

ATTACHMENT D

Preliminary Reservoir Storage Modeling Analysis

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in Collaboration with the

Water Acquisition and Management Subcommittee

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1.0 INTRODUCTION

The goal of this project was to assist the Middle Rio Grande Endangered Species Act Collaborative Program (Program) in undertaking a Preliminary Analysis of various options for storage and management of water in order to minimize the need for the Program to acquire supplemental water. The Water Acquisition and Management Subcommittee (WAM), working with the Utton Transboundary Resources Center (Utton Center) at the University of New Mexico School of Law, evaluated potential hydrologic models, and worked cooperatively to develop scenarios for alternative reservoir management using the Upper Rio Grande Water Operations Model (URGWOM). These scenarios would represent potential long-term institutional changes to help optimize reservoir storage flexibility. The goal was to help improve water management in the Middle Valley and, potentially, provide additional water for Program objectives.

The objective of the Preliminary Analysis was to identify whether any water savings might potentially be gained by implementation of alternative reservoir management scenarios and quantifying the magnitude of those savings. It was never anticipated that the savings would automatically be available as supplemental water for endangered species. Rather, the concept was that improved efficiencies would result in the *potential* for some of the saved water to be available to be managed for Program purposes. Making the water available for Program purposes would involve significant further analysis, environmental and policy considerations and political action. Concerted negotiations among stakeholders would be necessary. The institutional changes under consideration were envisioned to promote the long-term sustainability of Program accomplishments.

The process within WAMS of developing scenarios to model and the discussion of their potential advantages and constraints was a consensus process. As WAMS discussed this, every scenario proposed raised concerns on the part of at least one critical stakeholder opposed to modeling a revised reservoir operation scheme. This report will provide a summary of alternatives proposed and give a brief summary of the background concerning each. Although we did not reach agreement on proceeding with modeling any scenarios at this time, it is hoped that the process will provide some information and direction to future endeavors to examine potential revised reservoir operations.

2.0 BACKGROUND

The listing in 1994 of the Rio Grande silvery minnow (minnow) as endangered under the Endangered Species Act (ESA) and the drought conditions experienced in the Middle Rio Grande Valley since 1996 led to a lawsuit being filed in late 1999. Several environmental groups filed suit in federal district court in New Mexico against the Bureau of Reclamation and the U.S. Army Corps of Engineers. The lawsuit, *Minnow v. Keys*, has been through numerous hearings in district court and several issues have been appealed to the Tenth Circuit Court of Appeals. Since the date that the Preliminary Analysis was concluded, Congress has enacted legislation prohibiting the use of the San Juan-Chama Project water for endangered species, the City of Albuquerque has entered into a settlement agreement with the Plaintiffs, and the District Court has ruled on title to the Middle Rio Grande Conservancy District works. Further detail on the course of the litigation is contained in Appendix 1. Although not directly related to the Program, the on-going litigation has been in the background and will continue to effect the development of the Program.

Many believe that it is imperative that Middle Valley water users agree on alternative management strategies for the river to serve the needs of water users, meet the conditions of the Rio Grande Compact (Compact) and provide for minimum stream flows for the minnow. Failure to do so may mean protracted and costly litigation, uncertainty for water development projects, and potentially the extinction of a species.

2.1 The Middle Rio Grande Endangered Species Act Collaborative Program

Water management responsibilities in the Program area are presently divided among many different entities, including the State of New Mexico, federal agencies, Native American Pueblos and one Indian Nation, local governments, the MRGCD, and others. There are also important agencies involved that are not responsible for water management but are integral in the river management decision-making process, such as the U.S. Fish and Wildlife Service. The Collaborative Program provides a venue for all of these agencies and interest groups to talk with one another about river management concerns.

The Program is comprised of federal, tribal, state, and local governments, as well as non-governmental organizations, and universities. With significant funding from Congress, the Program funds projects for the benefit of the minnow and the southwestern willow flycatcher (flycatcher) in the areas of habitat restoration, water acquisition and management, and science. The Program seeks short and long-term solutions to the recovery of the endangered species with the goal that in promoting recovery, water users' plans will not be imperiled by the legal obligation of the federal government to protect these species. One of the purposes of the Program is to develop and exercise creative and flexible options under the Endangered Species Act (ESA) so that water use and development can proceed in compliance with applicable state and federal laws.

Although there is no direct link between the on-going litigation and the Program, many participants believe that the Program, if successful, provides the best opportunity to promote recovery of the species and potentially address some of the concerns of the parties to the litigation.

2.2 Water Acquisition and Management Subcommittee (WAM)

One of the most difficult challenges of the Program is to obtain sufficient water and adjust water management and operations to meet minimum flows for the minnow. WAMS was formed to address this important aspect of the Program. WAMS was created to evaluate water acquisition and management opportunities to support the goals of the Program and it functions under the direction of the Program.¹ WAM's objectives include researching, developing, evaluating and assisting in implementation of alternatives to lease or otherwise acquire water, implementation of water management alternatives, implementation of alternatives for efficient water use, and implementation of alternatives intended to offset any depletions caused by Program activities. Reservoir storage and operation is one component of water management and potentially, supply. The Preliminary Analysis was intended to make progress in this area.

There was some concern expressed on the part of Program participants that WAMS should be focusing on the water needs of the ten-year Program, not on long-term institutional changes. It is true that although there may be reservoir operational strategies that will assist in the short-term, the major benefit of the Preliminary Analysis would be long-term: institutional changes that would allow the Middle Valley to optimize its water supply including taking advantage of storage flexibility in wet years. In response, most WAMS members believed that some portion of the committee's work should be looking at the long-term. The Preliminary Analysis has required a relatively minor amount of WAM's time. Other activities have been of higher priority.

The drought conditions during 2004 while the Preliminary Analysis was discussed have provided the backdrop. Annual renewable water supply, not the ability to store it, has been the overwhelming problem. The need to find enough water to meet the needs of the ten-year Program has been WAM's focus. WAMS has supported installation of gages for quantifying water flow, development of a decision support system for rotational delivery of irrigation water in the Middle Valley, creation of a water demand budget and support for many activities directed toward meeting the water needs of the ten-year Program.

¹ Water Acquisition and Management Plan, Program Review Draft (February 9, 2004).

2.3 The Utton Transboundary Resources Center

The Utton Center is housed at the University of New Mexico School of Law to carry on the work of the late Professor Albert E. Utton to promote equitable and sustainable management and utilization of transboundary resources. The Utton Center offers impartial expertise and scholarship in examining and analyzing problems from a multidisciplinary standpoint. Although UNM is signatory to the Program, it does not have a direct stake in the outcomes of the decisions to be made regarding Program water supply. Thus, the Utton Center is in a position to act as a neutral party to assist in organizing and furthering the water management discussions.

The Utton Center felt this was an important project and that the representatives to WAMS could provide the expertise to develop and evaluate scenarios. The Utton Center offered to work cooperatively with WAMS on the Preliminary Analysis, by volunteering to assist in providing support to the process, scheduling meetings, developing and distributing scenarios, preparing meeting notes, providing progress reports, and coordinating among various stakeholders. Dick Kreiner, former co-Chair of WAMS and recently retired Project Manager with the Corps of Engineers, was an integral part of the project.

3.0 FRAMEWORK FOR PRELIMINARY ANALYSIS

WAMS previously developed a paper as part of its long-term plan entitled, *Storage and Management of Program Water*. As identified in that paper, the Program area has a limited amount of physical storage capacity in reservoirs that might be utilized by the Program, and legislative authorities govern the volume of water the Program area reasonably can expect in the future, depending upon climatic conditions. The difficulties that must be negotiated are timing, physical limitations on storage space, congressional authorizations, Treaties and Rio Grande Compact obligations, complex accounting, and meeting the many competing needs on the Rio Grande system.

The purpose of the Preliminary Analysis was to develop by consensus a range of alternatives to be objectively evaluated by WAMS using an agreed upon modeling tool. The concept was to develop reservoir storage scenarios to help improve management of the water storage system and minimize the need for acquisition of supplemental water for the Program. The goal was to show modeled quantification of water savings that could potentially be achieved through revised storage scenarios. WAMS would then be prepared to make recommendations for the Program to pursue. These recommendations might include: Program-sponsored studies to further technically evaluate alternative reservoir authorizations and operations; structured negotiations between critical stakeholders; and more detailed development of the legal, political, and environmental issues. It was always understood that the analysis was preliminary and that further work would be necessary in order to optimize reservoir management.

Because a variety of entities have interests in the waters of the Rio Grande and its reservoir storage facilities, it is important that a wide variety of interests be represented in any discussion of these issues. The Collaborative Program provides this setting more so than any other organization at this time. A diverse group of Middle Rio Grande water interests are involved in the Program, and participation is open to any interest group that chooses to participate. There is a common stated goal of protecting existing and future water use as well as promoting recovery of the endangered species. There are, however, critical stakeholders, for example, Cochiti Pueblo and the City of Santa Fe, who have chosen not to actively participate in the Program. Still, for the purposes of this project, the Collaborative Program provided a good venue for Middle Rio Grande water interests to look jointly at the reservoir storage system and its constraints, and to find whether, by working together creatively, we can collectively manage the river more effectively.

3.1 The Geographic Setting

The area of concern in the Collaborative Program is defined as the headwaters of the Rio Chama Watershed and the Rio Grande, including tributaries, from the New Mexico-Colorado state line downstream to elevation 4,450 feet, which is the spillway crest of Elephant Butte Dam.² It includes land within many counties and cities in New Mexico as well as land within 18 Indian Pueblos and one Indian Nation. The average annual precipitation in the area is between 7 and 15 inches. In the high mountain areas, it exceeds 25 inches, much in the form of snow. Thunderstorms are frequent during the summer monsoon months, but the greatest flood producing storms occur in the transitional seasons, March through May and September through October.³

The water supply for the region comes from the natural flow of the Rio Grande and its tributaries and from transbasin diversions from the San Juan-Chama project, which imports water from the Colorado River Basin. In addition, there is significant reliance on ground water, primarily for municipal use.

The majority of the surface water comes from snowmelt. The spring runoff usually begins in April and may continue through June and sometimes into July for high snow pack years. At the Otowi Bridge where New Mexico's upper index Compact gage is located, the Rio Grande's average annual flow is 1.1 million acre-feet. At San Marcial, above Elephant Butte, at the low end of the Middle Rio Grande Valley, the average annual flow is 923,000 acre-feet. Generally, the Rio Grande is a gaining stream above Otowi and a losing stream below Otowi. During the summer months, precipitation from thunderstorms may be a significant contributor to streamflow for short durations and many of the Rio Grande's largest tributaries in the Middle Rio Grande flow usually in response to these events.⁴ These tributaries include the Tijeras Arroyo, Rio Salado, Rio Puerco and Rio Jemez (although the Rio Jemez may more frequently have snowmelt runoff).

3.2 Overview of Reservoirs

The Bureau of Reclamation's San Juan-Chama Project (SJC) is a transbasin diversion system that imports water from tributaries of the San Juan River to supplement the native flow of the Rio Grande. The water is delivered through the Azotea Tunnel that runs under the Continental Divide to Willow Creek. Heron Reservoir was constructed in 1971 as part of the SJC on Willow Creek. Water is delivered to the Rio Chama and then to the Rio Grande. Since diversions for the project were initiated in 1970, the project has imported an average of 94,200 acre-feet into the basin annually. This water is not included in accounting under the Rio Grande Compact. The SJC water is primarily to be used for municipal/industrial and agricultural uses.

The next reservoir below Heron on the system is El Vado Reservoir, which was built as part of the MRGCD works in 1935. El Vado Reservoir is primarily used to store native Rio Chama flows for use by the MRGCD for irrigation. It is also where the Bureau of Reclamation stores prior and paramount water for the six Middle Rio Grande Pueblos.

Below El Vado, on the Rio Chama, is Abiquiu Reservoir, about 30 miles upstream of its confluence with the Rio Grande. This reservoir was built in 1962 for flood and sediment control purposes by the U.S. Army Corps of Engineers (COE). In 1981, the authorizing legislation was amended to allow storage of SJC water.

Further down on the system is the only reservoir in the Middle Valley that exists on the mainstream of the Rio Grande, Cochiti Reservoir. Cochiti Dam was built for flood and sediment control

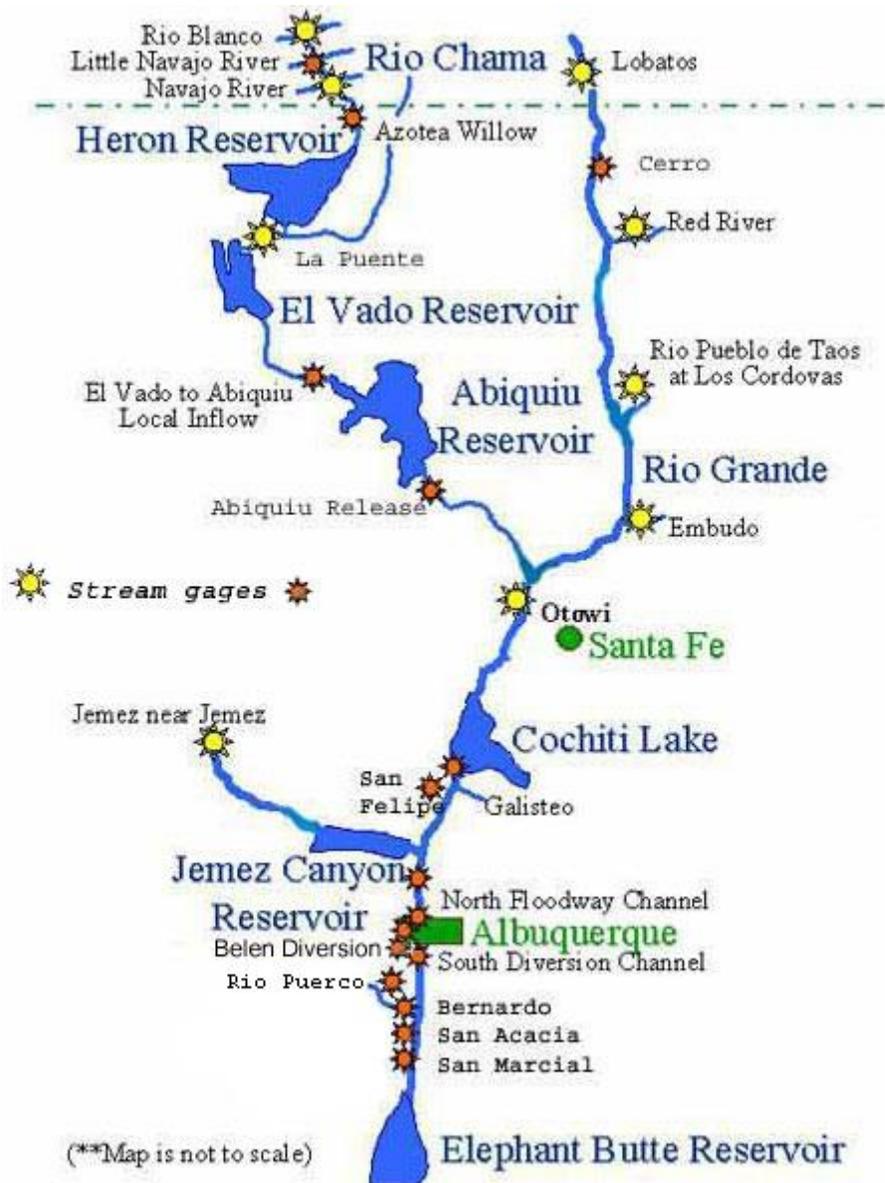
² Memorandum of Understanding, Middle Rio Grande Endangered Species Act Collaborative Program (2002).

³ Upper Rio Grande Water Operations Model, "About the Basin."

⁴ Ibid.

purposes, primarily to protect the City of Albuquerque. Authorizing legislation was added in 1964 to provide a recreational pool, and 5,000 acre-feet of SJC water was allocated annually for this purpose.

At the bottom end of the Middle Valley is Elephant Butte Reservoir, which is where New Mexico’s Compact water to Texas is delivered. About 57% of the water delivered to “Texas” under the Compact, is actually delivered to southern New Mexico farmers. More detail on the authorizations for the reservoirs is included in Appendix 3. On the following page is a U.S. Bureau of Reclamation graphic of the system.



3.3 Overview of Rio Grande Compact

The Rio Grande Compact (Compact)⁵ is an agreement between Texas, New Mexico and Colorado apportioning the waters of the Rio Grande above Ft. Quitman, Texas. New Mexico's annual water allocation available for use within the Middle Rio Grande is a maximum of 405,000 acre-feet of the flow of the Rio Grande as determined based upon the measurement at the Otowi index gage. New Mexico deliveries are measured as the releases from Elephant Butte Dam plus the change in storage in Elephant Butte, thus the evaporation loss is counted against New Mexico's Compact allocation. New Mexico is allowed to consume all of the tributary inflows into the Rio Grande between the Otowi gage and Elephant Butte. The Compact requires annual water accounting and provides for a system of annual debits and credits. Water must be retained in storage in reservoirs constructed after 1929 to the extent of each state's debits and cannot be used. It must be released upon demand of the downstream state. Article VII of the Compact provides that if usable storage in Elephant Butte and Caballo Reservoirs is less than 400,000 acre-feet, neither Colorado nor New Mexico may increase the amount of water stored in upstream reservoirs constructed after 1929. Water imported from the Colorado River Basin, in particular the San Juan-Chama water supply, is not subject to the Rio Grande Compact apportionment. The Compact does not affect the obligations of the United States to Indian tribes or impair Indian water rights. The obligation of New Mexico to deliver water is based upon single calendar years.

3.4 Water Uses - Demands and Projected Trends

Agricultural irrigation is the largest surface water use in the Collaborative Program area. It is estimated to account for approximately 40% of the water used between Cochiti and Elephant Butte (the "Middle Valley"). This figure does not include evaporative losses on water stored for agricultural purposes, which would constitute another 20% of the water evaporated.⁶ The largest area for evaporative losses is Elephant Butte Reservoir.

Consumption of surface water for municipal and industrial purposes is smaller, but in the Middle Valley is a larger proportion of use than in other parts of New Mexico. That use is currently estimated to be approximately 7% of water used in the Middle Valley. Many of the municipalities along the Middle Rio Grande that have contracts for the use of San Juan-Chama project water are planning to use that water.

Another major component of water use in the Middle Rio Grande occurs in the riparian zone. Riparian consumption by trees, other vegetation, river and soil evaporation is estimated to be approximately 37% of the usage in the Middle Rio Grande Valley.

This Preliminary Analysis project is focused on the evaporative loss component of depletion in the Middle Valley. From Elephant Butte, this is estimated as a range between 80,000 and 265,000 acre-feet per year, depending upon the quantity stored, temperature, wind, etc.⁷

3.5 URGWOM

The Upper Rio Grande Water Operations Model (URGWOM) program is intended to develop a computer model that is capable of simulating water storage and delivery operations in the Rio Grande from the Colorado/New Mexico stateline to below Caballo Dam in New Mexico. The intent is to use the model for flood control operations, water accounting, and evaluating water operations alternatives. The effort is a cooperative effort of six federal agencies which began in 1996. The agencies include the

⁵ NMSA 1978 § 72-15-23 Rio Grande Compact.

⁶ Middle Rio Grande Water Storage Study, S.S. Papadopulos & Associates, Inc. (2000).

⁷ *Ibid.*

Bureau of Reclamation, the U.S. Fish and Wildlife Service, the U.S. Geological Survey, the Bureau of Indian Affairs, the International Boundary and Water Commission (U.S. Section), and the U.S. Army Corps of Engineers. The Corps of Engineers has been the lead agency. Since 1996 a vast amount of data has been developed and stored in the URGWOM database. The data include climatic conditions, riparian evapotranspiration, evaporative losses at reservoirs, evaporative losses on river reaches, seepage, water operations, water usage, snowmelt runoff, and thousands of other pieces of information relative to the hydrology of the Upper Rio Grande watershed.

One difficulty expressed in WAMS with regard to using URGWOM is its accuracy in quantifying gains and losses after discrete quantities of water are released from reservoirs. Middle Valley gains and losses are difficult to estimate accurately between Cochiti and Elephant Butte. Further data gathering is needed, particularly regarding the connection between shallow ground water and river flows. It will take time to obtain and integrate these data into the model. (As an aside, WAMS has included support for model development and maintenance in its Program priorities. WAMS sees the need to continue to develop data regarding ground water and surface water interaction in the Middle Valley, because the seasonal variation in annual renewable water supply affect these values on an inter-annual basis.)

3.6 URGWOPS

The Upper Rio Grande Basin Water Operations Review (URGWOPS) is a separate project that is utilizing the URGWOM model to conduct a comprehensive system-wide review of water operations activities that are conducted under existing legal authorities of the joint lead agencies, which are the Corps of Engineers, the Bureau of Reclamation (BOR), and the New Mexico Interstate Stream Commission. These operations consist primarily of storage and release of water at reservoirs. All alternatives evaluated will consist of water operations under existing authorities. The review will be the basis of the water operations Environmental Impact Statement (EIS). The EIS will be prepared by the parties in accordance with NEPA and will present alternatives for the exercise of discretionary authority of the BOR, the Corps of Engineers, and the New Mexico Interstate Stream Commission with regard to operations at federally operated facilities in the Upper Rio Grande Basin. The EIS will evaluate the environmental, economic and social effects of these alternatives. The draft EIS is scheduled to be released for public comment in Calendar year 2005.

The Preliminary Analysis that is the subject of this report was anticipated to look at potential scenarios beyond what is already authorized by existing authorities. The original plan was that upon completion of the URGWOPS EIS (originally scheduled for October 2003), the URGWOM technical team (Tech Team) would still remain intact and the timing would be ideal for WAMS to request that the Tech Team evaluate the WAMS scenarios. These would include scenarios not included in the EIS, either because they went beyond existing authorities or the scenario was not promoted by the entity that owned the water and the right to store it.

4.0 PRELIMINARY ANALYSIS

4.1 Summary of Process

This project began in January 2004. The parties to the *Minnow v. Keys* litigation were in negotiations sponsored by the Governor's Office and the negotiations had come to a standstill. In discussing issues and needs with WAM, the Utton Center suggested that WAMS attempt to develop a variety of water management scenarios and test them using an agreed-upon computer modeling tool. It would thus be possible to evaluate which strategies helped the system and which did not. The focus of WAM's discussion could then be narrowed to look at the most promising alternatives in more detail. The concept was to develop a project that would result in Program funding being used to help evaluate water

management changes that might benefit the supplemental water needs of the Program and also insure that the demands of water users are met.

Initially, the work was to be done by a subcommittee of WAM. The Utton Center was tasked with developing a scope of work that outlined an approach. There was a general discussion about the different models that might be available. The Utton Center prepared a draft outline describing a process which was revised as the discussion progressed.⁸

WAMS held “technical issues” meetings throughout Spring 2004. Initially, these meetings consisted of formulating the project and discussing models. There was broad discussion of the issues and possibilities before the project that is the subject of this report was narrowed to be a Preliminary Analysis of reservoir storage alternatives.

For example, an interesting suggestion was made to examine a South African process, whereby different groups formed teams to create their own planning visions. The visions were then available for the parties to negotiate long-range solutions. As applied to the WAM/Utton Center project, the idea would be to form different groups, each with its own viewpoint on best management practices for the Middle Rio Grande. Each group would develop its own scenario and WAMS would then locate an appropriate tool to evaluate the hydrologic implications of the scenarios. This was not a computer model, but at this stage, a range of river management strategies, such as irrigation efficiencies, forbearance, etc., were under consideration.

It quickly became apparent that it was necessary to know the capabilities of various models in order to decide how to proceed and, at that point, the discussion turned to gaining a better understanding of the models available for the Middle Rio Grande. The list that was compiled of related efforts included these models, among others:

- HEC-RAS, a GIS based river flow model being used by Dr. Julie Coonrod at the UNM Department of Engineering;
- National Heritage Plan Rio Grande Basin Model;
- Flow2D;
- Upper Rio Grande Water Operations Model; and
- Sandia National Laboratories System Dynamics Model.

The Utton Center began research on the models and spoke to representatives from UNM, Sandia National Laboratories, and the U.S. Army Corps of Engineers. Several WAMS members were familiar with these and other tools and were able to provide information. During several meetings we discussed the various models and their ability to fulfill the needs of the project we were formulating.

The WAMS technical issues subcommittee met with the URGWOM Tech Team. Within WAMS there had been some skepticism of URGWOM’s usefulness in testing the scenarios. The basic issue, as mentioned before, was that Middle Valley gains and losses were not considered very accurate especially during low flow conditions. Several key members of WAMS did not think URGWOM would be useful to model river operations beyond reservoir operations. The URGWOM Tech Team also questioned whether URGWOM had the capability to meet specific daily flow targets. (URGWOM’s capabilities to model specific target flows have been significantly enhanced over the past year.) There were no alternative models presented which would be able to test a variety of water operations scenarios. The

⁸ See Appendix 2 for the most recent draft of the outline for the Preliminary Analysis.

project became focused on modeling reservoir storage opportunities and operations. URGWOM quite clearly was the best tool for this work and WAMS proceeded to have several joint meetings with the URGWOM Tech Team.

The URGWOM Tech Team asked that WAMS prepare specific scenarios and give those scenarios to URGWOM for modeling. It was understood that there might be funding needed in order to make rules adjustments for URGWOM to be able to test scenarios developed by WAM. From the URGWOM Tech Team's perspective it was critical that the project look at all stakeholder interests, not just endangered species needs. They wanted WAMS to obtain broad agreement on how ownership of storage rights, water rights, and releases would be modeled. In the Tech Team's opinion at that time, WAMS needed to be able to show who the water users would be (in addition to two endangered species) and how the water rights were owned. Others on the URGWOM Tech Team questioned whether WAMS should be considering scenarios that went beyond the legal authorizations for each reservoir.

Within WAM, the question was asked, "If we are modeling reauthorization of storage and trying to optimize storage, are we ignoring the endangered species purposes?" The conclusion was that WAMS should focus on finding management strategies to create more water for the Middle Valley. A next step would be attempting to negotiate some portion of the saved water as minimum flows for the minnow. There was discussion about the testing that would be done using URGWOM for the URGWOPS draft Environmental Impact Statement and that some of this testing might be able to incorporate WAMS ideas.

The URGWOM Tech Team prepared a preliminary draft scope of work for discussion purposes and WAMS used this draft to discuss how it could work with URGWOM to develop different reservoir storage accounts at Abiquiu, Heron and El Vado.

At the same time that WAMS discussed these issues, there were important related matters being discussed such as estimating the projected Program water demand. Another background discussion related to Article VII status of the Rio Grande Compact, and its projected effect to continue for much of the life of the Program. Some Program participants believed WAMS should only be looking at immediate water management strategies. Long-term flexibility for storage of water was not considered a priority. Most WAMS members agreed that long-term storage flexibility was of lower priority, but that it should be one component of WAM's effort. But the result was that the reservoir storage discussions became a fairly minor part of the WAMS work.

WAMS met again with representatives of URGWOM and made the case that, as a first step, it made sense to look at optimization, rather than engaging all entities in water negotiations. After showing potential water supply gains, the project could proceed to actively engage all stakeholders. During this time frame, it was made clear that any alternatives to be modeled in this Preliminary Analysis would be by agreement of all WAMS members. Also, before proceeding with any modeling work, the approval of the Program's Interim Steering Committee would be sought.

Intermixed in the discussion was whether the flow targets of the B.O. were realistic. A decision was made *not* to re-examine the flow targets as part of this project. Another bottom line in every discussion was that each scenario had to address Compact delivery requirements.

Early in the process it became clear that virtually all alternatives being considered posed problems to one water user group or another. The Utton Center continually tried to focus the project on the physical system at this stage; and to resist making judgments about ownership of water rights. The modeling analysis was intended as a preliminary analysis to help guide WAMS and the Program to focus attention on approaches that might offer the greatest potential benefit toward meeting Program goals. The Preliminary Analysis could provide information for a more focused analysis to consider alternatives. All parties were invited to suggest scenarios.

4.2 The Alternatives

The process within WAMS of developing scenarios to model and discussing their potential advantages and constraints was a consensus process. WAMS agreed that if there was not agreement on modeling an alternative, that alternative would not be pursued. As WAMS discussed this, virtually every scenario proposed raised concerns on the part of at least one critical stakeholder opposed to modeling a revised reservoir operation scheme. This report will provide a summary of alternatives proposed and give a brief summary of the background concerning each. Although there was not consensus to proceed to model any scenarios at this time through this project, the discussion may provide information and direction to future endeavors to examine potential revised reservoir operations.

Several scenarios were brought up and dropped quickly because of immediate and strong opposition by a stakeholder. The discussion of these alternatives was short and cursory. Other scenarios were discussed at length and in some detail before serious concerns were voiced. These alternatives were more fully developed with regard to potential operational benefits, the feasibility of modeling, and the constraints that would need to be addressed in order to implement institutional changes. The variation in the level of detail is reflected in this report.

1. Cochiti. Of the scenarios that were raised, discussed briefly, and dropped, Cochiti Reservoir was the most prominent. Many participants in the discussion were interested in the potential of modeling changed reservoir storage operations at Cochiti Reservoir. One particular interest was to model limited storage of native water in Cochiti to smooth releases from El Vado when summer thunderstorms occur below the Otowi Gage. This would preserve native water when releases have been made from El Vado to meet irrigation demand and a thunderstorm in the Middle Valley obviates the need for the water. The released water could be trapped in Cochiti and possibly used subsequently for irrigation, thereby potentially decreasing the need for supplemental water for the Program.

Another proposed idea was to model the creation of a native water pool to be managed for the Program to meet the obligations of the Rio Grande Compact. The concept was that this would replace the San Juan-Chama pool at Cochiti. Significant detail was presented on this potential alternative.

The Utton Center, being aware of the sensitivity of these issues to Cochiti Pueblo, requested that there be no further discussion of Cochiti Reservoir without concurrence of the Pueblo. A discussion of Cochiti had taken place in the Collaborative Program in 2002 and representatives of the Pueblo came to the Interim Steering Committee and voiced objection to any consideration of re-operation or reauthorization of Cochiti pending completion of a baseline study to be conducted by the Pueblo in cooperation with the Corps of Engineers. The baseline study is in progress and will evaluate the potential impacts of a range of water management changes at Cochiti Reservoir. In the summer of 2004, there was some indication that the Pueblo might be interested in discussing the potential benefits of various operations of the lake (in particular, the possibility of storing prior and paramount water) with broader Middle Valley interests and it was decided to make outreach to the Pueblo on this subject.

The Utton Center contacted the Pueblo to learn whether there was interest in working with the Program to model any scenarios at Cochiti. A letter was directed to the Governor requesting a meeting. The purpose of the letter was to suggest that several technical working meetings be held to discuss whether there was an opportunity to model scenarios that would provide beneficial information to both the Pueblo (as input into the baseline study) and to WAM. It soon became clear that the Pueblo was not ready to discuss the lake until completion of the baseline study. WAMS respected this decision and there was no further pursuit of these ideas.

2. Closed Basin

Another idea proposed was timing of delivery of water from the San Luis Closed Basin Project in Colorado. The suggestion was to work with the BOR and the State of Colorado to model increased water

deliveries during July, August, September and October. Once again, this was a dead end when reminded that the Interim Steering Committee specifically directed the WAMS *not* consider water sources from within Colorado. A commitment had been made on the part of the State of New Mexico and the Collaborative Program not to seek contribution to the Program from Colorado and there was correspondence from the Division Engineer in Alamosa, Colorado to this effect.

3. Forbearance. A suggestion was made to model forbearance in the MRGCD. This was immediately opposed by the MRGCD and several reasons were provided for its opposition. The scenario as drafted would have modeled a 5% MRGCD demand reduction. As drafted, it would have been up to the MRGCD to determine how the savings could be achieved, although WAM's intention was to look at voluntary agricultural forbearance.

Without it being clear that the alternative was contemplating compensation to irrigators who would voluntarily forebear, MRGCD viewed this as modeling an arbitrary reduction in MRGCD water. Further, a feasibility study for forbearance has recently (July 28, 2005) been completed and MRGCD staff felt that any further investigation of forbearance prior to completion of the study was premature. MRGCD also maintained that it has a fixed volume of losses depending upon flow, time of year, etc., so that it is not accurate to model a percentage of demand reduction. In addition, MRGCD maintained that the water does not belong to the MRGCD, but rather to the individual landowners. Finally, they felt that Middle Valley gains and losses are not refined sufficiently in the URGWOM model to model a forbearance alternative. For these reasons, and also the sense on the part of some WAMS members that this alternative did not fit with the reservoir storage focus of the Preliminary Analysis, this alternative was dropped pending the results of the feasibility study.

4. Abiquiu. Of the scenarios that were discussed in detail, two concerned Abiquiu Reservoir. Under one scenario, Abiquiu Reservoir operations would be modeled to retain water in Abiquiu in lieu of release to Elephant Butte Reservoir in May or June. Storage of native water would take place in unused city storage space and the remaining flood pool. Currently, when the inflow to Abiquiu Reservoir exceeds downstream channel capacity, water is stored and by July 1st, the water typically would have been released. However, after July 1st, when the natural flow at Otowi gage falls below 1,500 cfs, the Corps must postpone flood water evacuation until November 1st. Flood storage that is retained through the summer is released after November 1 and must be fully evacuated by March 31 of the following year. The release of the carryover flood water in storage is normally set at uniform rate. The problem with releases in May and June is that there could be higher loss rates through the Middle Valley and higher evaporation rates if the water is stored in Elephant Butte Reservoir. This scenario looks at storing compact delivery water and holding the water until November 1. Channel losses, compact deliveries, peak flows in the Middle Rio Grande Valley and reservoir losses would be compared to determine impacts and benefits.⁹

Concerns were raised about brown trout spawning and fishery habitat in the Rio Chama below Abiquiu Dam. Based upon this concern, several different options were proposed. One would be to evacuate storage between November 1st and December 25th at a uniform rate, rather than as in the past, delivering all the water in late December. The second would be to evacuate the storage beginning November 1st through March 1st. At all times the release rate from Abiquiu Reservoir during the irrigation season (at times when Abiquiu would be storing) would be set in accordance with MRGCD demand and other demands downstream (BO requirements) at Cochiti Dam, less mainstream flow. Abiquiu Reservoir operations would be modeled to maintain the minimum flows of the Biological Opinion when storing native water. No storage would take place if downstream demands are not being met. As envisioned, the irrigation demand would be set at the 2004 demand, as provided by the MRGCD, although other years are available.

⁹ See Appendix 3 for more details.

Modeling such a scenario raises issues with regard to ownership of the water. This is where the Program's discussions with the MRGCD, the State, the City, and the federal agencies could be productive in trying to reach a negotiated solution. The initial concept, however, was to model the potential water gains before beginning any discussion of management of the water.

The City of Albuquerque expressed reservations about pursuing any modeling studies of changed operations of Abiquiu. The City has a contract with the Corps of Engineers for reservoir storage and easements on the land upon which the reservoir is located. The City's concern is based on a belief that the Collaborative Program places too much emphasis on looking at the City for solutions and does not seek solutions from the other parties to these discussions. The City has expressed that it may consider working with the Collaborative Program on this alternative, and the one following, if other entities would agree to model changed reservoir operations in other reservoirs. The City in particular believes Cochiti Reservoir offers great potential.

Another proposed scenario to model at Abiquiu was based on retaining water in Abiquiu when not needed for delivery to Elephant Butte to meet Compact deliveries.¹⁰ The modeling time frame was to be a 40-year period, with the beginning condition an Article VII year, replicating the current drought cycle. After that, the model would utilize the sequence that URGWOPS uses, which is a random sequence of wet, average, and dry years. The alternative as it had been drafted was based on "if and when" storage space was not needed by the City of Albuquerque and its subcontractor. Details on how this would be characterized for the model runs would need to have been developed. This scenario is similar to previous proposal except the time frame is extended for a forty year period and any storage would be within the City's storage space.

The first phase would quantify the potential gains in water supply over a 40-year period for the Middle Valley based upon this revised operation. Subsequent work would be required in order to reach agreement on how to manage this water. The expectation was that there would be significantly less evaporative losses by storing the water in Abiquiu as opposed to delivering it to Elephant Butte.

Again, ownership of the conserved water would be a significant issue. The City of Albuquerque holds storage space easements at Abiquiu and there would need to be significant discussion over arrangements for storage and management of the water. Environmental evaluation would be needed, as well as appropriate legal instruments for water storage. In order to benefit the Program, there would need to be agreement among the State of New Mexico and other Middle Valley water users that some portion of the conserved water should be managed to help achieve minimum flows and other goals for recovery of the minnow and flycatcher. The State would need assurance that if any additional consumptive use occurred as a result of an alternate release scenario, those depletions be offset by Program-acquired water. Environmental analysis and clearance would be necessary. Finally, approval of the Compact Commission would be necessary because this is a change to operation of Abiquiu Reservoir under P.L. 86-645 and P.L. 100-522.

As previously mentioned, the City of Albuquerque has concerns about working with the Collaborative Program on any modeling at Abiquiu. Assuming that solutions to these valid concerns can be found, steps would need to be taken in order to implement this alternative, including developing consensus among Middle Valley water users on proposed operational revisions, approval of the Rio Grande Compact Commission, environmental analysis and documentation, a permit to store water from the State of New Mexico, and legal agreements for water storage.

5. Heron. WAMS also wanted to look at revised operations at Heron Reservoir. The idea was to look at system efficiencies and determine the best place to store Program-acquired supplemental water. The water would be San Juan-Chama water acquired from willing lessors. WAMS wanted to evaluate the ability to carry over storage of San Juan-Chama water in Heron instead of forcing the Program to move

¹⁰ *Ibid.*

the water to Abiquiu or El Vado if not needed in a particular year. One alternative involved comparing the operation of the City of Santa Fe's 2003 San Juan-Chama water if delivery had been taken at Heron Reservoir instead of forcing the City of Santa Fe to move the water to Abiquiu.¹¹ Management of City of Santa Fe water was used as an example to quantify the difference in evaporative loss in storing the water in Heron rather than moving it to Abiquiu. Currently, SJC water contractors must take delivery of contracted water in storage at Heron Reservoir by the end of the year, either by use, sale, or by contracts for storage elsewhere. Contracted water not called for by December 31 remains in Heron Reservoir as part of project water supply and no longer belongs to the individual contractor. The BOR, in the past, has negotiated temporary waivers with contractors that allow carryover until April 30 in order to provide release rates on the Rio Chama that enhance the fishery between El Vado and Abiquiu Reservoirs during the winter and provide flexibility in managing river flows. Temporary waivers in the past have extended beyond April 30th.

This alternative would require significant rules changes to the URGWOM model. Currently contracted water not called to be released by December 31st remains in Heron Reservoir as part of the project supply and no longer belongs to an individual contractor.

The Heron alternative is more complicated than Abiquiu due to the inter-connectedness between the authorizing legislation for the San Juan-Chama Project and the various compacts on the Colorado River and the Rio Grande. The City of Albuquerque believes that any modification to the "no carryover" provision in the City's San Juan-Chama Project water service contract with the Bureau of Reclamation for delivery of water at Heron Reservoir outlet works would require an amendment to that contract. The City is not interested in this scenario.

A second Heron scenario was to look at evaluating the capture of native Chama flows in Heron. These flows are currently bypassed as Heron is only authorized for storage of imported San Juan-Chama water. The potential magnitude of native inflow to Heron is relatively small, on the order of 20,000 acre-feet per year average over the past twenty years.¹² Potential operational benefits are minor. The legislative authority to store native water in Heron clearly does not currently exist. Modeling this alternative would require significant rules changes. Because Heron currently is only modeled with accounts for contractors' San Juan-Chama water, a new set of hypothetical rules would need to be developed.

Ownership of native Rio Grande water rights and the right to store would be required in order to store water in Heron Reservoir. The acquisition of Rio Grande or Rio Chama water rights would be expensive as previous WAMS analyses have illustrated. Unless these water rights are senior water rights, storage in Heron would not be allowed unless all downstream water rights had been satisfied.

Reauthorization of Heron would be required and as previously discussed, major stakeholders are opposed to seeking congressional changes to the authorization of Heron.

It is possible that, given the constraints and the small amount of water that could potentially be stored, it is worthwhile to spend significant time and energy to model this alternative.

6. El Vado. Proposals regarding El Vado were not very well formulated. It was proposed to model relocating the prior and paramount water from El Vado to either Cochiti or Abiquiu. Since discussion of those two reservoirs had been taken off the table, discussion of El Vado was not carried further. During Article VII or drought years these discussion might be helpful. When Article VII is not in effect, El Vado fills frequently and thus is not available for Program water storage in many years.

¹¹ *Ibid.*

¹² BOR Annual Operating Reports (1984-2003).

5.0 RECOMMENDATIONS

It is recommended that we conclude this initiative for the time being. The draft EIS for the Upper Rio Grande Water Operations Model is expected to be released in Calendar year 2005, when Phase 2 model testing will begin. Although this testing will be limited to operators and cooperators of URGWOM, it is possible that some concepts of interest to WAMS may be included in the testing.

We have been unable to address some concerns of stakeholders at this time. We hope this report will provide a starting point for future discussions of these important issues. WAMS should continue dialogue with the URGWOM Tech Team. The Preliminary Analysis can be resumed in the future if conditions are right.

We should keep several thoughts in mind for the Program. One, solutions to the water supply problems for the Program will need to come from a variety of strategies and sources. WAMS believes there will not be one individual solution, but rather, that a combination of water management strategies and sources may result in a sustainable supply. Thus, all possibilities should be evaluated, not just those that appear to have the most potential.

Second, the Middle Valley needs to be prepared for wet years when they come. It is interesting to look at the Corps of Engineers' 1989 Reevaluation of the Rio Grande Operating Plan. In 1988, when meetings were held on this plan, Elephant Butte was spilling and every reservoir on the system was filled. The management backdrop was too much water. Eight of the ten years preceding 1988 had experienced higher than normal runoff, resulting in all conservation space in the basin's reservoirs being filled, with pressure to use flood space for conservation purposes. Flooding occurred below El Paso and one of the goals of the plan was to optimize storage and release in Abiquiu, Cochiti, Jemez Canyon, Elephant Butte and Caballo Reservoirs.¹³

We are currently in a drought cycle and it is hard to envision the different management concerns that existed in 1988 and 1989. But the Middle Valley will have wet cycles again and we need to prepare for optimal operations of our reservoirs.

Early in the debates about how to address the water needs of the silvery minnow, six collaborating agencies prepared a White Paper (1996) outlining recommended management options.¹⁴ The Collaborative Program and WAMS should be credited with pursuing and continuing to explore many of these options. It is interesting to note that although the institutional changes contemplated in this report are characterized as "long-term," by contrast, in the White Paper, operational and institutional changes to reservoirs (proposed two years after the listing of the minnow as endangered) were considered a high priority:

Attention should first be directed towards more immediately attainable actions such as upstream water management options which can be accomplished within existing authorities and the acquisition of water. Concurrently, existing institutional constraints to implementing potential actions should be examined and efforts should be initiated to make institutional changes as may be deemed appropriate to help accommodate both water users and the silvery minnow in the long term. Where additional studies are deemed required to fully evaluate a potential action, the agencies and entities represented in the preparation of this paper should cooperate in securing the necessary resources to complete such studies promptly.¹⁵

We look forward to the water managers in the Middle Valley working together to optimize the use of our reservoirs: to meet the needs of water users, make New Mexico's required Compact deliveries, and provide some help in meeting the minimum flow requirements for the minnow.

¹³ Reevaluation of the Rio Grande Operating Plan, at Appendix B-5 (July 1989).

¹⁴ See Appendix 4.

¹⁵ Appendix 4, at page 5.

6.0 REFERENCES

- Upper Rio Grande Water Operations Model Rules Documentation (Dec. 2002 Draft)
- Water Acquisition and Management Subcommittee Background Paper: Storage and Management of Program Water
- Flood Control Act of 1948
- Reevaluation of the Rio Grande Operating Plan, U.S. Army Corps of Engineers, Albuquerque District (July 1989)
- Public Law 87-483, June 13, 1962 (San Juan-Chama Project)
- Flood Control Act of 1960 Public Law 86-645, July 14, 1960
- Public Law 93-493 (1974) (Elephant Butte Recreation Pool)
- Public Law 97-140 (1981) (Abiquiu – San Juan –Chama storage)
- Public Law 100-522 (1988) (Abiquiu – native storage)
- Public Law 88-293 (1964) (Cochiti rec pool)
- Rio Grande Water Management Study, Section 905(b) (WRDA 86) Analysis, U.S. Army Corps of Engineers, Albuquerque District (June 1998)
- A Legislative History of the Rio Grande Reservoirs in New Mexico, Albert E. Utton with the assistance of Robert Muehlenweg and Barbara G. Stephenson (June 29, 1979)
- Middle Rio Grande Water Supply Study, S.S. Papadopoulos & Associates, Inc. (2000)
- Water Management Strategy for the Middle Rio Grande Valley, Appendix D to the Rio Grande Silvery Minnow Recovery Plan, also known as the White Paper (1996)
- Bureau of Reclamation, Monthly Operating Reports (1984-2003)
- Upper Rio Grande Water Operations Model, Geographic Setting (website)
- Memorandum of Understanding, Middle Rio Grande Endangered Species Act Collaborative Program (2002)
- Rio Grande Compact, Section 72-15-23 (NMSA)

APPENDIX D-1**SUMMARY OF MINNOW LITIGATION THROUGH JULY 2005**

**Prepared by Susan Kelly,
Associate Director, Utton Transboundary Resources Center***

The Rio Grande silvery minnow (minnow) was one of the most abundant species of fish in the Rio Grande watershed system, and because of the imminent threat of extinction, was listed as an endangered species under the Endangered Species Act (ESA) in 1994.¹ At the time of its listing, the minnow had been eliminated from 95% of its historical habitat, and the majority of the minnows remaining were confined to the lowest 60 miles of the Rio Grande, between the San Acacia and Elephant Butte dams. Since the listing, minnow populations continue to decrease, and the Rio Grande continues to experience periods of time in which portions completely dry up.²

1996 was the first year of significant drought in the Middle Valley in several decades. The entire river flow was diverted at San Acacia late in the summer with large associated minnow kill. The Bureau of Reclamation initiated the San Juan-Chama supplemental water operations program, whereby San-Juan Chama water was used for irrigation and native flows were by-passed.

Drought conditions worsened from 1996 to 1999. To prevent the extinction of the minnow, the Department of Interior issued its RGSM Recovery Plan in 1999. Under court order, the U.S. Fish and Wildlife Service (USFWS) Regional Director accepted the plan, and critical habitat was designated for the minnow consisting of 163 miles of the mainstem Rio Grande in New Mexico from Cochiti Dam on the north to Elephant Butte Reservoir in the south.³ A subsequent challenge to the designation was brought to court under the case *MRGCD v. Babbitt*, 206 F. Supp. 2d 1156 (D. NM 2000). The district court required the USFWS conduct an EIS for the critical habitat designation and this ruling was upheld in the court of appeals at *Middle Rio Grande Conservancy District v. Norton*, 294 F.3d 1220 (2002).

In November of 1999, environmental groups opposed the Bureau of Reclamation and Army Corps of Engineers failure to complete consultation with the USFWS over Middle Rio Grande water operations. Environmental groups filed their lawsuit under the name *Minnow v. Keys*. The lawsuit named the Bureau of Reclamation (BOR) and the U.S. Army Corps of Engineers (Corps) as defendants due to their role in the diversion and storage of Rio Grande water. Their claim was that the failure of the federal defendants to consult with the USFWS as required by the ESA jeopardized the existence of the minnow.

Other water claimants in the Middle Rio Grande, the City of Albuquerque, the Middle Rio Grande Conservancy District (MRGCD), and the Rio Chama Acequia Association intervened in opposition to the plaintiffs' position.⁴ The State of New Mexico intervened for the reason that the disposition of the case would have a direct impact on the State Engineer's ability to supervise the appropriation and distribution of the waters of the Rio Grande. The water sources subject to the litigation are claimed for other uses. The water in Heron is under contract to many different municipalities and other water users, primarily the City of Albuquerque and the MRGCD, for municipal and irrigation

* Law students Ignacio Gallegos and Zach Jones provided research assistance; Kevin Flanigan, New Mexico Interstate Stream Commission, provided valuable comments.

¹ 59 FR 36995, July 20, 1994, codified in 50 CFR §17.11.

² Ibid.

³ 64 FR 36274, July 6, 1999.

⁴ Rio Grande Silvery Minnow v. Keys, et al., CIV 99-1320-JP/KBM.

purposes. Native Rio Grande flows are used by Middle Rio Grande irrigators, other water users, and by the State of New Mexico to meet its obligations under the Rio Grande Compact.⁵

Court-ordered mediation in the summer of 2000 resulted in two Agreed Orders⁶ that prevented drying of the lower sections of the river in the middle valley believed to hold the highest numbers of silvery minnows. Under those agreements, the City of Albuquerque, and to a much lesser extent, the MRGCD, were paid to provide water for the minnow. At the time, Abiquiu Reservoir was nearly full and Albuquerque had no place and no immediate need for its San Juan-Chama Project water. Almost 200,000 acre-feet of San Juan Chama water was used to maintain continuous flow down to Elephant Butte in 2000.⁷ At that time, there were virtually no silvery minnows in captivity. The Agreed Orders set in motion various actions by the parties to greatly increase captive population of silvery minnow.⁸ The minnow survived the 2000 drought summer.

Completion of consultation resulted in the issuance of a Biological Opinion (BO) by the FWS in June of 2001,⁹ which was subsequently challenged by the plaintiffs. They sought to require that the BOR exercise discretion to utilize San Juan-Chama water from Heron Reservoir and curtail deliveries of water to the San Juan-Chama contractors to meet the minimum flows required for the minnow. They also sought curtailment of native Rio Grande water deliveries to irrigators, primarily in the MRGCD.¹⁰

The federal district court ruled in April 2002,¹¹ upholding the 2001 BO but also holding that the BOR had discretion over use of both San Juan-Chama (SJC) and native water in the Middle Rio Grande Project for ESA purposes while the Corps did not have such discretion over its operations.¹²

A Conservation Water Agreement executed between the State of New Mexico and the United States of America provided for up to 100,000 acre feet of Rio Grande Compact delivery water for species use and established a temporary Conservation Pool in Abiquiu and Jemez Canyon Reservoirs.¹³ The Rio Grande Compact Commission, by unanimous resolution in accordance with PL 86-645, provided its advice and consent to a deviation of normal operations of Abiquiu and Jemez Canyon Reservoirs to allow for Conservation Pool operations.

Significant drought in 2002 resulted in reinitiating consultation and issuance by FWS of second BO in September 2002.¹⁴ Negotiations among the parties broke down and the environmental plaintiffs filed for emergency injunctive relief to seek release of a limited amount of SJC water from Heron Reservoir in order to comply with the June 29, 2001 BO and avoid massive drying in the Middle Rio Grande.¹⁵ A hearing was held immediately and the court subsequently ruled in favor of the Plaintiffs that the September 2002 BO was arbitrary and capricious. However, the Court imposed its own interim

⁵ Rio Grande Compact, 53 Stat. 785 (1939); *reprinted at* N.M. Stat. Ann. §72-15-23 (1978).

⁶ See Rio Grande Silvery Minnow v. Keys, et al., CIV 99-1320-JP/KBM (Docket Numbers 117 and 150).

⁷ Information provided by the Interstate Stream Commission

⁸ “Water Management in the Middle Rio Grande,” Belin, Aletta, NM State Bar Bulletin October 2, 2003, Volume 42, at 211.

⁹ Endangered Species Act – Section 7 Consultation Biological Opinion. Programmatic Biological Opinion on the Effects of Actions Associated with the U.S. Bureau of Reclamation’s, U.S. Army Corps of Engineers’, and Non-Federal Entities’ Discretionary Actions Related to Water Management on the Middle Rio Grande, New Mexico. 135 pp. Consultation conducted by Fish & Wildlife Service, Albuquerque, N.M., June 29, 2001.

¹⁰ Rio Grande Silvery Minnow v. Keys, et al., CIV 99-1320-JP/KBM, April 2002, Memorandum Opinion and Order.

¹¹ Ibid.

¹² Ibid at pages 49, 33, and 41 respectively.

¹³ Conservation Water Agreement, June 29, 2001, between the State of New Mexico, U.S. Dept. of Interior and the U.S. Army Corps of Engineers.

¹⁴ Endangered Species Act – Section 7 Consultation Biological Opinion. Biological Opinion and Conference Report on U.S. Bureau of Reclamation’s Amended Water Management Operations on the Middle Rio Grande through December 31, 2002. Consultation conducted by Fish & Wildlife Services, Albuquerque, N.M. September 12, 2002.

¹⁵ Belin, *supra* at 209.

flow standards, allowing the U.S. to meet lower flow levels than those required by the 2001 BO and directed Reclamation to take SJC water from the contractors if necessary.¹⁶

The ruling was immediately appealed to the Tenth Circuit Court of Appeals by the federal defendants and intervenors, which stayed the ruling pending the appeal. Oral arguments were heard in January 2003 before a three-judge panel, which affirmed the district court's ruling in June 2003.¹⁷ The federal defendants and intervenors petitioned for rehearing *en banc*. Meanwhile, the USFWS had issued a new Biological Opinion, dated March 17, 2003.

Many parties participated in confidential settlement negotiations sponsored by Governor Bill Richardson in the summer and fall of 2003.¹⁸ The federal government did not participate in the negotiations, which were ultimately suspended.

The State of New Mexico and the United States entered into an "Emergency Drought Water Agreement" in 2003. This agreement was actually an amendment to the Conservation Water Agreement. It provided that up to 217,500 acre-feet of relinquished Compact credit water, if available, to be divided among the Bureau of Reclamation (up to 70,000 acre-feet), the City of Santa Fe (up to 7,500 acre-feet), and the MRGCD (up to 140,000 acre-feet).¹⁹

In October 2003, the Tenth Circuit requested additional briefing from all parties on the question of whether the case was moot and its June 2003 ruling should be vacated. On January 5, 2004 the Tenth Circuit vacated the panel opinion as moot because the time frame covered by the District Court's 2002 ruling had expired. Furthermore, the New Mexico delegation had introduced, and Congress later enacted, legislation restricting the federal government from using San Juan-Chama project water to meet ESA obligations. The district court was ordered to determine whether there were unresolved issues to be tried.²⁰

The language in the Congressional appropriations bill also addressed the March 17, 2003 Biologic Opinion and is quoted here in full:

SEC. 205. (a) Notwithstanding any other provision of law and hereafter, the Secretary of the Interior, acting through the Commissioner of the Bureau of Reclamation, may not obligate funds, and may not use discretion, if any, to restrict, reduce or reallocate any water stored in Heron Reservoir or delivered pursuant to San Juan-Chama Project contracts, including execution of said contracts facilitated by the Middle Rio Grande Project, to meet the requirements of the Endangered Species Act, unless such water is acquired or otherwise made available from a willing seller or lessor and the use is in compliance with the laws of the State of New Mexico, including but not limited to, permitting requirements.

(b) Complying with the reasonable and prudent alternatives and the incidental take limits defined in the Biological Opinion released by the United States Fish and Wildlife Service dated March 17, 2003 combined with efforts carried out pursuant to Public Law 106-377, Public Law 107-66, and Public Law 108-7 fully meet all requirements of the Endangered Species Act (16 U.S.C. 1531 et seq.) for the conservation of the Rio Grande Silvery

¹⁶ Rio Grande Silvery Minnow v. Keys, 356 F. Supp. 2d 1222, 1234 and 1237 (D. NM 2002)

¹⁷ Rio Grande Silvery Minnow v. Keys, 333 F.3d 1109 (10th Cir. 2003).

¹⁸ Belin, *supra* at 210.

¹⁹ Emergency Drought Water Agreement, April 23, 2003, between the State of New Mexico, U.S. Dept. of Interior and the U.S. Army Corps of Engineers.

²⁰ Rio Grande Silvery Minnow v. Keys, 355 F.3d 1215 (10th Cir. 2004).

Minnow (*Hybognathus amarus*) and the Southwestern Willow Flycatcher (*Empidonax trailii extimus*) on the Middle Rio Grande in New Mexico.

(c) This section applies only to those Federal agencies and non-Federal actions addressed in the March 17, 2003 Biological Opinion.

(d) Subsection (b) will remain in effect until March 16, 2013.²¹

Plaintiffs filed a Motion to Dismiss Remaining Claims without prejudice.²² The defendants responded that the prior rulings (Memorandum Opinions and Orders of April 19, 2002 and September 23, 2002) should be vacated as for mootness and lack of subject matter jurisdiction. Subsequently, on April 26, 2004 plaintiffs withdrew their motion to dismiss.²³ Plaintiffs are asking Judge Parker not to vacate his rulings but to incorporate them into a final judgment that can be appealed yet again to the Tenth Circuit if defendants wish to do so.²⁴

The environmental Plaintiffs entered into negotiations with the City of Albuquerque and the Albuquerque-Bernalillo County Water Utility Authority to establish an "Environmental Pool" of 30,000 Acre Feet capacity within the Abiquiu Reservoir.²⁵ The parties reached an agreement on April 20, 2005. In return for the establishment of the "Environmental Pool," into which the Plaintiffs can store water legally acquired from voluntary purchases, leases and donations, the Plaintiffs will drop their remaining claims against the City and County and will refrain from challenging the legality of Section 205 of Public Law 108-447.²⁶ Court approval of Plaintiffs and City of Albuquerque's Stipulation and Joint Motion for Dismissal of Any and All Claims Regarding the San Juan-Chama Project or San Juan-Chama Water is still pending due to the concerns of the State of New Mexico regarding the wording of the Stipulation.

In 2002 the MRGCD filed a cross-claim to quiet title to ownership of El Vado Reservoir and the Angostura and San Acacia Diversion Dams and other land and irrigation works within the MRGCD. MRGCD also sought a declaratory judgment interpreting the effect of their 1963 transfer of State Water Rights Permit No. 1690 to the United States.²⁷ The federal defendants opposed this claim and environmental plaintiffs sided with the federal government on this issue. On July 25, 2005, the Federal District Court ruled that ownership of these properties and certain specific tracts identified in the cross-claim is declared to be in the United States of America.²⁸ The Court also ruled that Permit No. 1690 must remain in the name of the United States unless Congress authorizes its conveyance to the MRGCD.

²¹ Section 205, Pub.L. 108-447, 118 Stat. 2809 at 2949, 108th Congress, Second Session, Convening January 7, 2005, Consolidated Appropriations Act, December 8, 2004, see <http://www.pubklaw.com/legis/publaw108-447.html>.

²² Rio Grande Silvery Minnow v. Keys, et al., CIV 99-1320-JP/KBM (Docket Number 535, Filed 03-04-2004).

²³ Rio Grande Silvery Minnow v. Keys, et al., CIV 99-1320-JP/KBM (Docket Number 591, Filed 04-26-2004).

²⁴ Belin, Aletta, "Reflections on Six Years of Silvery Minnow Litigation," Rocky Mountain Mineral Law Foundation Paper, presented in Santa Fe, New Mexico (June 2005).

²⁵ Maria O'Brien. "Lessons Learned Resolving the Unresolvable: Rio Grande Silvery Minnow vs. City of Albuquerque", Rocky Mountain Mineral Law Foundation presentation, Santa Fe (June 2005).

²⁶ Maria O'Brien., supra.

²⁷ Rio Grande Silvery Minnow v. Keys, et al., CIV 99-1320-JP/KBM (Docket Number 21, Filed 2-07-2000, amended Docket Number 366, Filed 3-26-2002).

²⁸ Rio Grande Silvery Minnow v. Keys, et al. & MRGCD, CIV 99-1320-JP/KBM (Docket Number 665, Filed 7-25-2005).

APPENDIX D-2**DRAFT DESCRIPTION OF WORK (8/18/04)****WAMS RESERVOIR STORAGE PRELIMINARY ANALYSIS**

Prepared for review by Interim Steering Committee of the MRG ESA Collaborative Program

Background: The Water Acquisition and Management Subcommittee (WAMS) envisions meeting Program Water needs through improved management and annual lease/purchases of water from current users, storing such water in upstream reservoirs, with flows released as needed to provide for identified river needs. For the most part, the water to be secured, stored and managed for the Program is already being stored and managed in some fashion because water delivered to Elephant Butte Reservoir has been relied upon to provide the bulk of the flows to meet the Program requirements.

Goal: WAMS plans to undertake a preliminary analysis of various options for storage and management of water in order to minimize the need for the Program to acquire supplemental water. This effort will result in a report and recommendations to the InSC and Executive Steering Committees of the Program. It is acknowledged that the preliminary analysis is only one piece of the work that will be needed for the Program to meet the Program water demand and also that any changed reservoir management will most likely be a long-term strategy vs. a short-term strategy.

Overview: WAMS will evaluate potential hydrologic models to determine whether a tool exists that can be used or modified to test various options. WAMS will work cooperatively to develop alternatives. Initially, it appears that the URGWOM model is the most suited to fulfill the needs of this preliminary analysis. WAMS will work with the URGWOM technical team to develop a Scope of Work for working together on modeling alternatives. The URGWOM team will not be able to work on this until after October, 2004. This project will also involve the development of information on other factors, such as authorization constraints, legal issues, environmental, economic and other considerations. This work will be undertaken in close consultation with the Interstate Stream Commission, Bureau of Reclamation, Corps of Engineers, Middle Rio Grande Conservancy District, City of Albuquerque and other critical management agencies. After the alternative scenarios have been modeled and the results analyzed, all of the information will be compiled into a report to the Interim Steering Committee and the Executive Committee. The report may include recommendations for the Program on how to proceed and suggest particular areas where negotiations have the potential to result in agreed-upon changes in reservoir management that would further Program goals. Necessary implementation steps will be identified.

The Utton Center¹ will assist in coordinating this preliminary analysis, by providing support to the process in coordinating meetings, task management, progress reports, coordination between various stakeholders, and preparing the final report and recommendations.

¹ The Utton Transboundary Resources Center is a non-profit law and policy center at the UNM School of Law that is committed to using impartial expertise to help resolve transboundary resources conflicts, with the goal of helping to forge sustainable management plans for the future.

APPENDIX D-3**ADDITIONAL DETAIL ON ALTERNATIVES CONSIDERED****Abiquiu Reservoir Operation Alternative 1.**

Using 2004 hydrology and reservoir conditions, retain Rio Grande water in storage in Abiquiu Reservoir during the 2004 irrigation season that would have otherwise been delivered to Elephant Butte Reservoir.

- a. Set release rate from Abiquiu Reservoir during the March 1 through July 1 period in accordance with the following:
 - i. MRGCD demand at Cochiti Dam less main stream flow (if this difference >0); or
 - ii. Biological Opinion (B.O.) flow target less main stream flow (if this difference >0); whichever is less;
 - iii. At all times maintain a minimum flow of 200 cfs below Abiquiu Dam or inflow to the Reservoir, which ever is less.
- b. Evacuate storage beginning November 1st at a uniform rate so that all storage is evacuated by December 25th; alternatively,
- c. Evacuate storage beginning November 1 through March 1.

Potential Operational Benefits

Currently under Public Law 86-645, Abiquiu Reservoir is operated for flood control and to meet downstream demand of the MRGCD and Rio Grande Compact deliveries. Under current operating procedures, normal inflows and releases from El Vado are passed through Abiquiu, without regulation except due to channel constraints below the dam. When channel capacities are met, flood control operations begin at Abiquiu. Flood storage generally occurs between April and June. As further described in the URGWOM Rules Documentation, December, 2002 Draft:

Typically, if Rio Grande inflows exceed downstream channel capacities during April and May, Abiquiu captures this peak of snowmelt runoff, and releases it during June and early July. However, any Rio Grande storage remaining after the natural flow at Otowi drops below 1,500 cfs (July 1st or later) is carried over ... and not released until November 1st or later.... Depending on the volume of water from spring runoff, Abiquiu Reservoir has either been able to safely pass inflow without any carryover or has locked-in as little as 3,500 (1994) acre-feet to as much as 212,000 acre-feet (1987).

The concept with this alternative is to capture some of the native water, hold it, and deliver it the following fall, or alternatively by March 1. The result of this alternative would be to determine if, for the modeled year, evaporative loss savings could be realized by altering the release schedule and holding more water upstream until later in the year. Although other years are available, 2004 was used as an example year.

Legislative and Other Operational Authority

Abiquiu Dam was authorized for construction by the Flood Control Act of 1948 (PL 80-858) and the Flood Control Act of 1950 (PL 81-516). Operational guidelines for the Middle Rio Grande Project are included in Public Law 86-645 (1960) which states that all reservoirs will be evacuated completely on or before March 31st of each year. Any deviations from normal operating criteria other than an emergency must be made with the advice and consent of the Rio Grande Compact Commissioners. PL-86-645 states in relevant part:

Cochiti Reservoir, Galisteo Reservoir, and all other reservoirs constructed by the Corps of Engineers as a part of the Middle Rio Grande project will be operated solely for flood control and sediment control, as described below:

(a) the outflow from Cochiti Reservoir during each spring flood and thereafter will be at the maximum rate of flow that can be carried at the time in the channel of Rio Grande through the middle valley without causing flooding of areas protected by levees or unreasonable damage to channel protective works ...

(c) Subject to the foregoing, the storage of water in and the release of water from all reservoirs constructed by the Corps of Engineers as part of the Middle Rio Grande project will be done as the interests of flood and sediment control may dictate: *Provided*, That the Corps of Engineers will endeavor to avoid encroachment on the upper two hundred and twelve thousand acre-feet of capacity in Cochiti Reservoir, and all reservoirs will be evacuated completely on or before March 31 of each year ...

(d) All reservoirs of the Middle Rio Grande project will be operated at all times in the manner described above in conformity with the Rio Grande compact, and no departure from the foregoing operation schedule will be made except with the advice and consent of the Rio Grande compact

Because operation of the reservoir as outlined in this alternative would deviate from standard operations for flood and sediment control, ultimately the advice and consent of the Rio Grande Compact Commission would be necessary.

Feasibility of Modeling

In informal discussion with the Tech Team, this alternative was not envisioned to require significant rules changes at this time. It appears to be very feasible to model and, in fact, it would be possible to model three different years instead of just 2004 hydrology. The demand for the additional years could be set at 2004 demand, as provided by the MRGCD. Because of developments to the URGWOM model in order to evaluate how to meet the target flows of the 2003 Biologic Opinion, the Tech Team has been inputting rules into the model that will help refine evaluation of this alternative. In particular, a better assessment of how flows between Cochiti and Elephant Butte will be routed is being developed. It may be possible to add another alternative which would model release rates to meet the BO target flows.

Constraints/Issues

There has been concern expressed in WAMS about the accuracy of the URGWOM model to describe how water is routed between Cochiti and Elephant Butte. The discussion in WAMS and with the technical team has pointed out several areas where this concern can be alleviated. First, this limitation of URGWOM is recognized, but the problem exists under both the control situation and the model runs. There can be a comparison of the relative losses. It was suggested that the routing might be better examined at from an analytical standpoint, in other words, looking at flow regimes, time frames, river volumes, riparian ET, and other selected factors. URGWOM could be used for the base run for the reservoir evaporation and release schedule and then other analytic tools would be applied to refine the comparisons. We concluded that the alternative is only intended to be an evaluation of the level of the magnitude of the change. If by using URGWOM there are benefits of significant magnitude, further detailed studies of this alternative would need to be pursued. There would need to be agreement among the WAMS members, the URGWOM Tech Team and other stakeholders regarding the details of the model run.

Abiquiu Reservoir Operation Alternative 2.

Model the 40 year URGWOM period: When water is not needed to meet Compact deliveries in a given year, retaining that water in Abiquiu to provide water to manage Middle Valley water deliveries in

the subsequent year(s). The evaporative loss savings over the modeled period will be calculated. This storage would be based on “if and when” the space is not needed by the City of Albuquerque, or its subcontractors, for storage of its water.

Legislative and Other Operational Authority

The same legislative authorities that apply to alternative 1, are applicable here. However, because this alternative involves conservation storage in Abiquiu, Public Law 97-140 (Dec. 29, 1981, 95 Stat. 1717, Sect. 5) and Public Law 100-522 (Oct. 24, 1988, 102 Stat. 2604) are also important.

P.L. 97-140 provides for the storage of San Juan-Chama project water in Abiquiu. The Corps of Engineers is authorized to enter into agreements with entities that have contracted for San Juan-Chama water for a total storage of 200,000 acre-feet in Abiquiu. The storage of San Juan-Chama project water is not to interfere with the authorized purpose of Abiquiu Dam and Reservoir Project (for flood control and a sediment pool).

Later, with the passage of P.L. 100-522, native storage of Rio Grande system water was authorized:

Section 1. Water Storage.

Notwithstanding any other provision of law, the Secretary of the Army, acting through the Chief of Engineers, is authorized to store 200,000 acre-feet of Rio Grande system water at Abiquiu Dam, New Mexico, in lieu of the water storage authorized by section 5 of Public Law 97-140, to the extent that contracting entities under section 5 of Public Law 97-140 no longer require such storage. The Secretary is authorized further to acquire lands adjacent to Abiquiu Dam on which the Secretary holds easements as of the date of enactment of this Act if such acquisition is necessary to assure proper recreational access at Abiquiu Dam. The Secretary is further directed to report to Congress as soon as possible with recommendations on additional easements that may be required to assure implementation of this Act.

Section 2. Limitation.

The authorization to store water and to acquire lands under section 1 is subject to the provisions of the Rio Grande Compact and the resolutions of the Rio Grande Compact Commission.

Since Congress has authorized native storage, a Congressional change to authorizing legislation would not be required in order to implement this alternative. In addition, because Abiquiu is a post-1929 reservoir, there should be nothing intrinsic in the operation of the Compact that would prohibit this operational change. However, because a change in operations under P.L. 86-645 would be necessary, approval of the Rio Grande Compact Commission would be required.

Feasibility of Modeling

In meeting with the URGWOM tech team, it was concluded that this alternative is capable of being modeled using URGWOM. In order to begin with an Article VII condition, modifications to the sequence of model years currently being used would be needed. In addition, because URGWOM conducts model runs in increments of ten years, adjustments would be needed to obtain a 40-year sequence. This would be worthwhile in order to see the magnitude of the potential long-term gains from this operational strategy. Because Public Law 100-522 authorizes native storage in Abiquiu, there would not need to be other significant rules changes in URGWOM. The major concern of the URGWOM tech team was ownership and management of the conserved water rights. We reached agreement that as a first step it would be feasible to evaluate the savings. After this project is completed, there would need to be

discussions among stakeholders on how the releases would be managed. Again, agreement among stakeholders on the details of this model run would be necessary, in particular, coordination with the City of Albuquerque regarding their planned scenario for use of storage space in Abiquiu.

If the model runs show that this alternative has significant potential benefits to water supply, coordination with the Middle Valley water users and the State of New Mexico to develop potential release scenarios would be needed as a second phase.

Increase Storage Opportunities At Heron Reservoir Alternative 1.

Take delivery of San Juan-Chama Project water in Heron Reservoir in lieu of delivery of this water to Abiquiu Reservoir. Utilizing the 2003 Agreement between Santa Fe and the Bureau of Reclamation for purchase of San Juan-Chama Project water, change the operation such that delivery would be taken at Heron Reservoir instead of Abiquiu Reservoir. Then determine the evaporation savings gained by this operation. The release schedule of this water remains unchanged. This alternative would not impact the firm yield of the San Juan-Chama Project.

Legislative and Other Operational Authority

It is clear that the delivery point for the San Juan-Chama contractors' water is at the outlet of Heron Reservoir. This term is included in the SJC contracts. Further, pursuant to the SJC contracts, carryover storage of that water is not allowed. The contractors' water must be evacuated from Heron by December 31st of each year. Currently, the Bureau of Reclamation has been granting waivers for extension of this contractual provision to March 31st of each year.

Heron was authorized under Public Law 87-483 which authorized the San Juan-Chama Project in 1962. Under that law, the Secretary of the Interior must comply with all applicable provisions of the Colorado River Compact, the Upper Colorado River Basin Compact, the Boulder Canyon Project Act, the Boulder Canyon Project Adjustment Act, the Colorado River Storage Project Act and the Treaty with the United Mexican States. In addition, all provisions of the Rio Grande Compact must be met.

Typically Reclamation projects are authorized to provide storage for water to be captured during the runoff season and used that same year for irrigation or other authorized purposes. This is consistent with the wording of Section 8 of P.L. 87-483. That section reads:

(d) The amount of water diverted in the Rio Grande Basin for uses served by the San Juan-Chama project shall be limited in any calendar year to the amount of imported water available to such uses from importation to and storage in the Rio Grande Basin in that year.

This section has been interpreted to mean that no carryover storage is authorized in Heron, but the interpretation has been the subject of differing opinions. If there were agreement to evaluate this alternative from a physical modeling standpoint, there would need to be a thorough analysis of the Heron authorizing legislation including all of the relevant Compact legislation that affects the SJC project.

Reclamation has negotiated temporary waivers with contractors that allow carryover in order to provide release rates on the Rio Chama to enhance the fishery between El Vado and Abiquiu Reservoirs during the winter and provide flexibility in managing flows. If a waiver has been obtained by a contractor, the contractor's water must be released during late March and up until April 30th to a downstream reservoir where the contractor has storage space. Feasibility of modeling this alternative would involve limitations on storage in Heron that would not impair the firm yield of the project or the water rights of San Juan-Chama contractors. Funding may be needed to develop the required rules changes.

Constraints / Issues

The City believes that any modification to the "no carryover" provision in Heron authorizing legislation would lead to a revision of the City's contract with the Bureau of Reclamation for storage of

water in Heron and they do not want to revise their storage contract. The recently adopted Public Law 108-447 (Jan. 7, 2005) may allay the City's concerns. That law states:

Section 205. (a) Notwithstanding any other provision of law and hereafter, the Secretary of the Interior, acting through the Commissioner of the Bureau of Reclamation, may not obligate funds, and may not use discretion, if any, to restrict, reduce or reallocate any water stored in Heron Reservoir or delivered pursuant to San Juan-Chama Project contracts, including execution of said contracts facilitated by the Middle Rio Grande Project, to meet the requirements of the Endangered Species Act, unless such water is acquired or otherwise made available from a willing seller or lessor and the use is in compliance with the laws of the State of New Mexico, including but not limited to, permitting requirements.

The City of Santa Fe has expressed interest in evaluating this alternative because they are looking for alternate locations to store City of Santa Fe water. Further coordination with the City of Santa Fe on this issue is needed.

Increase Storage Opportunities At Heron Reservoir, Alternative 2.

Assuming the Program has acquired a certain amount of native water rights, capture native inflow to Heron up to the extent of these water rights, and maintain a Program pool by allowing for the carry-over of this storage from one year to the next if and when storage space is available. Storage could only be undertaken when the rights of downstream users are satisfied. This alternative would not impact the firm yield of the San Juan-Chama Project.

APPENDIX D-4**WATER MANAGEMENT STRATEGY
FOR THE
MIDDLE RIO GRANDE VALLEY**

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November 14, 1996

INTRODUCTION

The listing in 1994 of the Rio Grande silvery minnow as endangered under the Endangered Species Act and the drought conditions experienced in the middle Rio Grande valley during the first half of 1996 combined to underscore the need to address long-term water management options to meet water needs in the valley. The purpose of this paper is to outline alternative courses of action to satisfy these water needs that merit further investigation by agencies and entities which have a stake in water management for the valley.

The middle Rio Grande valley is hydrologically very complex and is home to substantial agricultural activity, urban development and the silvery minnow. Uncertainties exist in our understanding of the hydrologic connections between surface-water and ground-water systems in the valley principally due to a lack of data. There are also uncertainties regarding water needs over time for various purposes. Additionally, there are numerous incompatibilities between existing institutions as well as federal and state laws which affect water management in the valley and upstream reservoir operations for the valley.

Still, during the 1996 irrigation season, agencies and entities directly involved in water operations for the middle valley largely succeeded in satisfying the water needs of the silvery minnow and water users, including Middle Rio Grande Conservancy District (District) irrigators. This success was due to the District operating its system to allow native Rio Grande water to remain in the river undiverted for the minnow and the city of Albuquerque (City) and other entities making some of their San Juan-Chama Project water available to the District for use by irrigators at no cost to the water users in the valley. It is expected, however, that San Juan-Chama Project water owned by the City and these other entities may not be available in future years to augment surface-water supplies in the valley.

Without proactive water planning and related commitments to action, water management decisions may be made through litigation. Environmental organizations have sent Notices of intent to Sue, and others have contemplated legal action, regarding operation of the river system through the middle valley and related impacts to the silvery minnow. Government agencies with a stake in water management in the middle valley are now in the process of developing, plan for 1997 river operations for the silvery minnow and the District. Agencies and entities directly involved in water operations for the middle valley also share responsibilities in equitably meeting future water needs with the goal to satisfy water uses and the needs of the silvery minnow beyond 1997.

ACTIONS

To meet the needs of the silvery minnow, it is most desirable to take actions which will secure long-term, dependable amounts of water for the middle Rio Grande. In doing so, water users also need to be accommodated. No single action will by itself accomplish these goals.

However, the preparers of this paper believe that some combination of the following actions will be instrumental in meeting these goals. These alternative actions require further investigation and refinement to ensure that actions ultimately taken are responsive to these goals and to changing needs. Actions to be taken must be legal, economically feasible, politically acceptable and implementable in a timely manner. Successful implementation of any of these actions will require improved water measurement, monitoring and accountability. The following alternative actions are non-exclusive and no order of priority has been assigned to them.

1. Acquisition of Water: Acquisition of water from willing sellers to facilitate water supply management in the middle Rio Grande is an action that could be taken within existing laws. Modifications to existing laws and contracts might further facilitate various ways of implementing a water acquisition program which may involve elements of water-use forbearance agreements or water banking. While water could be acquired from water users, the District may need to be a party to agreements to allow such a program to be effective in satisfying needs of the water users and the silvery minnow. A water acquisition program may require sustained funding from federal and other sources, and it would require development of institutional and physical criteria for obtaining water in a timely manner.

2. Conjunctive Ground-Water and Surface-Water Use: The use of ground-water and surface-water supplies could be co-managed to contribute to meeting the needs of water users and the silvery minnow. During wet years, ground-water users such as the City might use a higher proportion of surface water for direct use or artificial ground-water recharge. During dry years, more ground water might be pumped in lieu of using surface water so that additional surface water may augment the total surface-water supply available for the silvery minnow and surface-water users such as the District. Another option is to strategically place shallow ground-water wells in the middle Rio Grande valley for use in times of severe surface-water shortages, thereby providing a supplemental source to the total water supply in years of low streamflow. This option could be expensive, but would provide a means to respond to emergency low-flow situations. These options would provide for a more comprehensive water use; however, institutional and water rights constraints need to be addressed to implement them.

3. Upstream Water Management: Changes to Rio Grande system water operations could increase the capability of storing native Rio Grande water upstream from the middle valley. Some reservoir and river operation options could require new authorizations, while other options could be accomplished under current authorities through changes to federal water control manuals. Possible options for consideration, in no order of priority, are: (1) storing Rio Grande water in vacant storage space in Heron Reservoir when space is available, as well as utilizing San Juan-Chama Project water; (2) transferring water from El Vado Reservoir to Abiquiu Reservoir; (3) increasing the storage capability in Abiquiu and Jemez Canyon Reservoirs; and (4) using Cochiti Lake for a re-regulation reservoir during the irrigation season. Aspects related to these options which would need to be addressed include: water supply. Native American water rights, effects on water management outside the middle valley, recreation, compliance with laws related to the environment, the Rio Grande Compact, and specific agency and project authorizations. There is also a need to annually prepare an operating plan for reservoirs and diversions of the Middle Rio Grande Project in consultation with stakeholders to specifically evaluate water management needs and opportunities for the middle valley.

4. Water-Use Efficiency Increases: Increased water-use efficiencies in the middle Rio Grande valley should contribute to an increase in the flexibility to manage the water supply. Options for action by which water-use efficiencies could be increased include improving off-stream water-delivery systems by such means as lining canals, improving on-farm irrigation practices, or improving water delivery

scheduling. Prior to taking action to increase efficiencies, the impacts of various options on the hydrology and the environment of the middle valley need to be assessed. Further, the disposition of water "saved" by these measures would need to be resolved in accordance with state and Federal water law and possibly by agreement with the District to allow water saving measures to effectively aid water managers in meeting the needs of the water users and the silvery minnow.

5. Water Rights Administration: Water rights in the middle Rio Grande valley are not adjudicated and much of the water uses in the valley are not metered. Metering surface- water and ground-water irrigation deliveries and drain flows would help clarify existing water uses and needs, quantify the available water supply, and identify water management options. Adjudicating water rights in the middle valley would, in conjunction with a metering program, allow for improved administration of water rights and improved water management. However, an adjudication may not be completed for the middle valley in the foreseeable future unless alternative dispute resolution procedures can be adopted by the state, water users and the court to carry the adjudication forward. Still, sustained funding from federal and other sources to meter and monitor flows throughout the valley is needed.

RECOMMENDATIONS

Agencies and entities directly involved in water operations for the middle Rio Grande valley should diligently and cooperatively investigate with the broader community of interests, the feasibility of implementing the actions described herein and develop a plan of action to serve as the basis for future river and reservoir operations to meet the needs of water users and the silvery minnow in the middle valley. Such a plan of action might include any combination of the alternative actions described herein which would lead to maximum improvements in water management for water users and the silvery minnow as a whole.

Attention should first be directed towards more immediately attainable actions such as upstream water management options which can be accomplished within existing authorities and the acquisition of water. Concurrently, existing institutional constraints to implementing potential actions should be examined and efforts should be initiated to make institutional changes as may be deemed appropriate to help accommodate both water users and the silvery minnow in the long-term. Where additional studies are deemed required to fully evaluate a potential action, the agencies and entities represented in the preparation of this paper should cooperate in securing the necessary resources to complete such studies promptly. These agencies and entities should also continue to dedicate staff to working on issues related to development and implementation of a plan of action to address future needs of both water users and the silvery minnow in the middle valley. To this end, the preparers of this paper seek confirmation from the leadership of their respective agencies or entities that the actions described herein should be pursued.