6.0 NON-STRUCTURAL ALTERNATIVES

The Rock Mountain Institute has defined water conservation as increasing the efficiency of water use without diminishing the quality of services. In some cases conservation may allow communities to downsize, defer, or avoid new water infrastructure. Water conservation may represent a non-structural alternative for meeting the Project's purpose and need. At the very least water conservation can reduce water consumption and the Project's operation costs. Due to the Project's expense and environmental considerations, the communities in the service area will need to make every reasonable effort to maximize the current water supplies. The objective of this section is to evaluate the potential application of a water conservation program.

6.1 Water Conservation

Like any water supply alternative, water conservation needs to be evaluated based on its potential yield and its potential costs. These issues were addressed in water conservation plans prepared for the City of Albuquerque (Brown et. al 1996), the Santa Ynez Water Conservation District (Stetson Engineers, 1992) and the City of Gallup Forty Year Water Plan (Shomaker 1991). For the Santa Ynez Water Conservation District, Stetson Engineers evaluated the reported costs of reducing water use with three approaches to water conservation: (1) public education, (2) incentive programs, and (3) regulations.

6.1.1 Public education programs

The goal of public education programs is to increase water user awareness of habits that waste water and to promote understanding in the community on water conservation topics. Public information programs are relatively inexpensive. The California Department of Water Resources (CDWR) estimated that a community will typically reduce water use by 4 to 5 percent if public information is the only conservation program offered by a water agency. However, those savings largely depend on the number of water users already practicing water conservation measures. The CDWR estimated that additional reductions in water use in a community that already has a high level of community awareness, like the City of Gallup, are closer to one percent at a unit cost of approximately $300 per acre-foot. In the *1984 Plan Formulation and Environmental Statement*, Reclamation expressed concerns over the long-term effectiveness of voluntary programs.

6.1.2 Incentive programs

A more aggressive approach to water conservation is to financially reward water conservation and penalize wastefulness. These incentives may include increasing the unit cost of the water or implementing a seasonal fee structure to further encourage conservation during peak demands periods. For residential users the response to conservation incentives tends to vary with household income. For commercial users the response to water conservation incentives depends on the relative cost of water compared to the total operating costs. Stetson Engineers estimated that the cost of an education program combined with an incentive program targeting a 15 percent reduction has a unit cost of $990 per acre-foot. However, in a community like Gallup that has already adopted above average water rates and a seasonal rate structure, the resulting unit costs needed to reduce water use an additional 15 percent will be higher. The City's water plan cites the following studies:

- A study by the Colorado Water Resources Research Institute indicates that increasing water rates from $0.43 to $0.86 per thousand gallons (a 100 percent increase) reduced consumption by 25 percent.

- A study of water rates in the City of Santa Fe demonstrates that increasing water rates from $1.60 to $4.06 per thousand gallons (a 151 percent increase) reduced consumption by 39 percent.

- A study by the Texas Department of Water Resources indicates that a 10 percent increase in water rates results in a 3 percent reduction in municipal water use.

- A study by the California Department of Water Resources indicates that a 10 percent increase in water prices, reduces inside residential use by 2.6 percent and outside residential use by about 4 percent.

Most water utilities generate much of their revenue through the per-unit charge for water. Consequently, increasing the unit costs may encourage water conservation and, at the same time, increase the revenue needed to repay construction obligations and to pay for system operation, maintenance and repair. If the water rate accurately reflects the cost of the service and the value of water, then economically reasonable conservation incentives benefit both the utility and its customers. However, if the unit cost of the water becomes too high, and if the water use declines too much, the utility's revenue declines. The water rate structure must provide a stable income for the utility while conveying an accurate value for delivery of the water. A well designed conservation program will achieve this balance over time and will still provide enough price elasticity so that short term use reduction is still possible to address emergencies and droughts (Brown, et al, 1996).

As shown in Figure 4.2, the overall per capita water use rates in the service area are already among the lowest in the region. Per capita water use in Farmington and Albuquerque is 250 gallons per capita per day. By comparison, the per capita water use rate in Gallup is less than 170 gallons per capita per day. Navajo water users use far less. Significant, cost-effective, water conservation opportunities may not be available due to the relatively high water rates and low use.

The operation and maintenance expensive of the Project water may be greater than the current water rates. This higher rate may result in water users utilizing the over drafted groundwater before turning to the more costly pipeline supplies. Some type of pumping restrictions in the Gallup area may be required.

6.1.3 Regulatory programs

The CDWR suggested that the only way to achieve a 30 percent reduction in water use is through a program combining public education, incentives and regulations. Based on the Stetson study the unit cost for this type of program is $1,600 per acre-foot. Once again, for a community with very little outdoor water use, the unit costs will be much higher. And, according to Reclamation mandatory programs are less acceptable to the public.

The City of Gallup has recently raised water rates which should encourage water conservation. According to the City of Gallup's Forty Year Water-Supply Master Water Plan the City has instituted water conservation regulations which:

- Prohibit any person from allowing potable water to flow from his property onto any street.
- Prohibit the watering of streets with potable water.
- Restrict potable water usage by any person to 500 gallons per capita per day for soil compaction, street and driveway construction, or any other construction except where special permission has been granted.
- Prohibit the use of City fire hydrants or connections except by members of the City Water or Fire Departments.
- Prohibit leaky pipes, taps and appliances.
- Set minimum water-use standards for new plumbing.

The City is also pursuing:

- A public information program to promote water conservation.
- Xeriscaping of City parks and facilities.
- Restricting turf areas in new landscaping.
- Tiered water charges.
- Restricting lawn watering.

Due to the low per capita water use rates, in the *1984 Plan Formulation and Environmental Statement,* Reclamation concluded that a water conservation plan would not work for the Navajo communities in the study area. While conservation measures may help the City of Gallup meet short-term needs, it was not a viable solution to meet long-term needs, and water conservation will not address the problem of declining water quality. As a non-structural alternative, water conservation did not meet the Project's purpose and need.

6.2 Water Reuse

Although current safe drinking act regulations limit water reuse applications, water reuse can significantly increase a community's usable water supply. Under certain circumstances reclaimed water can be used on outdoor landscaping and athletic facilities. The City of Gallup has implemented several innovative water reuse projects to irrigate its golf course and athletic fields.

Navajo-Gallup Water Supply Project

On the Navajo Nation, irrigated landscaping is very limited and most wastewater ends up in sewage lagoons or evaporation ponds. The Navajo Nation and Reclamation have contracted with Westlands Resources to investigate water reuse opportunities. Appraisal level studies have been conducted in Tuba City and Ganado. The Nation Park Service has received a grant from the Arizona Water Protection Fund to use NTUA effluent in Ganado for a riparian restoration project.

Out of necessity within the next couple of decades "toilet to tap" water reuse systems will become commonplace across the West. At the current time there are no direct effluent-to-drinking water systems in use in Arizona or New Mexico. To make the concept socially acceptable some type of disconnect between the effluent and drinking water may be needed. For instance, if the treated effluent can be recharged in the ground, treatment costs may be reduced and the concept becomes more acceptable to the water users. Treated effluent may be more accepted for industrial uses than residential uses. The reuse system may include normal oxidation, micro filtration, activated carbon and disinfection.

Cost estimates by Westland Resources Inc. indicate that the capital cost of a toilet-to-tap system for a community like Gallup is $16 per gallon. Meeting the current peak demand of 5.5 million gallons per day will require a system with a capital cost of approximately $90 million. If the wastewater is available, the cost of a system designed to meet the average 2040 demand will cost $165 million. The estimated operation and maintenance cost is between $600 and $1,000 per acre-foot. Additional distribution systems will also be required. Even if this approach could assure a water supply, these unit costs far exceed the estimated cost of meeting the City of Gallup's demand with the Project.

6.3 Conjunctive use of groundwater and aquifer storage

Groundwater may be used conjunctively with the surface water supply to enhance the overall water supply available for the Project. Three approaches for conjunctive use have been considered: (1) utilizing wells during the summer when the water demand is at its peak, (2) supplementing the Project's surface water supply with groundwater during critical years on the San Juan River, and (3) aquifer storage and recovery. These approaches are described in greater detail in the following sections.

6.3.1 Utilize wells for peak summer demand

During the first few years of Project operation, the Project will have adequate capacity to greatly reduce groundwater withdrawals. Eventually, however, the City of Gallup and NTUA will need to utilize their wells for short periods during the summer when the water demand is at its peak. By the year 2040 the City's system will need to produce approximately 1,400 are-feet of groundwater, primarily during the summer months. The aquifers will be able to recharge during the remainder of the year. Although the City of Gallup's well fields may be able to supplement the total projected peak demands for a short period of time, it is unlikely that they will be able to replace the total projected summer demand.

Navajo-Gallup Water Supply Project

The estimated recharge to the source aquifers is very low, far less than current withdrawals. As the water demand increases over the next 20 years, without the Project, the demand to recharge ratios will become far less favorable. In conclusion, during the early life of the Project, the 1.3 peaking capacity in the system will greatly reduce, or eliminate, the City's dependence on groundwater. By the year 2040, groundwater will be needed to help meet the summer peak demands.

6.3.2 Supplemental groundwater during critical years

Theoretically, groundwater could supplement or replace the Project's surface water supply during critical years on the San Juan River. These critical years would depend on the flow recommendations adopted by the San Juan River Recovery Implementation Program to assist the recovery of the endangered species in the San Juan River (Holden 1999). These flow recommendations are intended to mimic the natural hydrograph of the San Juan River. These recommended flows require releases from Navajo Reservoir with the appropriate duration and frequency. However, based on the historic flow data, the critical period during which the recommended flows would have been most difficult to achieve lasted for seven years. Consequently, the USFWS may expect a commitment of seven acre-feet of groundwater to off set an acre-foot of proposed surface water depletion. This option is not practical for these groundwater aquifers.

6.3.3 Aquifer storage and recovery

In a January 26, 2000 letter to the City, John Shomaker and Associates, Inc., presented a technical review of aquifer storage. Based on that review, it may be possible to store and recover Project water. Eventually, it may also be economically possible to store and recover treated wastewater. Conceptually, production wells in the Yah-ta-hey and Santa Fe well fields would be used as injection wells during periods when water is available in excess of the City's demand. This water would then be available during periods when surface water is not available in adequate amounts. During the first years of the Project the City may only be able to utilize approximately 4,500 acre-feet per year out of the total Project allocation of 7,500 acre-feet. The difference may be available for recharge. This approach has been successful in other communities. The City of Santa Fe is recharging water and is proposing to expand its program with Title XVI funds. Typically the storage and recovery cycle is seasonal. With a seasonal cycle the stored water does not have enough time to move far from the recovery well, and the groundwater head does not have enough time to dissipate to pre-storage levels before the water is recovered.

Shomaker notes that the source aquifers for the City of Gallup are confined, and that they have very low hydraulic conductivities and storage coefficients. Because of the low conductivity, groundwater movement is relatively slow. For these reasons, the injected water would stay within reach of a recovery well for a longer than typical period, and the rise in water levels would take a long time to dissipate. Therefore, a longer recovery period might be feasible. Injecting Project water may restore part of the large decline in water levels in the wells and extend the life of the fields beyond the limits predicted by the City. The cost of storing this water would be partly offset by a reduction in the pumping lifts. Shomaker speculates that the water levels are so deep that water may be injected successfully by gravity flow, requiring no pumping. Aquifer storage is especially sensitive to the quality and chemical characteristics of the water. Shomaker concludes that the concept is worth considering. But, a complex analysis is needed before the feasibility of the concept can be determined.