approved.	Individuals, municipalities, counties
Conservation easements and transfer of development rights	1	• Work with Taos Land Trust to identify tracts where a conservation easement would benefit local agriculture and protect water rights. Identify and secure funding sources.	Private citizens or non- profit organizations
	2	• Develop process for transfer of development rights in Taos County.	Local (municipal / county) planning staff and officials, BLM

[a] 1 = Begin implementing immediately (within 1 to 3 years)
2 = Begin implementing in 4 to 10 years

[b] Primary responsible parties as recommended at regional water planning steering committee meeting; participation is contingent on the wishes of the respective elective body. Others may also be involved.

[d] = Repair and maintenance funding available from ISC

WRAS = Watershed Restoration Actions Strategy
SWCD = Soil and water conservation district
USFS = U.S. Forest Service
BLM = Bureau of Land Management
NMED = New Mexico Environment Department
OSE = Office of the State Engineer
USGS = U.S. Geological Survey
WWTP = Wastewater treatment plant

Table 8-7. Implementation Schedule and Recommended Actions for Strategies to Meet Future Supply Needs
Page 3 of 3

Strategy	Implementation Priority [a]	Action	Responsible Party [b]
Growth management	1	• Complete Taos County growth management plan and updated land use ordinances.	Taos County, municipalities
	1	• Develop/update groundwater models to evaluate cumulative impacts of withdrawals.	Municipalities, counties, OSE, Taos SWCD
	1	• Seek funding for staff to evaluate sustainability issues associated with growth.	Counties
Watershed management	1	• Implement strategies identified in the WRASs.	SWCDs, municipalities, counties, USFS, BLM, Town of Taos Fire Department
		• Complete WRASs (i.e. Embudo watershed). • Conduct public education regarding watershed activities.	Embudo watershed group
		• Identify and implement priority projects for fuels reduction.	Amigos Bravos, USFS, public education clearinghouse
		• Use best management practices on any fuels reduction projects.	Counties, USFS, BLM
		• Complete Taos County Fire Protection Plan.	Taos County
		• Evaluate issues and options for addressing instream flow	BLM
Monitoring and measuring		• Improve data collection	

[a] 1 = Begin implementing immediately (within 1 to 3 years)
2 = Begin implementing in 4 to 10 years

[b] Primary responsible parties as recommended at regional water planning steering committee meeting; participation is contingent on the wishes of the respective elective body. Others may also be involved.

WRAS = Watershed Restoration Actions Strategy
SWCD = Soil and water conservation district
USFS = U.S. Forest Service
BLM = Bureau of Land Management
NMED = New Mexico Environment Department
OSE = Office of the State Engineer
USGS = U.S. Geological Survey
WWTP = Wastewater treatment plant

- Wells in the Central, South, and West subregions should be monitored to better characterize groundwater levels and improve model calibration. In particular, the Central subregion is experiencing the most growth, and a better understanding of water level trends in that subregion will be useful.

- Stream gaging on perennial streams is also essential to estimating gaining and losing reaches, an important component for model calibration and developing water budgets. Stream gaging is also critical to water resource management and sharing the limited supply available to water right users. In many parts of the region, acéquias are only estimating the distribution of water resources by visual appearance, which can result in disputes. With actual recorded streamflow measurements, parciantes have a sound method to determine sharing of water, particularly in times of short supply. While many of the stream are currently gaged in the region, the following additional sites could assist in improving the understanding of the resource and managing the water supply for surface water users:

  – North subregion:

    1. Latir Creek upstream of irrigation diversions (USGS gage 8263000, discontinued in 1969)
    2. Cabresto Creek near Questa (USGS gage 8266000, discontinued in 1995)
    3. Cabresto Creek at its confluence with Red River (if Cabresto Creek at Questa is not continued)

  – Central subregion:

    1. Arroyo Seco upstream of irrigation diversions
    2. Rio Fernando de Taos (USGS gage 8275000, discontinued in 1980)

  – South subregion:

    1. Rio Pueblo at its confluence with Embudo Creek
    2. Rio Santa Barbara at its confluence with Embudo Creek

  – West subregion:

    1. Arroyo Aquaje de la Petaca (although flows are short and infrequent)

- Measurement of agricultural diversions not only also improves model calibration, but again, is fundamental to gaining trust among parciantes, particularly during droughts. As with stream gaging, an instrument that measures and records water diversions helps to resolve disputes regarding how much is being diverted by each water right holder. The Rio Hondo acéquias, with funding from ISC, installed equipment to measure diversions by acéquias in 2006.

- Better assessment of recharge can be obtained with the above data collection combined with model calibration. A better understanding of all water budget components, including recharge, will help the region to manage the water resources sustainably.

- Defining existing forest conditions is critical to developing a plan for restoration and monitoring of treatments. Field monitoring and mapping of vegetation types and densities at a more detailed level than existing coverage would be useful.

- Identifying septic tank locations is necessary to assess potential problem areas with regard to water quality contamination. With septic tank locations mapped, planners can assess both the need and possibilities for wastewater treatment infrastructure improvements.

- Defining domestic well locations is also a critical first step for planners to assess the need for new water supply infrastructure. The maps shown in this plan are approximate; a full mapping of all domestic wells would be useful.

- Water quality data in the vicinity of high-density septic tanks or other sources of contamination is essential to identify and treat potential health hazards.

Successful implementation of the strategies identified on Table 8-7 will depend on the ongoing commitment of stakeholders within the region as well as funding to support the projects. Funding for projects is expected to be most successful if funding requests involve multiple communities and/or counties taking advantage of regional project funding mechanisms such as Clean Water Act grants, Water Trust Board grants, CFRP grants, and others. Potential funding sources for strategy implementation are included in Table 8-8.

Table 8-9. State and Federal Funding Sources
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Program Title *Agency* Web Site or Contact [a]	Description
General Information	
Taos Soil and Water Conservation District http://www.nm.nrcs.usda.gov/partnerships/swcd.html#Taos	Provides technical and financial assistance for thinning and fire hazard mitigation and for water quality improvements
Catalog of Federal Domestic Assistance http://www.cfda.gov/	Good information about funding sources, grant writing, etc.
Federal Grants Search www.grants.gov	Searches all federal agency sources for grant information
Federal Drought Programs http://www.iwr.usace.army.mil/iwr/drought/feddrghtprogs.htm	Summary of federal funding sources available for drought programs.
Catalog of Federal Funding Sources for Watershed Protection http://cfpub.epa.gov/fedfund/	Topical listing of funding sources related to watershed protection.
Links to private funding sources http://www.epa.gov/owow/nps/capacity/funding.htm	List of links for private funding sources for various areas.
Funding Programs	
New Mexico Clean Water State Revolving Fund *New Mexico Environment Department*, *Construction Programs Bureau* Santa Fe: 505-827-2806 http://www.nmenv.state.nm.us/cpb/cpbtop.html http://www.nmenv.state.nm.us *New Mexico Water Trust Board* Contact New Mexico Finance Authority (NMFA) U.S. *Environmental Protection Agency (EPA)* http://www.epa.gov/owm/cwfinance/cwsrf/	Eligible projects include water supply development, conservation, watershed management, and infrastructure. Water quality protection projects for wastewater treatment, nonpoint source pollution control, and watershed and estuary management.
Community Development Block Grants *Department of Housing and Urban Development* http://www.state.nm.us/clients/dfa/Files/LGD/CDB/index.html	Funding source for 40-year plans.
Community Facilities (CF) Direct Loans and Grants *U.S. Department of Agriculture (USDA)* http://www.rurdev.usda.gov/rhs/cf/cp_dir_grant.htm	Provides loans for the development of essential community facilities for public use in rural areas and towns with a population of 20,000 or less.
Emergency Community Water Assistance Grants *USDA Rural Utility Services (RUS)* Albuquerque: 505-761-4955 http://www.rurdev.usda.gov/nm/ http://www.usda.gov/rus/water/programs.htm#EMERGENCY http://www.usda.gov/rus/water/	Assists rural communities that have had a significant decline in quantity or quality of drinking water.
Irrigation Works Construction Loan Fund *New Mexico Interstate Stream Commission* Santa Fe: 505-827-6134 Fax 505-827-6188 http://www.ose.state.nm.us/isc_acequias_construction_loan.html	Makes loans to entities such as irrigation districts, community ditch associations, and municipalities for engineering and design, construction, or rehabilitation of irrigation works.

[a] Web site address as of June 2006; address and information found there is subject to change.

Table 8-9. State and Federal Funding Sources
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Program Title *Agency* Web Site or Contact [a]	Description
Acéquia Restoration and Rehabilitation Program *U.S. Army Corps of Engineers, Albuquerque office* *New Mexico Interstate Stream Commission* Santa Fe: 505-827-6160 Fax 505-827-6188	Joint program with U.S. Army Corps of Engineers (COE); provides eligible acéquias with COE grants that fund up to 75% of a project's cost with 25% acéquia funding. Matching requirements may be met through state grants (17.5%) and loans (7.5%).
Ditch Rehabilitation Grant Program *Office of the State Engineer* Santa Fe: 505-827-6191 Fax 505-827-6188	Joint program with U.S. Soil Conservation Service; provides grants to community ditches for construction, repair, and improvement of ditches, dams, reservoirs, flumes, and appurtenances.
Planning Assistance to States *U.S. Army Corps of Engineers* Albuquerque*: (505) 342-3109* http://www.spa.usace.army.mil	Assists in planning for the development, utilization, and conservation of water and related land resources and ecosystems.
Reclamation States Emergency Drought Relief Act of 1991 - Title II *U.S. Bureau of Reclamation* Albuquerque Area Office: 505-248-5323 http://www.usbr.gov/uc/progact/waterconsv/wtr_wmp.html	Assistance in the construction and planning of projects that mitigate effects of drought.
Conservation Technical Assistance *USDA Natural Resource Conservation Service* Albuquerque Office: 761-4407; 1-800-410-2067 http://www.nrcs.usda.gov/programs/cta/	Planning and implementation of solutions to natural resource concerns, including drought.
Safe Drinking Water Act Revolving Loan Program *New Mexico Environment Department, Construction Programs Bureau* Santa Fe: 505-827-2806 http://www.nmenv.state.nm.us/cpb/cpbtop.html http://www.nmenv.state.nm.us *U.S. EPA* http://www.epa.gov/safewater/dwsrf.html	Water infrastructure improvements, for small and disadvantaged communities and for pollution prevention to ensure safe drinking water.
Water and Waste Loans and Grants *USDA Rural Development* Albuquerque: 505-761-4955 http://www.rurdev.usda.gov/nm/ http://www.usda.gov/rus/water/programs.htm	Development or improvement of water or wastewater disposal systems in rural areas.
Snow Survey and Water Supply Forecasting Program *USDA Natural Resources Conservation Service* Albuquerque: 505-761-4407; 1-800-410-2067 http://www.nrcs.usda.gov. http://www.nrcs.usda.gov/programs/snowsurvey/	Monitoring of climatic and hydrologic elements necessary to produce water supply forecasts.

[a] Web site address as of June 2006; address and information found there is subject to change.

Table 8-9. State and Federal Funding Sources
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Program Title *Agency* Web Site or Contact [a]	Description
Reclamation Water Reclamation and Reuse Program *U.S. Bureau of Reclamation* Albuquerque: 505-248-5323 http://www.cfda.gov (Search using keyword: groundwater or wastewater) http://www.usbr.gov/pmts/writing/guidelines/	Appraisal and feasibility studies on water reclamation and reuse projects.
Small Watershed Program *USDA Natural Resources Conservation Service* Albuquerque: 505-761-4407; 1-800-410-2067 http://www.nrcs.usda.gov/programs/watershed/	Agricultural water management, municipal and industrial water supply, groundwater recharge, and watershed protection projects.
Conservation Partnership Initiative *USDA Natural Resources Conservation Service* Albuquerque: 505-761-4407; 1-800-410-2067 http://www.nrcs.usda.gov/programs/cpi/	Funds projects that promote terrestrial and freshwater aquatic wildlife habitat and address invasive species (such as noxious weeds). (See guidance for additional non-watershed related project eligibility)
Environmental Quality Incentives Program (EQIP) *USDA Natural Resources Conservation Service* Albuquerque: 505-761-4407; 1-800-410-2067 http://www.nrcs.usda.gov/programs/eqip/	Practices to address soil, water, and related natural resource concerns on farm and ranch lands.
Emergency Water Supplies *USDA Rural Development* Santa Fe: 505-476-9600 http://www.dps.nm.org/emergency/index.htm	Provision of emergency water supplies to communities that may run out of adequate drinking water.
Finance Authority Emergency Funding and Water and Wastewater Grant Program *NMFA* Contact: NMFA at (505) 984-1454 toll free, 1-877-ask-nmfa	Provision of emergency water supplies.
Emergency Conservation Program *USDA Farm Services* Albuquerque *:* 505-761-4407; 1-800-410-2067 http://disaster.fsa.usda.gov/ecp.htm	Rehabilitation of farm lands and conservation facilities.
Public Assistance /Emergency Measures Program *New Mexico Emergency Management Ce* 8-113 Regional Office Main Number (940) 898-5 Santa Fe: 505-476-9600 http://www.dps.nm.org/emergency/index.h http://www.fema.gov/about/contact/regions.sntm	Activities to alleviate consequences of the subject of a Presidential Emergency or Major Disaster Declaration (such as drought).
Economic Adjustment Program: Sudden and Severe Economic Dislocation Components *U.S. Department of Commerce EDA* http://www.osec.doc.gov/eda/	Prevention of serious economic dislocations or reestablishment of employment opportunities after a sudden and significant dislocation.

[a] Web site address as of June 2006; address and information found there is subject to change.

Table 8-9. State and Federal Funding Sources
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Program Title *Agency* Web Site or Contact [a]	Description
Conservation Reserve Program *USDA Natural Resources Conservation Service* http://www.nrcs.usda.gov/programs/crp/	Helps farmers and ranchers address water resource concerns on their lands.
Emergency Watershed Protection *USDA Natural Resources Conservation Service* http://www.nrcs.usda.gov/programs/ewp/	Emergency recovery measures to relieve imminent hazards to life and property as a result of natural disasters.
New Mexico State Forestry	Provides grants to fund community wildfire protection plans (CWPPs) and forest planning
Emergency Well Construction and Water Transport *USACE* *U.S. Army Corps of Engineers Albuquerque District Office* Albuquerque: 505-342-3109 http://www.spa.usace.army.mil	Construction of wells or transport of water drought-distressed areas.
Water Quality Program *USDA CSREES* http://www.csrees.usda.gov/nea/nre/in_focus/water_if_waterquality.html	Provide watershed- based information for assessing and improving sources of water quality impairment in targeted watersheds.
Unsolicited proposals *U.S. Geological Survey* http://www.usgs.gov/contracts/grants/unsolbk.html	Research proposals in many earth science areas, including hydrology and conservation.
State-EPA NPS Partnership *U.S. Environmental Protection Agency* http://www.epa.gov/owow/nps/partnership.html	Focus on nonpoint source topic-specific needs including: watershed planning and implementation.
Land and Water Conservation Fund Grants to States *National Park Service* http://www.nps.gov/ncrc/programs/lwcf/	Matching grants to states and local governments for the acquisition and development of public outdoor recreation areas and facilities.
Water Reclamation and Reuse Program *U.S. Bureau of Reclamation* http://www.usbr.gov/pmts/writing/guidelines/	Projects for reclamation and reuse of municipal and other wastewaters and naturally impaired waters.
Natural Resources Conservation Service--Conservation on Private Lands *National Fish and Wildlife Foundation* Program Number: 62681 http://www.nfwf.org/programs/nrcsnacd.cfm	Projects that engage private landowners, primarily farmers and ranchers, in the conservation and enhancement of fish and wildlife and natural resources on their lands.

[a] Web site address as of June 2006; address and information found there is subject to change.

Table 8-9. State and Federal Funding Sources
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Program Title *Agency* Web Site or Contact [a]	Description
Development of Community Wildfire Protection Plans *New Mexico Energy, Minerals and Natural Resources* Contact: Donald Griego, Fire Management Officer, Forestry Division Guide Reference No.: 5572035 - 12/18/2006 Potential Offerors may obtain a copy of the CWPP handbook at: http://www.safnet.org/policyandpress/cwpphandbook.pdf	Funding available through competitive proposal process for Community Wildfire Protection Plans (CWPP) for Wildland Urban Interface (WUI) areas. Plans should address local forest, range and watershed conditions, values-at-risk; and the reduction of fuel hazards to prevent fires and improve public safety, as well as the stakeholders that will be involved in the plan's development.

[a] Web site address as of June 2006; address and information found there is subject to change.

Some of the actions identified in this plan can be carried out by individual water providers, but most of the strategies are best pursued on a regional level. The ongoing cooperation of the counties and/or municipalities in the region will be necessary to oversee implementation of these strategies and will be key to successfully moving forward with this plan and protection of the region's resources.