

# Zuni Drought Contingency Plan



*Prepared by*  
**The Zuni Tribe**  
**Water Resources Section**  
**Conservation Program**  
**Zuni, New Mexico**

*In conjunction with*  
**Natural Resources Consulting Engineers, Inc.**  
**Berkeley, California & Fort Collins, Colorado**

**December 18, 2001**

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ZUNI TRIBAL COUNCIL  
PUEBLO OF ZUNI

RESOLUTION NO. ~~M70-2001-B050~~

WHEREAS, the Zuni Tribal Council, consisting of the Governor, Lieutenant Governor, and six Tenientes, is declared to be the legislative authority of the Pueblo of Zuni by Article V, Section 1, of the Constitution of the Zuni Tribe; and,

WHEREAS, the Zuni Tribal Council has the authority, in accordance with Article VI, Section 1(d) of the Constitution, to represent the Tribe and to act in all matters that concern the welfare of the Tribe; and,

WHEREAS, the Zuni Tribal Council has the authority, in accordance with Article VI, Sections 1(f) & 1(g) of the Constitution, to regulate the use of tribal resources involving water; and,

WHEREAS, in accordance with the Zuni Land Conservation Act of 1990 and through Tribal Resolution M70-93-L138, the Zuni Tribal Council approved the *Zuni Resource Development Plan* as a strategic document for the sustained development and management of the Tribe's natural resources; and,

WHEREAS, the *Zuni Resource Development Plan* includes provisions to "develop drought management procedures, risk analysis, and assessment of environmental and social impacts"; and,

WHEREAS, the Zuni Tribal Council accepted funding from the U.S. Bureau of Reclamation enabling the Tribe to develop the Zuni Drought Contingency Plan.

NOW, THEREFORE, BE IT RESOLVED, that the Zuni Tribal Council hereby adopts the Zuni Drought Contingency Plan.

BE IT FURTHER RESOLVED, that the Zuni Tribal Council hereby directs the Zuni Department of Natural Resources to coordinate the implementation of the Zuni Drought Contingency Plan, including providing and securing any necessary resources.

BE IT FURTHER RESOLVED, that the Zuni Tribal Council hereby directs all other appropriate Tribal programs and requests that all appropriate U.S. Bureau of Indian Affairs and U.S. Indian Health Service programs cooperate to support the implementation of the Zuni Drought Contingency Plan, including providing and securing any necessary resources.

NOW, THEREFORE, BE IT FURTHER RESOLVED, that the Zuni Tribal Council hereby directs the Zuni Department of Natural Resources to seek Congressional recognition for the Zuni Drought Contingency Plan leading to Tribal sovereignty in the declaration and mitigation of drought conditions on Zuni lands.

ZUNI TRIBAL COUNCIL:

*Malcolm B. Bowekaty*  
Malcolm B. Bowekaty, Governor

*E.P. Bowekaty*  
Eldred P. Bowekaty, Head Teniente

*Arden Kucate*  
Arden Kucate, Teniente

*Vivian M. Hattie 12/18/01*  
Vivian M. Hattie, Teniente

*B. Martza*  
Barton Martza, Lt. Governor

*Absent (Excused)*  
David W. Wyaco, Sr, Teniente

*Absent (Excused)*  
Dan Simplicio, Teniente

*Absent (Excused)*  
Charlotte T. Bradley, Teniente

CERTIFICATION

I hereby certify that the foregoing resolution was duly considered by the Zuni Tribal Council at a duly called meeting at Zuni, New Mexico, at which a quorum was present and that the same was approved by a vote of 5 in favor and 0 opposed on December 18, 2001.

*E.P. Bowekaty*  
Eldred P. Bowekaty, Tribal Council Secretary  
Pueblo of Zuni

~~APPROVED~~ / DISAPPROVED

*Malcolm B. Bowekaty*  
Malcolm B. Bowekaty, Governor  
Pueblo of Zuni

## INTRODUCTION

The purpose of the Zuni Drought Contingency Plan is to provide the Zuni Tribe with a policy and system for monitoring, assessing, and mitigating Zuni drought conditions, while supporting the sovereignty of the Zuni tribal government with respect to other governmental agencies when addressing drought situations on Zuni lands.

The Plan was funded by the U.S. Bureau of Reclamation under the authority of the Reclamation States Emergency Drought Relief Act of 1991, Title II, Drought Contingency Planning. Funding for the Plan was included as part of a request for emergency assistance during the drought of 1996, which affected a majority of the southern and western United States.

The drought of 1996 demonstrated the need for Zuni to be better prepared for periods of water shortages. Development and implementation of the Zuni Drought Contingency Plan will improve that preparedness. Utilization of the Plan will reduce the impacts of water shortages by identifying and monitoring areas and people at risk and by enhancing performance and coordination of drought related actions. Zuni expects that recognition of the Plan by Congress will support the Tribe's sovereign status to work directly with federal agencies on a government-to-government basis without requiring drought declaration by the State of New Mexico.

The Plan has been adopted by the Zuni tribal government through Tribal Resolution M70-2001-B050 and meets all the criteria in the authorizing federal legislation. It consists of the following four main components for implementation: 1) Monitoring, 2) Impact Assessment, 3) Response, and 4) Mitigation. In addition to these procedures, the Plan evaluates Zuni's risk for drought and includes considerations to ensure the proper implementation of the Plan.

Due to limited resources and the priority to address Zuni homelands, this Plan was designed for the Tribe's lands in New Mexico, i.e. the main Zuni Reservation and Mazone Ranch, which are located almost entirely within the Zuni River watershed. At this time, this Plan does not apply to the Zuni Salt Lake, which is used and managed subject to special cultural considerations and lies outside the Zuni River watershed. Figure 1 shows the Zuni lands covered by this Plan in relation to the Zuni River watershed. As additional resources become available and as priorities dictate, the other Zuni lands may be addressed in the future.

Nothing in this Plan is intended to address or quantify any water rights or claims of the Zuni Tribe.

This Plan has been prepared with careful consideration of Zuni culture and religion. While traditionally in the past it was considered "taboo" for people to talk about the likelihood of natural disasters, such as drought, the Tribe realizes that modern circumstances dictate that the Zuni government address this issue. And in the spirit of traditional ways which dealt with drought using more actions than words, this Plan will also focus on actions.

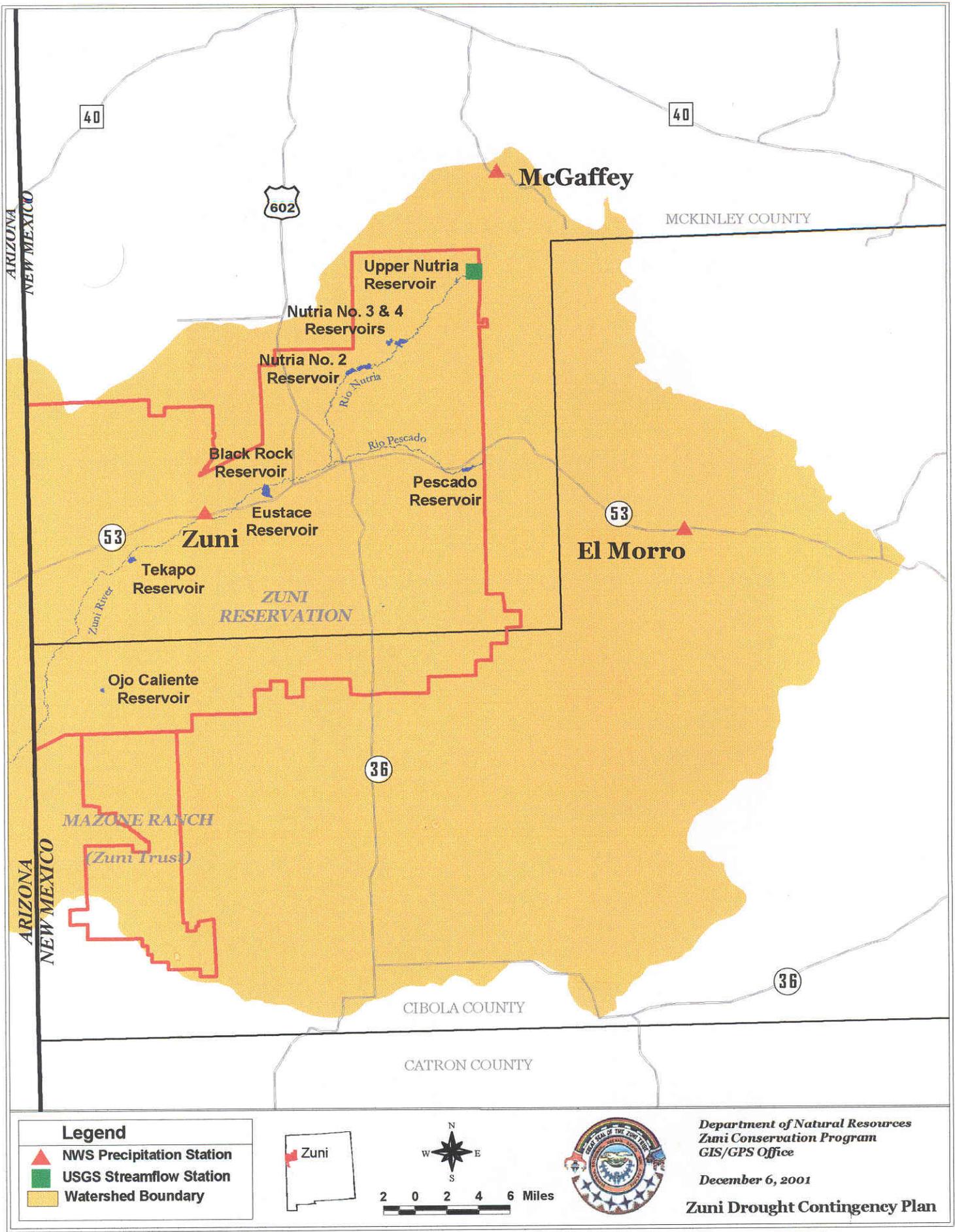


Figure 1: Zuni Lands, Drought Monitoring Stations and the Zuni River Watershed

Department of Natural Resources  
 Zuni Conservation Program  
 GIS/GPS Office  
 December 6, 2001  
 Zuni Drought Contingency Plan

## RISK

The vulnerability, or risk, of a society to drought may be defined generally as the extent to which it will be affected by periods of natural water shortages. This risk is different for every region, and even varies within a certain locality, since it is influenced by both natural and human factors. It also usually changes as human interaction with the environment evolves.

In order to adequately address drought at a local level, it is important to understand drought and the risk for Zuni from a local perspective, which includes natural and social/cultural dimensions. Having evolved and prospered in a semi-arid environment, the Zuni people have accepted drought as a natural phenomenon that has influenced their traditional practices and beliefs. Valuing water as precious and sacred with the deepest reverence is at the heart of Zuni culture and religion.

Historical accounts and evidence from tree-ring and climate studies report that severe droughts occurred in the Zuni area in the 970s to late 980s, the late 1230s, the 1580s, the late 18<sup>th</sup> century, the 1820s, the 1890s, 1921, and the 1950s [Hart, Richard, E., 1995, *Zuni and the Courts*, University Press of Kansas; Rose, Martin, 1989, *Rebuttal Report: Present and Past Climate of the Zuni Region*, Plaintiff's Exhibit 5000, Expert Testimony submitted to the United States Claims Court as evidence in the case *Zuni Indian Tribe v. United States*, Dockets 327-81L (Ct. Cl., filed May 12, 1981) and 224-84L (filed May 3, 1984)]. The drought of the late 18<sup>th</sup> century forced Zunis to move in temporarily with pueblos along the Rio Grande. Because of the risk of drought, Zunis would store at least a two-year supply of food. They made extensive use of their aboriginal territory for hunting and gathering when crops failed. Also, special religious pilgrimages were made during periods of drought. In recent times, Zuni has experienced droughts in 1996 and 2000, when requests for emergency assistance were made to the Bureau of Reclamation. Primary impacts were to livestock forage and water and fishing lakes. While past experiences have strengthened Zuni's ability to cope with drought, modern circumstances necessitate an evaluation of Zuni's current drought risk.

The *Drought Risk Assessment*, included in Appendix A, was performed to determine drought risk for different water use sectors in the context of water supply and use. Table 1 summarizes Zuni's current water supply use, management according to Tribal policies, and drought risk for the seven major water use sectors: 1) municipal, 2) domestic, 3) farming, 4) ranching, 5) fish & wildlife/recreation, 6) construction, and 7) wildfire suppression. The municipal sector includes the main water system supplying water for domestic, commercial, institutional, industrial, and urban fire suppression needs. The domestic sector includes domestic water systems not connected to the main water system. Religious water uses are not included here due to cultural considerations.

Drought risk is qualitatively described as "low", "medium", or "high" based on the potential impacts to water use from a decrease in the natural water supply with respect to "normal" or "average" hydrologic conditions. Risk does not consider the ability of supplies to meet all demands during "normal" conditions. "Extra" risk is described as added vulnerability from the underutilization of existing supplies due to lack of development. Zuni's drought risk is

**TABLE 1: Water Use and Drought Risk**

<b>Water Use Sector</b>	<b>Surface Water Supply</b>	<b>Ground Water Supply</b>	<b>Water Management</b>	<b>Drought Risk</b>
Municipal	Not applicable.	New wells from large, regional aquifer. Old wells from smaller, local aquifer.	Managed by Zuni Water Department subject to Zuni Utility Department Ordinance Title XXII (1988).	LOW risk for new wells/aquifer. MEDIUM risk for old wells/aquifer.
Domestic	Not applicable.	From springs and wells completed in local aquifers of minor to moderate extent.	Managed by individual owners and Zuni Water Department (Nutria & Ojo systems), subject to Zuni Range Code for Range Units.	LOW to MEDIUM risk depending on particular aquifer.*
Farming	Crop irrigation from Rio Nutria for NIU, from Cebolla Creek & Rio Pescado for PIU, and from Zuni River for ZIU and TIU. Some rainfed fields also supplied from runoff.	Crop irrigation from Nutria Springs for NIU, from Pescado Springs for PIU, and from Ojo Caliente Springs for OIU.	Managed by individual farmers and irrigation units subject to Zuni Irrigation Association Regulations and By-Laws (1992).	HIGH risk for rainfed fields. HIGH risk for surface water, especially when only source, such as ZIU & TIU. LOW to MEDIUM risk for ground water sources, such as NIU, PIU, OIU.* EXTRA risk for all irrigation units lacking adequate infrastructure.
Ranching	Livestock watering from rivers, lakes, and stock ponds (such as earthen tanks, rock catchments, and other collection developments).	Livestock watering from springs and wells completed in local aquifers of minor to moderate extent.	Managed by grazing permittees subject to Zuni Range Code (1976), Range Improvement Permits issued by BIA Natural Resources Branch, and to by-laws of the Zuni Livestock Committee (1993) and the four livestock associations which are represented on the Committee.	HIGH risk for forage/vegetation. HIGH risk for surface water sources. LOW to MEDIUM risk for ground water depending on particular aquifer.* EXTRA risk for all grazing units lacking adequate infrastructure.
Fish & Wildlife/ Recreation	From rivers, lakes, stock ponds, and other drinkers.	From springs and wells. Constructed wastewater treatment wetlands from municipal system.	Managed by Zuni Fish & Wildlife Department and Game & Fish Enforcement subject to Zuni Game and Fish Code (1976) and regulations for other uses.	HIGH risk for forage/vegetation. HIGH risk for surface water sources. LOW to MEDIUM risk for ground water depending on particular aquifer.*
Construction	From lakes.	From springs and wells.	Managed by Zuni Real Estate Services subject to Water Permits & supporting Tribal Resolutions and to regulations for other uses.	HIGH risk for surface water sources. LOW to MEDIUM risk for ground water depending on particular aquifer.*
Wildfire Suppression	From lakes and stock ponds.	From springs and wells, including municipal system.	Managed by BIA Zuni Agency Forestry/Fire Management Branch subject to regulations for other uses but no specific policies, except that use ranching water only with permission and replace amount used afterwards.	HIGH risk for surface water sources. LOW to MEDIUM risk for ground water depending on particular aquifer.*

Irrigation Units: NIU=Nutria; ZIU=Zuni; PIU=Pescado; TIU=Tekapo; OIU=Ojo Caliente

\*The risk depends on the particular aquifer since the aquifers have varying water yields and withdrawals which will affect its productivity and reliability during drought.

influenced by three main factors: 1) natural water supply availability, 2) development & infrastructure, and 3) management & policy.

With respect to water supply, drought risk is highest for uses dependent on precipitation and surface water and lowest for uses dependent on ground water. While most sectors use water from both surface and ground water supplies, depending on location, a general ranking of relative risk can be made considering the dominant water supply and the ability of a sector to “go” where water is available. In order from highest to lowest risk, the current ranking of water use sectors’ vulnerability to drought is: farming, ranching, fish & wildlife/recreation, wildfire suppression, construction, domestic, and municipal.

With respect to development and infrastructure, surface water is used more than necessary by some sectors due to the lack of development of ground water resources. Many existing wells are not used for ranching and other uses due to a lack of infrastructure. If sustainably managed, sufficient ground water should exist in various aquifers to support ranching, wildfire suppression, and construction, which currently compete with other surface water uses. Also, while major springs are used by all sectors, except municipal, they could be further developed and made more accessible for multiple uses to avoid conflicts between sectors. Consequently, surface water could be reserved primarily for farming and fish & wildlife/recreation, and wildfire suppression when needed. However, existing reservoirs and irrigation systems lack adequate storage and infrastructure to meet current demands even during “normal” conditions.

With respect to management and policy, water resources administration has not been adequately developed for normal conditions, much less for periods of water shortages. Few water-related regulations exist at Zuni. The Tribe lacks a comprehensive water policy for all water uses. Existing tribal policies for specific sectors do not adequately address water use and are in need of updating and/or enforcement to be effective. And some sectors do not even have a policy. Regardless of policy, the Tribe has also lacked sufficient coordination and planning for water resources development, management, and protection. Furthermore, a lack of “organizational memory” has caused past water studies, projects, problems, and solutions to be forgotten, which sometimes affects new initiatives. Until establishment of the Water Resources Section within the Zuni Conservation Program in 1995, Zuni has not had a comprehensive water resources program to address these types of issues.

Being a Tribe has its unique drawbacks and benefits when dealing with drought and related water resources development. In terms of benefits, Zuni’s history and cultural experience in its aboriginal, desert territory provides an advantage for coping with drought and its impacts. In terms of disadvantages, the Tribe has lagged behind mainstream society in securing sufficient resources for developing water resources infrastructure and acquiring its rightful water rights. Also, past actions by the federal government to “civilize” Zunis have resulted in the loss of many traditional practices which helped to minimize drought impacts. Nonetheless, with an understanding of and respect for drought, Zuni will continue to prosper for many millennia into the future through its strong culture, adaptability, and respect for the environment.

## MONITORING

The purpose of this Plan component is to establish a drought monitoring system using existing data collection efforts for collecting, analyzing, and disseminating information to decision makers and the community in order to declare the appropriate stage of drought.

The *Drought Monitoring Plan*, included in Appendix B, describes the three drought indices selected for Zuni: the Palmer Drought Severity Index (PDSI), the Z-Score Precipitation Index (ZPI), and the Stream Flow Index (SFI). These indices, or triggers, were chosen based on the availability of regularly-collected data, applicability to the Zuni area, and ease of determination. The PDSI is already calculated on a weekly basis for New Mexico's Climate Division 1, which includes all of the main reservation and Mazone Ranch. The ZPI will be calculated by Zuni using precipitation data from three National Weather Service stations: El Morro, McGaffey, and Zuni. The SFI will be calculated by Zuni using stream flow data from the U.S. Geological Survey station on the Rio Nutria at Nutria Canyon. Figure 1 shows these drought monitoring stations in relation to Zuni lands and the Zuni River watershed.

Table 2 shows the values of these indices which trigger the various drought stages. The PDSI and ZPI will be used for the municipal sector, as well as other sectors using ground water. The PDSI and SFI will be used for the farming sector, as well as other sectors using surface water. Table 5 shows the responsibilities of governmental organizations at Zuni for monitoring the different water use sectors. It also includes other data presently collected that will be useful for monitoring drought conditions. Table 7 shows other agencies which can provide assistance for monitoring activities. Forecasts for streamflow, the ENSO cycle (El Nino/La Nina), and climate and weather conditions will also be used as appropriate.

Indices will be determined on a monthly basis from April through October of each year. Since monthly data for the precipitation and stream flow stations are available one to two weeks after the end of each month, status reports will be prepared at mid-month intervals for the previous month. If drought conditions are indicated, then a meeting will be held with the appropriate organizations listed in Table 5 to discuss the information. Depending on the drought status and conditions indicated by other monitoring information, recommendations will be made to the Governor regarding issuance of a drought declaration through Tribal Resolution. When a drought declaration is made, appropriate agencies and the community will be notified, and impact assessment activities will be activated to determine the appropriate response actions. The "Implementation" section includes communication procedures for drought information.

Recommendations are described in Appendix B for additional data collection. Reservoir and ground water levels and major springs should be monitored to better indicate actual water supplies. The Safety of Dams Early Warning System will provide some additional data. However, Table 6 shows recommended priorities for other monitoring activities with estimated costs. Other recommendations include improving range surveys and monitoring, continuing the U.S. Geological Survey streamflow gaging stations, compiling all water resources data and information from existing studies, reports, etc. into a Hydrology Library, and implementing a comprehensive system for monitoring all water supplies and uses.

**TABLE 2: Drought Monitoring Triggers and Stages**

Drought Stage	General Wetness (All Water Use Sectors)	Ground Water Supply (Municipal Sector)	Surface Water Supply (Farming Sector)
	Palmer Drought Severity Index (PDSI)	Z-Score Precipitation Index (ZPI)	Stream Flow Index (SFI)
Normal	PDSI between -0.9 and + 5.0	ZPI is greater than -0.50	SFI greater than or equal to Q <sub>75</sub>
Alert (Mild Drought)	PDSI between -1.0 and -1.9 for more than 2 months or between -2.0 and -2.9 for 1 month	ZPI between -0.50 and -0.99	SFI between Q <sub>75</sub> and Q <sub>90</sub>
Warning (Moderate Drought)	PDSI between -1.0 and -1.9 for 9 months or more, between -2.0 and -2.9 for at least 2 months, or -3.0 or less for at least 1 month	ZPI declining between -1.0 and -1.49	SFI between Q <sub>90</sub> and Q <sub>95</sub>
Emergency (Severe to Extreme Drought)	PDSI between -2.0 and -2.9 for 9 months or more, between -3.0 and -3.9 for at least 2 months, or -4.0 or less for at least 1 month	ZPI declining and less than -1.5	SFI less than or equal to Q <sub>95</sub>
Emergency (drought receding)	After severe to extreme drought, PDSI improves to greater than -2.0 for 2 consecutive months	ZPI turns in positive direction for 2 consecutive months	SFI less than or equal Q <sub>95</sub>
Warning (drought receding)	PDSI continues to improve to greater than -1.5 for 2 consecutive months	ZPI rising in positive direction and between -1.00 and -1.49 for 2 consecutive months	SFI between Q <sub>90</sub> and Q <sub>95</sub>
Alert (drought receding)	PDSI continues to improve to greater than -1.0 for 2 consecutive months	ZPI rising in positive direction and between 0.0 and -0.99 for 2 consecutive months	SFI between Q <sub>75</sub> and Q <sub>90</sub>

See the *Drought Monitoring Plan*, Appendix B, Section 3 for a detailed explanation of these indices and stages.

In general, the PDSI and ZPI will be used for the sectors supplied by ground water, and the PDSI and SFI will be used for sectors supplied by surface water.

In the event of conflict between two indices, preference should be given to the ZPI for the ground water sectors and to the SFI for the surface water sectors.

## **IMPACT ASSESSMENT**

The purpose of this Plan component is to establish a drought impact assessment system using existing resources for collecting, analyzing, and disseminating information to decision makers and the community for determining appropriate response actions.

Once a drought declaration is made by the Governor, the appropriate agencies will be notified and begin the process of impact assessment. Table 5 shows the responsibilities of governmental organizations at Zuni for assessing impacts to the different water use sectors. The “Implementation” section includes communication procedures for drought information.

Potential impacts may include water system pressure problems or failure, increased public health problems from heat, dryness, and blowing dust, wildlife intrusion on crops and forage, poor crop yield and livestock health, loss of crops and livestock, financial and emotional strain on farmers and ranchers, loss of farmers and ranchers due to these problems, increased soil erosion, loss of fish and wildlife, reduced fishing and hunting permit revenue, construction delays or costs increases, and increased urban and wild fires.

Identifying impacts primarily involves inspecting the particular resource or communicating with the water users and community. Direct impacts may be straightforward to quantify while indirect impacts may require a more thorough evaluation. Nonetheless, assessing the type and extent of impacts is important to determine the appropriate response actions.

## RESPONSE

The purpose of this Plan component is to develop a response system for providing emergency, short-term assistance to relieve identified impacts. As in dealing with any type of disaster situation, this type of emergency response is referred to as crisis management.

After a drought declaration is made and impacts have been identified, then the appropriate agencies will determine and implement the necessary response actions. Table 5 shows the responsibilities of governmental organizations at Zuni for providing response assistance to the different water use sectors. Table 3 shows the possible response actions for the different water use sectors. Table 7 shows other agencies which can provide assistance with the response actions. The “Implementation” section includes communication procedures for drought information.

The *Drought Mitigation Alternatives Assessment*, included in Appendix C, and Appendix B describe some of these and other response actions in more detail. These actions may be implemented at various drought stages depending on the severity of identified impacts. Any policies dictating mandatory measures to be taken by the community will be implemented only with the approval of the Tribal Council.

In cases of conflicts between water use sectors for the same source, prioritizing water uses may be necessary. In determining the relative importance of uses, considering which uses are essential, socioeconomically valued, and nonessential will be required. For Zuni, essential uses include drinking, maintaining public health, and wildfire suppression. Socioeconomically valued uses include farming, ranching, construction, and fish & wildlife. Nonessential uses include recreation and unnecessary domestic uses, such as lawn watering, car washing, etc. While this prioritization scheme may generally be applied, certain circumstances may dictate prioritizing uses on a case by case basis, especially for uses of equal importance. Under these circumstances, meetings will be held with the appropriate entities to determine water use priorities, subject to approval of the Tribal Council.

Recommended response priorities include modifying old municipal wells and pumping facilities for other uses, acquiring portable pumping, storage, and distribution units, and enhancing development of and access to major springs. Table 6 shows these recommended priorities for response actions with estimated costs.

**TABLE 3: Drought Response Actions**

Water Use Sector	Possible Response Actions
All Sectors	Distribute water conservation and drought information to community Seek outside assistance (such as for emergency water, feed, personal financial assistance, etc.) Seek voluntary limits on non-essential uses Increase active enforcement of relevant Tribal codes and policies Anticipate conflicts between different sectors and prioritize water uses Use old municipal wells or other existing wells as appropriate (see Appendix C, Appendix 1) Haul water as appropriate (on-Zuni lands, off-Zuni lands, IHS water tanker) Use portable pumping/storage/distribution units Increase maintenance/repair of roads for water hauling routes Drill new wells as appropriate, such as those listed in Appendix C, Section 2.2 Use/improve Nutria/Pescado/Ojo Caliente/Black Rock springs & develop other springs
Municipal	Impose water use restrictions, such as those listed in Appendix B, Section 4.0 Stockpile equipment and supplies Maintain old wells (Z-4, Z-7 & F-2) and pumping facilities for emergency backup Increase system inspections for maintenance, leaks, and inefficiencies
Domestic	Share wells Connect to main system Repair and use small systems at Nutria and Ojo Caliente
Farming	Reuse irrigation tail water (return flow) Measure and regulate diversions to ensure diverting only amount necessary Schedule irrigation rotation for equal shares Leave fields fallow Select appropriate crops, such as traditional Zuni varieties and other drought-resistant crops Use traditional runoff fields Use field conservation measures (eg. level fields, line ditches, efficient irrigation/tillage, mulch) Use water from beaver ponds Use treated wastewater from constructed wetlands for forage, if quality is acceptable
Ranching	Repair existing wells, pumps, and watering facilities (tanks, pipelines, drinkers) Use water from beaver ponds Use treated wastewater from constructed wetlands, if quality is acceptable Purchase, transport (Tribal semi-trailer), and store (wool warehouse) bulk emergency feed Reduce herds Increase frequency and extent of range surveys and monitoring Control grazing in sensitive/impacted areas Rotate/rest pastures Open/lease additional grazing areas, such as Forest Unit, Mazone Ranch, Arizona ranches
Fish & Wildlife/ Recreation	Use treated wastewater from constructed wetlands Modify fishing and/or hunting limits and/or fees Prepare for decreased revenue from permits Manage beavers and their dams as appropriate Manage fish stocking as appropriate
Construction	Use treated wastewater from constructed wetlands Ensure adequate notice of requests and coordination of issuing permits Increase monitoring of permitted water use Reduce or limit water use and/or construction projects Increase water royalties
Wildfire Suppression	Impose fire restrictions Use treated wastewater from constructed wetlands Use fire suppressants that reduce or eliminate water requirements Reduce forest fuels Increase field personnel Use portable 1,500 gallon water tank where needed

## MITIGATION

The purpose of this Plan component is to develop mitigation strategies for implementing long-term measures to reduce drought risk. As in dealing with any type of disaster, this type of strategic approach is referred to as risk management.

Table 5 shows the responsibilities of governmental organizations at Zuni for providing assistance with mitigation actions to the different water use sectors. Table 4 shows the possible mitigation actions for the different water use sectors. Table 7 shows other agencies which can provide assistance with the mitigation actions. The *Drought Mitigation Alternatives Assessment*, included in Appendix C, describes some of these and other mitigation actions in more detail.

A primary, general mitigation strategy will be to expand and enhance the sustainable development of ground water to lessen the demand on surface water and heavily used ground water sources. Also, the rehabilitation and maintenance of existing surface and ground water developments will be pursued.

Recommended priorities include restoring storage capacities for all reservoirs, as listed in Appendix D, rehabilitation of existing and installation of new farming irrigation facilities, as listed in Appendix E, rehabilitation of existing and development of new range watering facilities, as listed in Appendix F, modification of old municipal wells and pumping facilities, and enhancement of existing spring developments. Table 6 shows these recommended priorities with estimated costs. Other recommendations for ongoing activities include improving the Water Permit process, continuing to promote sustainable natural resources development, management, and protection, enhancing educational and assistance opportunities to land users and the community, and increasing efforts to secure Zuni's water rights. Evaluating and improving the Water Permit system should also be a priority based on the water shortages and problems experienced during the summer of 2001.

**TABLE 4: Drought Mitigation Actions**

Water Use Sector	Possible Mitigation Actions
All Sectors	Promote water conservation & drought education, including demonstration projects Develop well permitting and assistance program Develop a Tribal Water Plan and Code Secure water rights Develop drought contingency plans for each water use sector Improve administration and enforcement of relevant Tribal codes and policies Enhance/maintain/protect Nutria/Pescado/Ojo Caliente/Black Rock/other spring developments
Municipal	Provide adequate resources for system operation, maintenance, repair, and replacement Implement a rate structure or surcharge program to discourage wasteful water practices Maintain old wells (Z-4, Z-7 & F-2) and pumping facilities for emergency backup Meter all system connections Improve record keeping to report water use Update Zuni Utility Department Ordinance Title XXII (1988) Evaluate feasibility for water reuse Provide incentives for installation of water-saving devices and replacement of defective fixtures Promote xeriscaping if/when lawn watering allowed Implement Source Water Assessment for old wells & perform/implement one for new wells
Domestic	Encourage connection to municipal system Rehabilitate small systems at Nutria & Ojo Caliente and develop ones at other farming villages
Farming	Use existing wells or drill new wells, as listed in Appendix C, to augment limited crops Measure irrigation diversions Replace irrigation ditches with pipelines and appropriate valves Reuse irrigation tail water (return flow) Use treated wastewater from constructed wetlands for Tekapo Unit, if quality acceptable Evaluate/repair/maintain existing dams and irrigation works Develop reservoir operation rules to optimize irrigation releases Increase capacity of reservoirs through dredging or modification Implement soil moisture monitoring program Use traditional Zuni crop varieties and other drought-resistant varieties Use traditional runoff fields and techniques Conduct training for farmers (irrigation & planting methods, soil & water conservation, etc.) Use field conservation measures (eg. level fields, line ditches, efficient irrigation/tillage, mulch)
Ranching	Evaluate/repair/maintain existing springs/wells & watering facilities (tanks, pipelines, drinkers) Develop new springs/wells with watering facilities Evaluate/repair/maintain existing stock ponds (earthen & other water harvesting catchments) Construct new stock ponds Address water development ownership issues (i.e. costs/fees, technical assistance, maintenance) Conduct training for ranchers (range & herd management, well/pump maintenance, etc.) Revise, implement, and enforce Zuni Range Code Develop range management plans for each range unit Improve range survey and monitoring methods
Fish & Wildlife/ Recreation	Dredge Eustace and Nutria Nos. 2, 3 & 4 Reservoirs and channel between Nutria Nos. 3 & 4 Construct drinkers (see "Farming" & "Ranching" above for other water developments) Implement beaver management plan Restore and protect riparian and wetland areas
Construction	Maintain old municipal wells Develop other accessible sources, such as Ojo Caliente sump Improve Water Permit system by evaluating policies and financial system and accountability Develop permit revenue set-aside for water development/management Include adequate funding for water in construction project budgets
Wildfire Suppression	Implement fuels reduction program Maintain old municipal wells

## IMPLEMENTATION

Two main factors for the successful implementation of the Plan are 1) the involvement of all appropriate organizations and the community and 2) the ongoing evaluation and revision of the Plan to meet Zuni's changing needs.

Involving the appropriate organizations and the community includes proper coordination of activities and distribution of information. Table 5 shows the responsibilities of governmental organizations at Zuni for drought related actions. Support will be provided by other programs not listed, such as the GIS/GPS Section of the Zuni Conservation Program for database and mapping assistance, the Office of Planning and Development for assistance with securing funding, and the Game and Fish Officers for enforcement of relevant codes. Also, the Tribal Council and Tribal Administrator, BIA Superintendent, and IHS Director will provide direction and authority for certain actions. The Governor will make drought declarations.

All official communications to entities outside the Zuni government regarding drought declarations will be made through the Tribal Administrator and Tribal Council. Information will be distributed to the community using the local radio station, KSHI, and local newspaper, *The Shivi Messenger*, and if necessary, through flyers and/or meetings.

The Plan will be reviewed and updated at a minimum of every five years. It will also be evaluated and revised following the occurrence of drought events. Appendix B, Section 5.3 describes items to consider when revising the Plan.

While the Plan is ready for implementation, several priorities are recommended for monitoring, response, and mitigation to enhance and support the Plan. Table 6 shows these priority actions and the required funding for implementation.

Table 7 shows agencies outside of Zuni which can provide assistance with drought related actions. A comprehensive list of the most-up-to-date information on drought assistance programs, resources, and points of contacts is available within the Catalog of Federal Assistance Programs on the website of the Western Drought Coordination Council at <http://enso.unl.edu/wdcc>.

Overall responsibility and point of contact for the Zuni Drought Contingency Plan will reside with the Water Resources Section of the Zuni Conservation Program.

**TABLE 5: Drought Organizational Responsibilities**

<b>Water Use Sector</b>	<b>Agency</b>	<b>Monitoring</b>	<b>Impact Assessment</b>	<b>Response &amp; Mitigation</b>
All Sectors	ZCP Water Resources Section	Determine drought triggers; Monitor water levels, including management of the Flood Early Warning System	Assess impacts to water supplies	Improve water resources management; Assist with actions in Tables 3 & 4; Coordinate assistance from BOR, COE & FEMA
	ZCP Watersheds Section	Assist Water Resources Section; Monitor erosion	Assist Water Resources Section; Assess impacts on erosion	Assist Water Resources Section; Implement erosion control measures
	Zuni Water Rights Program	Assist with funding	Not applicable	Assist with funding; Secure water rights; Assist with development of water code & plan
Municipal and Domestic	Zuni Water Department	Monitor main system operation, use, and demand	Assess impacts to main system	Issue main water system use restrictions; Pursue actions in Tables 3 & 4
	IHS Environmental Health	Assist with water quality data collection	Assess impacts to public and environmental health	Pursue actions in Tables 3 & 4; Coordinate assistance from PHS (water tanker)
	Zuni Environmental Protection Program	Assist with water quality data collection	Assess impacts to public and environmental health	Pursue with actions in Tables 3 & 4; Coordinate assistance from EPA & NMED
Farming and Ranching	BIA Branch of Natural Resources	Conduct snow surveys & range surveys/monitoring; Issue Grazing & Range Improvement Permits; Complete annual crop reports; Communicate conditions from farmers and ranchers; Communicate monitoring information with McKinley County FSA Committee	Assess impacts to farming and ranching	Seek irrigation development funding; Improve effectiveness of Zuni Range Code; Pursue actions in Tables 3 & 4; Coordinate assistance from USDA (FSA, NRCS), McKinley County FSA Committee and other BIA offices; Coordinate assistance to farmers and ranchers
	ZCP Agriculture Section	Communicate conditions from farmers	Assess impacts to farming	Pursue actions in Tables 3 & 4 for farming; Coordinate assistance to farmers
	ZCP Range Section	Monitor ranch well levels; Communicate conditions from ranchers	Assess impacts to ranching	Pursue actions in Tables 3 & 4 for ranching; Coordinate assistance to ranchers
	Zuni Cooperative Extension Service	Communicate monitoring information with County/State CES	Assess impacts to farming and ranching	Pursue actions in Tables 3 & 4; Coordinate assistance from County/State CES & USDA
Fish & Wildlife/ Recreation	Zuni Fish & Wildlife Department	Monitor lakes for fish needs and other supplies for wildlife needs & populations	Assess impacts to fish & wildlife populations & habitat	Pursue actions in Tables 3 & 4; Liaison to NRCS State Technical Committee; Coordinate assistance from USFWS & NMGF
Construction	Zuni Real Estate Services	Coordinate with Water Resources Section for issuing Water Permits and monitoring permitted water use	Coordinate with construction project managers to assess impacts to projects	Modify Water Permit conditions accordingly; Increase monitoring of permitted water use; Pursue actions in Tables 3 & 4
Wildfire Suppression	BIA Branch of Forestry/ Fire Management	Collect weather station, rain gages, and mobile weather readings; Log water source conditions; Issue fire danger rating	Assess impacts to forests and potential water sources	Issue fire restrictions; Pursue actions in Tables 3 & 4; Coordinate assistance from USFS, NPS, and other BIA offices

Acronyms: ZCP=Zuni Conservation Program; BIA=U.S. Bureau of Indian Affairs, Zuni Agency; IHS/PHS=U.S. Indian Health Service/Public Health Service; CES=Cooperative Extension Service; for other acronyms, see Table 7.

**TABLE 6: Drought Funding Priorities**

<b>Plan Component</b>	<b>Activity</b>	<b>Cost</b>
Monitoring	Develop storage capacity ratings and install water level gages at the following 3 reservoirs: Eustace, Tekapo, and Ojo Caliente @ \$10,000 each	\$30,000
	Install water level gages at the following 4 reservoirs: Upper Nutria, Lower Nutria, Nutria No. 3, Nutria No. 4 @ \$1,500 each	\$6,000
	Install water level recorders at the following 4 wells: 2 wells in the Glorieta-San Andres aquifer; and 2 wells in the Sonsela sandstone of the Chinle Formation @ \$2,000 each	\$8,000
	Install discharge gaging stations at the following 4 springs: Nutria, Pescado, Ojo Caliente, and Black Rock @ \$3,000 each	\$12,000
		<b>SUBTOTAL: \$56,000</b>
Response	Modify 3 old municipal wells and pumping facilities (F-1, F-3 & F-4) for use by other sectors @ \$10,000 each	\$30,000
	Enhance developments at the following 4 springs: Nutria, Pescado, Ojo Caliente, and Black Rock @ \$15,000 each	\$60,000
	Acquire 5 portable pumping/storage/distribution units @ \$6,000 each	\$30,000
		<b>SUBTOTAL: \$120,000</b>
Mitigation	Restore water supply storage capacity for all reservoirs: (See Appendix D)	\$67,689,600
	Develop new and rehabilitate existing farming water developments: (See Appendix E)	\$879,806
	Develop new and rehabilitate existing ranching water developments: (See Appendix F)	\$999,600
		<b>SUBTOTAL: \$69,569,006</b>
<b>All Components</b>		<b>TOTAL: \$69,745,006</b>

**TABLE 7: Drought Assistance Partners**

<b>Agency</b>	<b>Monitoring</b>	<b>Response &amp; Mitigation</b>
National Oceanic & Atmospheric Administration (NOAA)	Assistance with climate and weather forecasting and drought monitoring at regional and national scales	Not applicable
National Weather Service (NWS)	Assistance with acquiring precipitation data from the three stations used for the ZPI trigger; Assistance with the Early Warning System through the established Memorandum of Understanding	Not applicable
U.S. Geological Survey (USGS)	Assistance with acquiring streamflow data from the Rio Nutria station for the SFI trigger; Assistance with other surface water monitoring activities	Not applicable
Natural Resources Conservation Service (NRCS)	Assistance with snow surveys and streamflow forecasts	Emergency assistance through Emergency Watershed Protection Program and other drought relief programs; Mitigation assistance through EQUIP, WRP, WHIP, etc.
Bureau of Reclamation (BOR)	Assistance with funding for monitoring equipment and activities	Emergency assistance through Reclamation States Emergency Drought Relief Act; Mitigation assistance through proposed Indian Small Water Projects Act for farming, General Investigations for ranching, and other programs-Native American Program funding, Technical Assistance, etc. & special Congressional allocation
Federal Emergency Management Agency (FEMA)	Not applicable	Assistance with damage estimates, recommendations of disaster assistance funding, and updating of Plan
Environmental Protection Agency (EPA)	Assistance with collection of water quality data	Assistance with Source Water Assessment and other mitigation activities
U.S. Department of Agriculture Farm Service Agency (FSA)	Not applicable	Assistance through American Indian Livestock Feed Program, CRP, ECP, EFP & other USDA drought relief programs
National Park Service (NPS)	Not applicable	Assistance with fire suppression
U.S. Forest Service (USFS)	Assistance with monitoring fire conditions	Assistance with fire suppression
U.S. Fish and Wildlife Service (USFWS)	Assistance with monitoring fish & wildlife	Assistance with mitigation activities
U.S. Army Corps of Engineers (COE)	Assistance with funding for monitoring activities	Assistance with response and mitigation activities
NM Office of Emergency Management (NMOEM)	Sharing data; Liaison for NM Drought Plan	General emergency assistance
NM Environment Department (NMED)	Assistance with collection of water quality data	Assistance with mitigation activities
NM Office of the State Engineer (NMOSE)	Sharing data; Liaison for NM Drought Plan	Cooperation to secure water rights
NM Game and Fish Department (NMGF)	Assistance with monitoring fish & wildlife	Assistance with mitigation activities
McKinley & Cibola County	Sharing data	General emergency assistance

## Reservoir Storage Restoration

Reservoir Name	Past Storage		Current Storage		Accumulated Sediment (acre-feet)	Sediment Removal Cost <sup>6</sup>
	Date	Capacity (acre-feet)	Date	Capacity (acre-feet)		
Upper Nutria	Unknown	Unknown	1993 <sup>1</sup>	120	Unknown	Unknown
Lower Nutria	Unknown	Unknown	1993 <sup>2</sup>	5	Unknown	Unknown
Nutria No. 3	1968 <sup>3</sup>	1,076	1993 <sup>1</sup>	0	1,076	\$4,304,000
Nutria No. 4	1968 <sup>3</sup>	878	1993 <sup>1</sup>	747	131	\$524,000
Nutria No. 2	1968 <sup>3</sup>	2,560	1993 <sup>1</sup>	2,560	0	\$0
Pescado	1968 <sup>3</sup>	720	1993 <sup>1</sup>	720	0	\$0
Black Rock	1908 <sup>3</sup>	15,000	1993 <sup>1</sup>	2,230	12,770	\$51,080,000
Tekapo	1937 <sup>4</sup>	400	1972 <sup>5</sup>	300	100	\$400,000
Ojo Caliente	1937 <sup>4</sup>	275	1972 <sup>5</sup>	250	25	\$100,000
Eustace	1968 <sup>3</sup>	230	Unknown	Unknown	Unknown	Unknown
<b>All Reservoirs<sup>7</sup></b>		<b>21,139</b>		<b>6,932</b>	<b>14,102</b>	<b>\$56,408,000</b>
Contingency @ 20% (for "unknown" quantities)						\$11,281,600
<b>TOTAL</b>						<b>\$67,689,600</b>

<sup>1</sup>U.S. Army Corps of Engineers, *Zuni Feasibility Study*, June 1993.

<sup>2</sup>Zuni Conservation Program, Unpublished survey data for Lower Nutria Diversion Dam, July 1993.

<sup>3</sup>U.S. Bureau of Reclamation, *Examination of Dams and Appurtenant Facilities for Bureau of Indian Affairs, Zuni Indian Reservation, New Mexico*, January 1969.

<sup>4</sup>Dreamer, Mort, *Report on Minor and Major Construction Activities, Zuni Indian Irrigation Project, Zuni, New Mexico*, August 1993.

<sup>5</sup>Orr, Brennon, *Water Resources of the Zuni Tribal Lands, McKinley and Cibola Counties, New Mexico*, U.S. Geological Survey Water Supply Paper 2227, 1987.

<sup>6</sup>The cost for sediment removal was determined using an estimated unit cost of \$4,000 per acre-foot of sediment.

<sup>7</sup>For purposes of determining total past storage, current storage, and accumulated sediment for all reservoirs, "unknown" capacities were assumed unchanged and, therefore, the resulting "unknown" accumulated sediment was assumed to be zero, even though these reservoirs most likely have accumulated sediment.

## Farming Water Development and Rehabilitation

<b>Irrigation Unit</b>	<b>Description</b>	<b>Quantity</b>	<b>Cost Per Foot</b>	<b>Cost</b>
Nutria	Install 15-inch PVC pipeline	10,000 feet	\$10.88	\$108,800
	Install 12-inch PVC pipeline	10,000 feet	\$7.45	\$74,500
	Install 8-inch PVC pipeline	11,469 feet	\$3.33	\$38,200
Pescado	Install 12-inch PVC pipeline	7,080 feet	\$7.45	\$52,800
	Install 10-inch PVC pipeline	8,000 feet	\$5.60	\$44,800
	Install 8-inch PVC pipeline	10,000 feet	\$3.33	\$33,300
Zuni	Install 18-inch PVC pipeline	10,000 feet	\$14.30	\$143,000
	Install 12-inch PVC pipeline	12,000 feet	\$7.45	\$89,400
	Install 8-inch PVC pipeline	16,544 feet	\$3.33	\$55,100
Tekapo	Install 12-inch PVC pipeline	5,560 feet	\$7.45	\$41,422
	Install 8-inch PVC pipeline	5,000 feet	\$3.33	\$16,650
Ojo Caliente	Install 8-inch PVC pipeline	10,560 feet	\$3.33	\$35,200
<b>Subtotal</b>				<b>\$733,172</b>
Contingency @ 20%				\$146,634
<b>TOTAL</b>				<b>\$879,806</b>

## Ranching Water Development and Rehabilitation

Range Unit	Well Name	Description	Itemized Cost	Cost
Zuni/Nutria Cattle Assoc.	RWP 38	Install solar water pump	\$20,000	\$20,000
Zuni Cattle Association	IRR 2	Install solar water pump	\$20,000	\$20,000
L. Mahkee	ECW 2	Install solar water pump & 12,000 gallon storage tank	\$20,000 \$10,000	\$30,000
Z. Romancito	Romancito	12,000 gallon storage tank	\$10,000	\$10,000
C. Walela	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
F. Loncacello	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
R. Lateyice	Paquin well	Install solar water pump & 12,000 gallon storage tank	\$5,000 \$10,000	\$15,000
Michael Soseeah	Tekapo well	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
Paul Leekity Sr.	Leekity well	Install solar water pump	\$5,000	\$5,000
D. Romancito	ECW 9	Install solar water pump	\$20,000	\$20,000
Chris Martza	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
Lolita Wytewa	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
Gabriel Paloma	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
Dorothy Ponchuella	RWP 32	Install solar water pump & 12,000 gallon storage tank	\$1,500 \$10,000	\$11,500
Lynn Neumeyah	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
Jack Mahkee/Ruby Wolf	RWP 3	12,000 gallon storage tank	\$10,000	\$10,000
Dixie Tsabetsaye	Zuni 1	Install solar water pump	\$1,500	\$1,500
Francis Leekya Jr.	ECW 1	12,000 gallon storage tank	\$10,000	\$10,000
Roseleen Eustace	RWP 29	Install solar water pump	\$1,500	\$1,500
Gilbert Quam	ECW 14	Install solar water pump	\$20,000	\$20,000
Chauncey Simplicio	RWP 5	Install solar water pump	\$60,000	\$60,000
Jack Mahkee	RWP 33	12,000 gallon storage tank	\$10,000	\$10,000
Quentin Bowannie	Bowannie well	12,000 gallon storage tank	\$10,000	\$10,000
Virginia Alvarado	RWP 26	Install solar water pump	\$20,000	\$20,000
Jonathan Lementino	No facilities	Install solar water pump & 12,000 gallon storage tank	\$1,500 \$10,000	\$11,500
Randolph Lallo	ZCE 20	Install solar water pump & 12,000 gallon storage tank	\$1,500 \$10,000	\$11,500

Anson Wallace	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
Paul Peynetsaye	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
Auqustine Panteah	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
Martha Lonasee	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
Lorelei Pooacha	Loncession well	Install solar water pump & 12,000 gallon storage tank	\$5,000 \$10,000	\$15,000
Joey Nastacio	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
Ed Beyuka	No facilities	Install solar water pump & 12,000 gallon storage tank	\$1,500 \$10,000	\$11,500
Amos Pooacha	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
Darrel Quam	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
Bernard Bowekaty	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
Sidney Quam	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
Mike Laate	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
Ricky Laahty	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
Elroy Chopito	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
Lorraine Natachu	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
Leland Peyketewa	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
Calvert Martinez	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
Pitkin Natewa	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500

Alvin Nastacio	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
Fred Bowannie Jr.	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
Craig Eustace	Eustace well	Install solar water pump & 12,000 gallon storage tank	\$1,500 \$10,000	\$11,500
Derrick Hattie	Hattie well	Install solar water pump & 12,000 gallon storage tank	\$1,500 \$10,000	\$11,500
Jimmy Yawakie	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
Orson Nakatewa	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
Joe Tsabetsaye	ECW 8 ECW 19	Install solar water pump Install solar water pump & 12,000 gallon storage tank	\$20,000 \$3,000 \$10,000	\$33,000
Richard Wytewa	No facilities	Drill new well Install solar water pump & 12,000 gallon storage tank	\$2,000 \$1,500 \$10,000	\$13,500
Wayne Quam	Warren Ondelacy well	Install solar water pump & 12,000 gallon storage tank	\$65,000 \$10,000	\$75,000
<b>Subtotal</b>				<b>\$833,000</b>
Contingency @ 20%				\$166,600
<b>TOTAL</b>				<b>\$999,600</b>