SENATE JOINT RESOLUTION 94-32 CONCERNING THE MANAGEMENT, CONSERVATION, AND PRESERVATION OF THE WATER RESOURCES OF THE STATE OF COLORADO

by

Department of Natural Resources

Division of Water Resources

Colorado Water Conservation Board

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SENATE JOINT RESOLUTION 94-32

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Executive Summary

The general welfare of the State of Colorado depends upon a continuous and reliable supply of water. Management of that supply requires consideration of many factors, including, available supply, demand, conservation, preservation, compact and federal decree constraints, and drought preparedness. Considering these factors and in anticipation of the need to answer future questions on several issues affecting Colorado's water resources, the 1994 Colorado General Assembly passed Senate Joint Resolution 94-32. This resolution requested that the Colorado Water Conservation Board and the Division of Water Resources jointly inventory and briefly summarize recent studies made concerning Colorado's water supply and water needs.

This document is in response to Senate Joint Resolution 94-32 (See Appendix A). The format and numbering system used correspond to that in the resolution.

The objectives of SJR 94-32 are to:

- Inventory the information readily available for each water division of the state regarding water supply, drought periods, anticipated shortages, existing and future needs, compact limitations and other information regarding the efficient management, conservation and preservation of its water resources.
- Identify the nature and extent of information needed to enable the state to make informed decisions regarding the efficient management, conservation and preservation of the water resources of the state.
- Set forth a plan to obtain the information identified above.
- Perform the above activities with existing staff resources.

The approach taken to fulfill SJR 94-32 was as follows:

- Prepare a draft report based on readily available information.
- Obtain review from Division Offices of the Division of Water Resources.
- Obtain Colorado Water Conservation Board and other interested party review.
- Incorporate comments received.
- Prepare a final report.

The report contains tables and figures that illustrate, in various ways, Colorado's water supplies. It also contains appendices that describe the sources used and limitations placed on the state's

water supplies under interstate compacts and U.S. Supreme Court decrees. A bibliography has been prepared containing approximately 7,500 seperate items, and is available upon request.

Conclusions

The key conclusions and products of this report are:

- A bibliography has been developed which describes approximately 7,500 pertinent reports related to water supply, drought periods, expected shortages, and interstate compacts. On a broad scale, a wealth of individual information items exist throughout the state. Local, smaller scale, data also exists, but are too numerous to describe. The bibliography shows that most of the data on a statewide basis has not been updated since the early 1970's.

- Large scale data collection needs are significant and include additional irrigated acreage information in Divisions 1, 2, and 3 and ground water pumping data in Divisions 1 and 3. Compilation of statewide data is also needed. Detailed, local data requirements are expected to continue to be addressed as needed.

- Data management needs are large in Divisions 1, 2 and 3. These needs are similar to those which resulted in developing the Colorado River Decision Support System (CRDSS) for Divisions 4, 5, 6 and 7, and the South Platte Water Rights Management System (SPWRMS) in Division 1. A plan and schedule have been developed which will allow a statewide "Colorado Water Decision Support System" to be realized. The development of this system is estimated to cost 5 million dollars and would take approximately 8 years to complete.

- Development of accurate water budgets throughout the state is difficult given the current level of data collection and available resources.

- Approximately 70% of the water available for use in Colorado comes during the May though July runoff period. Therefore, the keys to drought preparedness must include storage and runoff forecasting, demand management, interruptible supply arrangements, conjunctive use and other innovative tools to aid in managing Colorado's water resources. While there may be adequate storage to meet today's needs under normal runoff conditions, there is not enough storage to sustain these uses through a severe and sustained period of drought. However, development of additional storage is very expensive, permit intensive, and requires 20 to 30 years from planning to construction. As growth continues in the state, the ability to meet increasing demands and to sustain water supplies through droughts will become increasingly difficult. Decisions on how future supply demands are met will have to be made in the very near future if the state is to meet those demands.

- In the Colorado River Basin (Water Divisions 4, 5, 6 and 7) consumptive use of water is the measure of Colorado's compact apportionment under the "Law of the Colorado River." Therefore, it is important to be able to accurately determine the consumptive use of water on the west slope, particularly as Colorado comes closer to fully using its compact apportionment. Given this background, the needs of the Colorado River Basin are:

  1. Improved runoff forecasting.

  2. Additional real-time satellite-linked stream gaging stations.

  3. Improved estimates of consumptive use through additional climate stations, lysimeter data, and maintenance of the irrigated acreage data developed for 1993 as part of the CRDSS project.

- The Arkansas River, the Rio Grande, Costilla Creek, the La Plata River, the Republican River, the North Platte and Laramie Rivers, are being depleted at or very near the limits established by interstate compacts or U.S. Supreme Court decrees. Significant developable water only remains in the Colorado River Basin (Divisions 4, 5, 6 and 7) and in the South Platte River Basin (Division 1). Preliminary demand projections indicate that Colorado would consume all of those remaining compact entitlements.

- Colorado is facing increased demands for water from downstream states in the Colorado River Basin, the South Platte River Basin, the Republican River Basin, the Arkansas River Basin, the North Platte Basin, the Laramie River Basin, and the Rio Grande Basin. These demands stem from either growth, the needs of endangered wildlife species listed under the Endangered Species Act, or both. Colorado must be able to defend its compact and federal decree apportionments against those increasing demands and related efforts to challenge or litigate these apportionments. The importance of having quality data to support decision systems and models became evident in the litigation with Kansas (Kansas v. Colorado, 1985). The legislature, the Colorado Water Conservation Board and the Division of Water Resources should, therefore, continue to develop data centered decision support systems similar to the CRDSS in each of Colorado's major river basins.

Plan and Schedule

Table 4.1 and Figure 4.1 present a list and schedule for developing the information and evaluation tools that are expected to be needed to effectively manage, conserve and preserve the State of Colorado's water resources. The list and schedule are based on the available information identified in this report and builds on the experience and successes of existing

programs described in Section 3.2. The estimated costs assume 85% of the work to be privately contracted and 15% of the work to be performed by state employees. It is envisioned the plan be re-evaluated annually for progress, and to examine technological advances and any unique demands that arise within specific regions of the state.

Acknowledgements

The preparers of this report were Mr. Ray Bennett and Mr. Joseph Grantham, Division of Water Resources, and Mr. Randy Seaholm, Water Conservation Board. They acknowledge the legislators foresight in requesting this assessment of Colorado's water resource information. It has become obvious over the past few years that the only way the state can adequately develop and protect its water resources is through sound basic data and information. This assessment focuses on the status of that information and should allow future plans to be developed to address the areas of need as described in this report.

The Colorado Water Conservation Board and the Executive Director, Daries (Chuck) Lile and his staff, with the State Engineer, Hal Simpson, and his staff, provided much needed direction, hard work and focus in the preparation of this report. Finally, a special thanks to the Division Offices of the Division of Water Resources. These people are actually out in the field administering the waters of the state daily and have a clear knowledge of the needs of the state to protect this most precious resource. Any endeavor such as this would run the risk of being an "ivory tower" educational exercise without their insight. Their hard work and dedication is deeply appreciated.

1.0 Introduction

The general welfare of the State of Colorado depends upon a continuous and reliable supply of clean water. The state's ability to supply water to meet the present and future water needs must consider in whole the available water supplies and the efficient management, conservation, and preservation of those supplies. It is further recognized that the state's water supplies are subject to interstate compacts and equitable apportionment decrees which require large amounts of water arising in Colorado to flow downstream to other states, and that water supplies are also variable and subject to periods of prolonged and extreme droughts.

Considering these factors and in anticipation of the need to continue to answer future questions on several issues affecting Colorado's water resources, the 1994 Colorado General Assembly passed Senate Joint Resolution 94-32. This resolution requested that the Colorado Water Conservation Board and the Division of Water Resources jointly inventory and briefly summarize recent studies made concerning Colorado's water supply and water needs.

This document is in response to Senate Joint Resolution 94-32 (See Appendix A). The format and numbering system used correspond to that in the resolution.

1.1 Objectives

The objectives of SJR 94-32 are to:

- Inventory the information readily available for each water division of the state regarding water supply, drought periods, anticipated shortages, existing and future needs, compact limitations and other information regarding the efficient management, conservation and preservation of its water resources.

- Identify the nature and extent of information needed to enable the state to make informed decisions regarding the efficient management, conservation and preservation of the water resources of the state.

- Set forth a plan to obtain the information identified above.

- Perform the above activities with existing staff resources.

1.2 Approach

The approach taken to fulfill SJR 94-32 was as follows:

- Prepare a draft report based on readily available information.

- Obtain review from Division Offices of the Division of Water Resources.
- Obtain Colorado Water Conservation Board and other interested party review.
- Incorporate comments received.
- Prepare a final report.

1.3 Background

As an overview, the following discussion of Colorado's water supply is taken from the report "Water for Tomorrow, Colorado State Water Plan", (USBR, CWCB, February, 1974):

The total water supply available to the state is derived through complex usage of supplies from several sources. Supplies pumped from deep and shallow aquifers usually have a close relationship with the surface water supply. The normal water supply situation including state water outflow and Transmountain diversions that prevailed in 1970 is summarized in Table 1.1. (In order to update Table 1.1 from 1974, it required many assumptions to be made. Updated information was supplied where readily available, however, it highlights the need for updated data to complete an accurate water budget for the state. The most difficult part of Table 1.1 to determine is the water depletions portion that requires significant data on diversions, consumptive use and return flows. This component of the water budget is discussed in Section 3.0).

The annual surface runoff in any particular stream varies widely from year to year depending upon the precipitation. Other factors that influence the runoff are the soils, topography, geology, and vegetative cover. The average annual runoff ranges from 20 inches in the high mountains to less than 0.25 inches in the arid parts of the plateau and plains sectors of the state. By sub basins, the Upper Colorado sub basin experiences the highest runoff, the average annual being 6.6 inches. The Republican River sub basin has an average annual runoff of 0.4 inches which is the lowest in the state.

The water depletions in the state occur as a result of the utilization of a complex surface and ground water resource system. Some uses such as the generation of hydroelectric power cause little, if any, depletions. Also, in most cases water depletions for fish and wildlife, and recreational uses are minor; however, there can be substantial non beneficial evaporation losses from reservoirs kept full for these uses. Water supplies used for irrigation result in much greater depletions than any other purpose or combination of purposes. However, substantial return flows result from irrigation which are in turn put to successive uses. Other uses which result in lesser but substantial water depletion are municipal and industrial use, and mining and processing of minerals.

Interstate compacts require Colorado to permit specified quantities of water to cross its boundaries into other states for downstream use. In addition to the outflows required to satisfy

the compacts, some flood flows which cannot be managed by existing water resource developments also leave the state. Table 1.2 presents a list of the major international and interstate documents that affect Colorado's use of water.

Table 1.1 provides useful information on the long term average water supplies available for diversion and use as of 1970. Table 1.1 shows native (natural or undepleted) water supplies totalled 15,583,000 acre-feet in 1970 and that Colorado consumed an estimated 5,268,000 acre-feet of water. This resulted in approximately 10,315,000 acre-feet of water leaving the state.

The information in Table 1.1 has not been updated since 1970 on a statewide basis and, will require a considerable effort to do so. Nonetheless, a comparison was made of historic long term average basin outflows through 1993 shown on Figure 1.1 to 1970 basin outflow values on Table 1.1. The historic long term average outflow totalled 10,434,000 acre-feet, which is considered to be about the same as in 1970.

The Colorado River Basin is the only basin in the state for which updated information is available for the entire basin. This information is current as of 1985 and is displayed in Table 1.1a. This data shows that although consumptive uses have increased by approximately 500,000 acre-feet since 1970, the basin's natural flow has also been higher and thus the increase in consumptive uses have been masked.

Other factors to consider are the requirements and obligations of International Treaties, Interstate Compacts, and U.S. Supreme Court decisions. These documents must be evaluated before reaching any conclusions concerning basin outflows and unused compact entitlements. It would require considerable text and detail to explain the constraints imposed upon Colorado by each compact and federal decrees. However, it is clear the following basins are being depleted at or near the limits of depletions or consumptive use established in these documents:

- The Arkansas River Compact (1948)
- The Rio Grande Compact (1938)
- The La Plata River Compact (1922)
- The Republican River Compact (1942)
- The Costilla Creek Compact (1944 Rev. 1963)
- Nebraska v. Wyoming, 325 U.S. 589 (1945) (The North Platte River)
- Wyoming v. Colorado, 353 U.S. 953 (1957) (The Laramie River)

The Colorado River Basin and South Platte River Basin still have the potential for additional depletions based on estimates of current use under the compacts. A more complete discussion of the legal documents effecting the Colorado River is contained in Appendix C. In short, Colorado is entitled to consumptively use up to 3.079 million acre-feet under the 1970 "Criteria for Coordinated Long Range Operation of Colorado River Reservoirs" and current hydrologic conditions in the basin. This is significantly less than the 3.855 million acre-feet of consumptive use that Colorado believed would be available to it when the compacts were originally

negotiated, and is due in part to legal assumptions made in the "criteria" which Colorado and other Upper Basin states do not concur in.

As of 1985, the best estimate of Colorado's average annual consumptive use of Colorado River water was 2.3 million acre-feet. (For further discussion on water demands, see Section 2.3). However, summing the maximum consumptive use by projects currently in-place yields a value of approximately 2.6 million acre-feet, indicating that Colorado may have as little as 450,000 acre-feet left to develop under its Colorado River Compact apportionment. These values are now in the process of being reviewed and refined through the development of the Colorado River Decision Support System.

Additional development in the Colorado River Basin is also dependent on maintaining sufficient progress under the Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin (the "Recovery Program"). The U.S. Fish and Wildlife Service (Service) has listed four Colorado River fishes (Colorado squawfish, humpback chub, bonytail chub and razorback sucker) as endangered. Under the Endangered Species Act (ESA) each federal agency shall insure that any action is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat for the species. The "Recovery Program" was established through a cooperative agreement signed by the Secretary of Interior, the Western Area Power Administration, the states of Colorado, Wyoming and Utah, water users, environmental groups and others. The purpose of the program is to recover the endangered fish species in the Upper Colorado River basin while allowing water development to continue by acting as the "reasonable and prudent alternative" upon which the Service relies when asked to issue a biological opinion for any given project in the Upper Colorado River basin. The program is comprised of specific actions the parties involved have agreed to take toward full recovery of the endangered fish.

One of the most significant aspect of the "Recovery Program" from the perspective of this report is the appropriation of recovery instream flows. Each state will appropriate recovery instream flows in accordance with state water law and in a manner that will be most beneficial for the endangered fish. The recommended recovery instream flow appropriations will be of a relatively large magnitude and will significantly impact when future water rights will have water available to them. Failure to appropriate recovery instream flows would likely result in a finding of insufficient progress by the Service and the issuance of jeopardy opinions for projects proposed in the Upper Colorado River Basin. Thus, the states are motivated to assure that the "Recovery Program" succeeds. As a result, Colorado envisions needing to be able to fully manage all its water resources to the maximum extent possible in order to fully develop its compact apportionment while meeting the goals of the "Recovery Program."

The South Platte River compact was negotiated to prevent diversions by water rights in the lower reach (east of the Washington-Morgan County line) junior to June 14, 1897, during the irrigation season (April 1 to October 15) when the flow of the Julesburg gaging station is less than 120 c.f.s. There are no constraints on use outside the irrigation season or above the lower reach. The flow at Julesburg does not fall below 120 c.f.s. except in July and August in normal years

and for longer periods during drought years. Thus, there is potential to consume additional water in the South Platte River Basin if constraints resulting from the Endangered Species Act can be addressed through the implementation of a basin-wide recovery plan. This recovery plan is now under negotiation pursuant to a June, 1994 Memorandum of Agreement between the Secretary of Interior, Governor Romer and the Governors of Nebraska and Wyoming.

Figure 1.1 shows the seven irrigation water divisions of the state, major streams, and the historic average annual stream flows (USGS Water Resources Data, Colorado). As of 1993, more than 10 million acre-feet of water leave the state in an average year. Of that amount, approximately 87% (9.097 million acre-feet) flows west from the Continental Divide toward the Pacific Ocean and 13% (1.337 million acre-feet) flows east toward the Atlantic Ocean. The location of the state's water supply is in direct contrast to the location of consumptive use in the state, with approximately 25% located west of the Continental Divide and 75% located east. The difference in location between water supply and demand has resulted in the development of 24 transmountain diversions within the state. (See Figure 1.2).

Figure 1.3 shows a typical hydrograph for two rivers in the state that are not significantly impacted by upstream storage. As presented, approximately two-thirds of the runoff occurs over one-quarter of the year. The seasonal timing of runoff has resulted in the development of many surface reservoirs to capture the spring runoff for use later in the year.

Table 1.3 summarizes the total decreed absolute and conditional water rights in the state by Water Division as of 1990. It clearly shows the magnitude and importance of reservoir storage to manage the significant variances of runoff to better meet the demands of the users. As of 1990, a total of 8,747,632 acre-feet of reservoir storage had been constructed and decreed by the court as absolute water rights. (Absolute water rights are those that have been placed to beneficial use. Conditional water rights are decreed, but will be placed to beneficial use at some future date, i.e., through development of the specific project).

Finally, Colorado law, which includes interstate compacts, governs the allocation and administration of water rights in the state. Within Colorado, water is distributed according to the prior appropriation doctrine. A comparison of Figure 1.1 with Table 1.3 clearly suggests that if all conditional rights were to be developed, unappropriated water would not exist in the state. Furthermore, such future development would often need to be curtailed in order to meet the state's compact obligations.

Water Resource Investigations Report 88-41-1 entitled, "Estimated Use of Water in Colorado

2.0 Data Inventory

Key water supply and water use studies conducted by federal, state and water user organizations within the last 15 years were identified and tabulated into a bibliography. In addition, histograms were prepared for each Water Division to provide an indication of historic water supply and drought periods over time.

2.1 Bibliography

A bibliography of approximately 7,500 key water supply and water use studies conducted by federal, state and water user organizations within the last 15 years has been developed. This was accomplished by combining a search of the United States Geologic Survey library with local knowledge provided by the reviewers of this report (Division of Water Resources, Colorado Water Conservation Board, and water user organizations). The bibliography is compiled in a database that can now be searched by key words such as state water division, author, date, river basin, drought, and interstate compact, and will be of assistance to water resource managers in researching available literature in the state. The bibliography is not attached to this report due to its size, however, a printout is available upon request.

2.2 Division Histograms

Figures 2.1 through 2.7 are histograms that display annual flow volumes over time for three selected stream flow gages in each State Water Division. The gages were selected by location to provide an indication of water supply at different places within each Division. All Division histograms include one or more gages that represent flows from Colorado to downstream states. The Division of Water Resources operates and maintains more than 200 gaging stations throughout the state which supply stream flow data to support the administration of water rights and provide data for various water resource studies. The United State Geologic Survey also maintains and operates another 200 stations.

In reviewing the histograms, the solid horizontal lines shown on Figures 2.1 through 2.7 depict the average historic stream flow at each gage. Stream flow volumes below the average represent droughts of various duration and severity. For example, Figure 2.1 shows the average flow of the South Platte River near Kersey is approximately 880,000 acre-feet per year. It also indicates that relatively severe droughts occurred in the 1930's and again in the 1950's. Further, it indicates dry years as being a fairly frequent occurrence, emphasizing the need for dry year

repayment studies. Presently, this provides the best indicator as to how the unused compact apportionment may be fully used in the future.

recognized as the most recent periods of extended drought and are often used for water supply planning purposes. The drought of 1977 is recognized as the driest single year on record in most basins.

2.3 Water Use and Future Demands

While water use information is collected by various users and government agencies daily, it is not compiled in any type of statewide report with any regularity.[1] The last published report on water use for the entire State of Colorado was published by the U.S. Geological Survey in Water-Resource Investigations Report 88-41-1 entitled, "Estimated Use of Water in Colorado, 1985." Figure 2.8 shows summary results for the state. This figure shows that of the 20,844 million gallons used each day in 1985, approximately 75% was returned to the stream system. Further, about 60% of the water diverted is used by irrigated agriculture and an estimated 35% is used in the generation of electrical power, leaving 5% of Colorado's water use for domestic, commercial, industrial and other purposes.

Future demands for water, in particular from the Colorado and South Platte rivers, will continue to increase. Demographic information available for the Front Range area indicates that by the year 2020, this area's population will increase 1,095,000, for a total of 3,830,000 people.[2] Metropolitan water supply need projections, taken from the Metropolitan Supply Environmental Impact Statement, estimate a water demand of 703,000 acre-feet by the year 2035. (See Figure 2.9). Current projections for developed water in that year are 418,000 acre-feet, leaving a shortfall of 285,000 acre-feet. This shortfall will have to be satisfied, with the South Platte and Colorado River basins being possible candidates for that supply in the long term. Short term solutions will have to include improved water resource management and water conservation strategies that must be utilized to the fullest extent possible to meet the increasing demand related to growth in the interim, while new projects are being planned and constructed.

For example, the Front Range Metropolitan Water Forum was established in 1993 by Governor Romer to explore cooperative approaches to coordinate and integrate the operations of many existing but separate water systems in the Denver Metro area. Since its inception, technical experts have worked closely with the State's consultant, Hydrosphere, in evaluating four areas: conjunctive use, effluent management, interruptable supply arrangements, and systems integration. Preliminary results are promising, especially in the area of conjunctive use. A progress report is due late summer of 1995, with final results available in 1996.
Also included are Colorado's depletion projections for the Colorado River (Table 2.2). This information is used by the U.S. Bureau of Reclamation in their planning studies and by the Western Area Power Administration in determining power rates in their project rate of

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[1]Since 1993, the Division of Water Resources has published an Annual Report of the State Engineer which does provide compiled data on total surface water diversions by type of use for the preceding water year. However, it does not provide data on consumptive use or ground water use at this time.

[2] The year 1992 is the last year of actual population figures.

repayment studies. Presently, this provides the best indicator as to how the unused compact apportionment may be fully used in the future.

3.0 Information Needs

3.1 Data Availability

This section identifies the nature and extent of the information needed to enable the state to make informed decisions about the management, conservation and preservation of its water resources. It builds upon the review of the data identified in Section 2.0, Data Inventory. Section 4.0, Plan and Schedule, describes how these information needs may be addressed in a prioritized fashion.

One approach commonly used in water resource management to aid in data identification needs is to prepare a water budget to describe the various inflow, outflow, and storage terms of a river basin. The water budget can then be used to demonstrate the magnitude of the various components to assist in prioritization of a data collection program. Further, the water budget can verify information used in planning models, evaluate long term trends and estimate components that are inherently difficult to measure, such as consumptive use and interactions of stream flows with ground water. Table 1.1 is an example of the results of a water budget analysis for each of the basins shown.

Water budgets can be prepared for different sized hydrologic units at different levels of detail. Figure 3.1 presents a schematic of the major terms associated with a water budget appropriate for the state. The schematic includes a global budget of an entire river basin and sub-balances for the stream system, ground water system and the land (soil) system. Table 3.1 provides a description of each term. The items labeled ***inflows, outflows*** and ***storage changes*** represent the components required to perform a global water budget for a basin or sub-area. The items labeled ***Other Key Internal Balance Terms*** include key components required to perform sub-balances within a basin or sub-area. (Current and complete water budgets for each Water Division and the state as a whole were not available for use in this report).

Table 3.2 is a table ranking data availability in each Division. Data was ranked as follows:

- ***Good*** indicating the data is generally available
- ***Fair*** indicating the data is available in limited amount or with a limited effort, or requires a program to remain current
- ***Poor*** indicating the data is generally unavailable or available only with significant effort
- ***N/A*** indicates the data is generally not applicable for that Division

3.2 *Data Management and Evaluation Tools*

There are at least two key components to making informed decisions on management, conservation and preservation of the water resources of the state: data acquisition and data interpretation. The first, data acquisition, is described above in terms of data availability and data quality. The second, data interpretation, requires storage, retrieval, and evaluation tools that allow water supply questions to be answered accurately and efficiently. Colorado already has several data management and evaluation programs operating or under development in selected parts of the state. These include:

Colorado River Decision Support System (CRDSS) CRDSS is in the second year of a projected four-year project to develop a relational database and planning tools that will allow key water supply questions on the Colorado River Basin (Divisions 4, 5, 6 and 7) to be answered. The principal goal of the CRDSS is to provide the capability to develop credible information on which to base informed decisions concerning management of Colorado River water resources. CRDSS will:

- Develop accurate, user-friendly databases helpful in the administration and allocation of waters in the Colorado River and its tributaries.
- Provide data and models to evaluate alternative water administration strategies that can maximize use of available resources in all types of hydrologic conditions.
- Be a functional system for use by decision-makers and others, and be maintained and upgraded by the state.
- Have the capability to represent current and potential federal and state administrative and operating policies and laws.
- Promote information sharing among government agencies and water users.

South Platte Water Rights Management System (SPWRMS) SPWRMS development is complete and implementation is beginning as a water administration tool that provides real-time data to assist in the daily management of the South Platte River Basin (Division 1). The SPWRMS was designed to facilitate water rights administration and river management decisions in the South Platte River Basin through the following:

- Enhanced transfer and exchange of data between agencies and water users by providing direct user access to the data.
- Monitoring of physical conditions of the basin.

- Spatial monitoring and analysis of water use in the basin.
- Administrative analysis, such as curtailment and allocation evaluations.

HydroBase This is a relational and geographic database system designed in 1994. It uses current technology to store and display diversions, stream flows, water rights and well data collected and maintained by the state. It is expected to encompass the entire state, but currently, is only being applied in Water Divisions 4-7 as part of the CRDSS project. Key components of HydroBase include:

- Water rights
- Diversions
- Stream flows
- Well permits
- Irrigated acreage
- Dams
- Geographical information (topology, hydrography, highways, etc.)

Satellite-Linked Monitoring System (SLMS) SLMS is a program that has been in place since 1985. It now allows access to real-time and historic stream flow and diversion data from 229 gaging stations across the state. These software systems provide data for more effective water rights administration, water resource management, computerized hydrologic record development and flood warning. The Satellite-Linked Monitoring System consists of four primary sub-systems:

- Remote station hardware that measures, collects and transmits stream flow observations to a satellite.
- Satellite communication links and transmission receiving hardware.
- Computer hardware and software systems.
- Computer communication hardware and software.

A goal of the Water Conservation Board and Division of Water Resources is to integrate CRDSS, SPWRMS, Hydrobase and SLMS into one statewide unified system. Conceptually, the software developed for the South Platte Water Rights Management System will be incorporated into the Colorado River Decision Support System in year three (1995-1996) of its development.

For its part, HydroBase is designed and planned as the unified database structure that will join all data components that support CRDSS, SPWRMS, and future internal software development and water data access. This interlocking design is part of the Water Conservation Board's long range plan goals but as yet, is not funded. It is suggested, and the design allows, that CRDSS be extended to the remaining non-Colorado River Basin areas of the state in the near future.

Because of the geology of the western slope, ground water data and planning tools were not required for the Colorado River Basin. Therefore, to extend CRDSS to Divisions 1, 2 and 3, existing and undeveloped ground water data and planning models may be needed to realize a statewide "Colorado Water Decision Support System" or "CWDSS."

4.0 Plan and Schedule

Table 4.1 and Figure 4.1 present a list and schedule for developing the information and evaluation tools that are expected to be needed to effectively manage, conserve and preserve the State of Colorado's water resources. The list and schedule are based on the available information identified in this report and builds on the experience and successes of existing programs described in Section 3.2. The estimated costs assume 85% of the work to be privately contracted and 15% of the work to be performed by state employees. It is envisioned the plan be re-evaluated annually for progress, and to examine technological advances and any unique demands that arise within specific regions of the state.

5.0 Conclusions

The key conclusions and products of this report are:

- A bibliography has been developed which describes approximately 7,500 pertinent reports related to water supply, drought periods, expected shortages, and interstate compacts. On a broad scale, a wealth of individual information items exist throughout the state. Local, smaller scale, data also exists, but are too numerous to describe. The bibliography shows that most of the data on a statewide basis has not been updated since the early 1970's.

- Large scale data collection needs are significant and include additional irrigated acreage information in Divisions 1, 2, and 3 and ground water pumping data in Divisions 1 and 3. Compilation of statewide data is also needed. Detailed, local data requirements are expected to continue to be addressed as needed.

- Data management needs are large in Divisions 1, 2 and 3. These needs are similar to those which resulted in developing the Colorado River Decision Support System (CRDSS) for Divisions 4, 5, 6 and 7, and the South Platte Water Rights Management System (SPWRMS) in Division 1. A plan and schedule have been developed which will allow a statewide "Colorado Water Decision Support System" to be realized. The development of this system is estimated to cost 5 million dollars and would take approximately 8 years to complete.

- Development of accurate water budgets throughout the state is difficult given the current level of data collection and available resources.

- Approximately 70% of the water available for use in Colorado comes during the May though July runoff period. Therefore, the keys to drought preparedness must include storage and runoff forecasting, demand management, interruptible supply arrangements, conjunctive use and other innovative tools to aid in managing Colorado's water resources. While there may be adequate storage to meet today's needs under normal runoff conditions, there is not enough storage to sustain these uses through a severe and sustained period of drought. However, development of additional storage is very expensive, permit intensive, and requires 20 to 30 years from planning to construction. As growth continues in the state, the ability to meet increasing demands and to sustain water supplies through droughts will become increasingly difficult. Decisions on how future supply demands are met will have to be made in the very near future if the state is to meet those demands.

- In the Colorado River Basin (Water Divisions 4, 5, 6 and 7), consumptive use of water is the measure of Colorado's compact apportionment under the "Law of the Colorado

River." Therefore, it is important to be able to accurately determine the consumptive use of water on the west slope, particularly as Colorado comes closer to fully using its compact apportionment. Given this background, the needs of the Colorado River Basin are:

1. Improved runoff forecasting.

2. Additional real-time satellite-linked stream gaging stations.

3. Improved estimates of consumptive use through additional climate stations, lysimeter data, and maintenance of the irrigated acreage data developed for 1993 as part of the CRDSS project.

- The Arkansas River, the Rio Grande, Costilla Creek, the La Plata River, the Republican River, the North Platte and Laramie Rivers, are being depleted at or very near the limits established by interstate compacts or U.S. Supreme Court decrees. Significant developable water only remains in the Colorado River Basin (Divisions 4, 5, 6 and 7) and in the South Platte River Basin (Division 1). Preliminary demand projections indicate that Colorado would consume all of those remaining compact entitlements.

- Colorado is facing increased demands for water from downstream states in the Colorado River Basin, the South Platte River Basin, the Republican River Basin, the Arkansas River Basin, the North Platte Basin, the Laramie River Basin, and the Rio Grande Basin. These demands stem from either growth, the needs of endangered wildlife species listed under the Endangered Species Act, or both. Colorado must be able to defend its compact and federal decree apportionments against those increasing demands and related efforts to challenge or litigate these apportionments. The importance of having quality data to support decision systems and models became evident in the litigation with Kansas (Kansas v. Colorado, 1985). The legislature, the Colorado Water Conservation Board and the Division of Water Resources should, therefore, continue to develop data centered decision support systems similar to the CRDSS in each of Colorado's major river basins.

Table 1.1[16/]

Annual Water Supplies and Depletions
(1,000 acre-feet)

Basin and Subbasin	Water Supplies				Water Depletions[1/]					
	Native[2/]	Exports[3/]	Imports[3/]	Available	Irrigation[4/]	M&I, Rural[5/]	Other	Total	1970 Basin Outflow	1993 Basin Outflow
Arkansas River	875	7	101[6/]	969	704	58	29	791	178[7/]	142
Colorado River										
Green River	2,103[8/]	0	0	2,013	113	2	12	127	1,886	2,218
Upper Main Stem	6,738	539[9/]	0	6,199	969	14	45[10/]	1,028	5,171	5,059
San Juan-Colorado	1,987	3	130[9/]	2,114	195	3	8	206	1,908	1,820
Basin Total	**10,738**	**412**	**0**	**10,326**	**1,277**	**19**	**65**	**1,361**	**8,965[11/]**	**9,097**
Missouri River										
North Platte	600	22[12/]	0	578	108	1	1	110	468	436
South Platte	1,441	0	336[12/]	1,777	1,251	164	58	1,473	304	387
Kansas River	353	0	0	353	220	3	8	231	122	47
Basin Total	**2,394**	**0**	**314[13/]**	**2,708**	**1,579**	**168**	**67**	**1,814**	**894[7/]**	**870**
Rio Grande	1,576[14/]	0	4	1,580	617	6	679[15/]	1,302	278	325
State Summary	**15,583**	**419**	**419**	**15,583**	**4,177**	**251**	**840**	**5,268**	**10,315**	**10,434**

1/ Estimated depletions under 1970 conditions of development
2/ Undepleted average annual water supply
3/ 1968 to 1970 annual average
4/ Irrigation consumptive use and associated consumptive reservoir and conveyance losses
5/ Rural domestic, municipal and industrial consumptive uses and related reservoir losses
6/ Includes 7,000 acre-feet exported to South Platte River
7/ 1950 to 1970 annual average
8/ Includes 237,000 acre-feet inflow of Little Snake River from Wyoming
9/ Includes internal basin diversion of 130,000 acre-feet from Dolores river to the San Juan River
10/ Includes 19,000 acre-feet of main stem reservoir evaporation from Curecanti Project
11/ 1914 to 1970 annual average
12/ Includes internal basin diversions of 22,000 acre-feet from North Platte River to the South
13/ Includes 14,000 acre-feet evaporation attributable to imports from Colorado River
14/ 1924 to 1969 annual average
15/ Includes 658,000 acre-feet nonbeneficial use in Closed Basin based on assumptions and limited data available in 1974.
16/ **Sources**: All values, except for the "1993 Basin Outflow," are from, "Water for Tomorrow, Colorado State Water Plan, Phase I - Appraisal Report" dated February, 1974. The "1993 Basin Outflow" is the long term average from USGS Water Resource Data for Colorado-1993. This comparison indicates no significant change in the long term average basin outflow. See "1.3 Background" section of the report for further discussion.

TABLE 1.1a
Colorado River Basin
Estimated Average Annual Water Supply and Depletions
(acre feet)

	1906-85 Average Annual Natural Flow (AF) (1)	1981-85 Average Exports	1981-85 Average Supply Available	1981-85 Average Agriculture Consumption	1981-85 Average M&I Consumption	1981-85 Average Evaporation	1981-85 Average Total Depletions (5)	1981-85 Average Basin Yield
Green River Basin								
Little Snake R.	220,400							
Yampa R.	1,241,100							
White R.	573,400							
TOTAL	2,034,900	0	2,034,900	143,300	17,400	6,500	167,200	1,867,700
Colorado River Basin								
Main Stem	3,602,400							
Gunnison R	2,378,700							
Dolores R.	843,500							
TOTAL	6,824,600	500,400	6,324,200	1,011,100	20,100	67,600	1,098,800	5,225,400
San Juan River Basin								
San Juan R.	1,938,200	3,400	1,934,800	211,300	4,300	8,700	224,300	1,710,500
CRSP Evaporation						306,400	306,400	
STATE TOTAL	10,797,700	503,800	10,293,900	1,365,700	41,800	389,200	1,796,700	8,803,600

	1906-85 Average Annual Natural Flow (AF) (1)	Maximum Exports to Date (3)	Supply Available	1981-85 Maximum Agriculture Consumption (2)	1981-85 Maximum M&I Consumption (4)	1981-85 Maximum Evaporation (2)	1981-85 Potential Maximum Total Depletions (5)	Basin Yield
Green River Basin (4)								
Little Snake R.	220,400			14,900		500		
Yampa R.	1,241,100			89,400	18,900	4,500		
White R.	573,400			54,300	7,000	1,500		
TOTAL	2,034,900	0	2,034,900	158,600	25,900	6,500	191,000	1,843,900
Colorado River Basin (4)								
Main Stem	3,602,400			548,500	38,400	47,100		
Gunnison R	2,378,700			462,000	14,700	17,900		
Dolores R.	843,500			67,200	3,500	7,300		
TOTAL	6,824,600	630,500	6,194,100	1,077,700	56,600	72,300	1,206,600	4,987,500
San Juan River Basin (4)								
San Juan R.	1,938,200	4,300	1,933,900	230,000	11,400	13,900	255,300	1,678,600
CRSP Evaporation						341,100	341,100	
STATE TOTAL	10,797,700	634,800	10,162,900	1,466,300	93,900	433,800	1,994,000	8,510,000

NOTES

1. Natural flows reflect only water which originates in Colorado. Thus, 248,600 af of Little Snake flows originating in Wyoming and 259,800 af of San Juan River water are not included.
2. Ag and Evaporation values have not exceeded the maximum values recorded during the 1981-85 period.
3. Exports reached an all time high in 1978. Through 1994, annual exports from the Colorado have not exceeded this value.
4. Maximum M&I values from U.S. Geological Survey WRIR 88-4101, all other values from U.S. Bureau of Reclamation Consumptive Uses and Losses Report.
5. Depletion values do not include exports, depletions from exports column must be added in to compute the total depletions occurring from a basin.

Table 1.2
International and Interstate Documents Affecting Colorado's Use of Water

Type	Document	Date
International Treaties	Mexican Treaty on Rio Grande, Tijuana, and Colorado Rivers	1945
Interstate Compacts	Colorado River Compact	1922
	La Plata River Compact	1922
	South Platte River Compact	1923
	Rio Grande River Compact	1938
	Republican River Compact	1942
	Costilla Creek Compact	1944 (Rev.1963)
	Upper Colorado River Compact	1948
	Arkansas River Compact	1948
	Animas-La Plata Project Compact	1969
U.S. Supreme Court Cases	Nebraska v. Wyoming	1945
	Wyoming v. Colorado	1957
	Kansas v. Colorado	1995
Agreements	Pot Creek Memorandum of Understanding	1958

Table 1.3

Total of Current Water Rights in Colorado
(except well water rights)
November 4, 1990

Reservoir Storage Rights in Acre-Feet

Division	No of Rights	Total Absolute (AF)	Total Conditional (AF)
1	3,150	2,644,426	5,554,021
2	1,266	1,771,549	514,388
3	330	395,534	172,037
4	1,590	1,720,648	2,998,740
5	2,078	1,738,288	3,603,256
6	1,950	159,995	6,815,036
7	516	317,194	2,096,065
State Total	10,880	8,747,632	21,753,594

Direct Flow Rights in CFS
(excludes wells)

Division	No of Rights	Total Absolute (CFS)	Total Conditional (CFS)
1	8,481	111,673	31,126
2	6,888	57,678	11,070
3	4,385	25,640	3,712
4	11,167	40,187	45,157
5	13,631	45,718	90,508
6	7,461	18,882	64,378
7	4,168	10,528	4,697
State Total	56,181	310,305	250,647

TABLE 2.1

1994 COLORADO POPULATION PROJECTIONS

REGION \ YEAR	1990 EST.	1995	2000	2005	2010	2015	2020
FRONT RANGE	2,700,000	3,010,100	3,191,800	3,346,000	3,502,900	3,667,500	3,830,000
WESTERN SLOPE	334,300	374,900	406,900	436,900	467,300	498,300	529,600
EASTERN PLAINS	133,200	144,900	150,100	154,700	159,400	163,700	167,500
SAN LUIS VALLEY	40,300	43,100	44,800	46,200	47,500	48,600	49,500
EASTERN MOUNTAINS	103,200	111,800	118,000	123,800	129,400	134,900	140,200
COLORADO TOTAL	3,311,000	3,684,800	3,911,600	4,107,600	4,306,500	4,513,000	4,716,800

Source: Colorado State Demographer - 1994. Values are rounded to the hundred.

TABLE 2.2

COLORADO RIVER DEPLETION PROJECTIONS
STATE OF COLORADO
(1000 acre-feet\ year)

ITEM \ YEAR	1990	2000	2010	2020	2030	2040	2,050	2060+
1971 Comprehensive Framework Study (1965 data)	1,707	1,707	1,707	1,707	1,707	1,707	1,707	1,707
1966-1989 CHANGES								
Agricultural-Irrigation & Stock								
Bostwick Park	4	4	4	4	4	4	4	4
Silt	4	4	4	4	4	4	4	4
Dallas Creek	5	5	5	5	5	5	5	5
Dolores	32	32	32	32	32	32	32	32
Stagecoach\Yamcolo	4	4	4	4	4	4	4	4
Exports	10	10	10	10	10	10	10	10
Miscellaneous	24	24	24	24	24	24	24	24
Municipal\ Domestic								
Dallas Creek	2	2	2	2	2	2	2	2
Dolores	5	5	5	5	5	5	5	5
Stagecoach\ Yamcolo	1	1	1	1	1	1	1	1
Taylor Draw	2	2	2	2	2	2	2	2
Exports	187	187	187	187	187	187	187	187
Miscellaneous	6	6	6	6	6	6	6	6
Power\ Industrial								
Craig\ Hayden	13	13	13	13	13	13	13	13
Tri-State (Colo. Ute)	1	1	1	1	1	1	1	1
Industrial								
Blue Mesa	5	5	5	5	5	5	5	5
Green Mountain	2	2	2	2	2	2	2	2
Ruedi	2	2	2	2	2	2	2	2
Minerals								
Bluestone	4	4	4	4	4	4	4	4
Other								
Upper Gunnison	5	5	5	5	5	5	5	5
Miscellaneous	2	2	2	2	2	2	2	2
FRAMEWORK + 1966-89 CHANGES	2,027	2,027	2,027	2,027	2,027	2,027	2,027	2,027
ANTICIPATED DEPLETIONS								
Agricultural-Irrigation & Stock								
Silt	0	1	1	1	1	1	1	1
Dolores	0	13	40	40	40	40	40	40
Municipal\ Domestic								
Dallas Creek	0	5	8	10	10	10	10	10
Dolores	0	1	2	4	4	4	4	4
Taylor Draw	0	2	5	5	5	5	5	5
Wolford Mountain	0	7	15	15	15	15	15	15
Exports	0	70	110	130	150	175	175	175
Miscellaneous	0	1	3	4	5	6	7	8
Power\ Industrial								
Craig\ Hayden	0	6	6	6	8	8	11	13
Tri-State (Colo. Ute)	0	5	5	8	8	8	8	8
Industrial								
Blue Mesa	0	5	5	5	5	5	5	5

TABLE 2.2

COLORADO RIVER DEPLETION PROJECTIONS
STATE OF COLORADO
(1000 acre-feet\ year)

Green Mountain	0	3	8	13	18	18	18	18
Ruedi	0	8	13	13	13	13	13	13
Stagecoach\ Yamcolo	0	9	9	9	9	9	9	9
Minerals								
Ruedi	0	0	5	15	30	30	30	30
Other								
Upper Gunnison Basin	0							
Aqua-Chem	0	5	10	10	15	20	25	34
		0	1	1	1	1	1	1
Paradox-Salinity	0	2	2	2	2	2	2	2
TOTAL ANTICIPATED	2,027	2,170	2,275	2,318	2,366	2,397	2,406	2,418
POTENTIAL DEPLETIONS								
Agricultural-Irrigation & Stock								
Animas-La Plata	0	0	0	10	25	65	83	83
West Divide (Area)	0	1	1	1	1	4	20	38
Fruitland Mesa (Area)	0	0	0	0	0	0	21	21
San Miguel (Area)	0	0	0	0	0	0	13	13
Savory Pothook (Area)	0	0	0	0	0	0	12	12
Municipal\ Domestic								
Animas-La Plata	0	5	20	38	38	38	38	38
San Miguel (Area)	0	0	0	0	0	0	12	12
Minerals\ Oil Shale\ Energy	0	0	0	0	1	4	18	36
Unspecified future Consumptive Use by basin								
Yampa	0	0	0	0	0	0	28	28
White	0	0	0	0	0	0	25	25
Colorado mainstem	0	0	0	0	0	0	30	30
Gunnison	0	0	0	0	0	0	32	32
San Juan	0	0	0	0	0	0	24	24
TOTAL POTENTIAL DEPLETIONS	0	6	21	49	65	111	356	392
TOTAL SCHEDULED DEPLETIONS	2,027	2,176	2,296	2,367	2,431	2,508	2,762	2,810
EVAPORATION STORAGE UNITS	269	269	269	269	269	269	269	269
TOTAL DEPLETIONS	2,296	2,445	2,565	2,636	2,700	2,777	3,031	3,079
STATE SHARE OF 6.0 MAF YIELD	3,079	3,079	3,079	3,079	3,079	3,079	3,079	3,079
REMAINING WATER AVAILABLE	783	634	514	443	379	302	48	0
PERCENT OF STATE SHARE	25%	21%	17%	14%	12%	10%	2%	0%

Table 3.1
Water Budget Descriptors

Inflows:	Description
Precipitation	The total precipitation, in all forms, falling on a basin or sub-area
Stream Inflow	The mainstem stream flow entering a basin or sub-area
Tributary Inflow	The tributary stream flow entering a basin or sub-area
Imported Water	Imports to a basin or sub-area
Ground Water Inflow	Subsurface inflow to a basin or sub-area

Outflows	Description
Stream Outflow	Stream flow leaving a basin or sub-area
Ground Water Outflow	Subsurface outflow from a basin or sub-area
Exported Water	Exports from a basin or sub-area
Agricultural Use	Consumptive use associated with agricultural activities
Municipal & Industrial	Consumptive use associated with municipal and industrial activities.
Native Vegetation Use	Consumptive use by native vegetation and phreatophytes.
Other Use	Intercepted precipitation, reservoir evaporation, etc.

Storage Changes	Description
Reservoir Storage	Change in surface reservoir storage.
Ground Water Storage	Change in ground water storage.
Soil Moisture Storage	Change in soil moisture storage.

Other Key Terms	Description
Surface Diversions	Total diversions from surface supplies to agricultural, municipal, industrial, and other purposes.
Ground Water Pumping	Total pumping from ground water supplies to agricultural, municipal, industrial and other purposes.
Surface Water Returns	Portion of surface diversions and ground water pumping that are not consumed and return to the stream.
Deep Percolation	Portion of precipitation, surface diversions, and ground water pumping that are not consumed and recharge ground water.
Stream/Aquifer Flux	Inflow or outflow between a stream and ground water aquifer.
Irrigated Acreage	Any land use requiring the application of water to the land.

Table 3.2

Data Quality by Division

Data availability has been ranked as follows:

- ***Good*** indicating the data is generally available,
- ***Fair*** indicating the data is available in limited amount or with a limited effort, or requires a program to remain current, and
- ***Poor*** indicating the data is generally unavailable or available only with significant effort.
- ***N/A*** indicates the data is generally not applicable for that Division.

	1	2	3	4	5	6	7
Inflows:							
Precipitation	Good	Good	Good	Good	Good	Good	Good
Stream Inflow	Good	Good	Good	Good	Good	Good	Good
Tributary Inflow	Fair	Fair	Fair	Fair	Fair	Fair	Fair
Imported Water	Good	Good	Good	Good	Good	Good	Good
Ground Water Inflow	Fair	Good	Fair	N/A	N/A	N/A	N/A
	1	**2**	**3**	**4**	**5**	**6**	**7**
Outflows:							
Stream Outflow	Good	Good	Good	Good	Good	Good	Good
Ground Water Outflow	Poor	Fair	Poor	N/A	N/A	N/A	N/A
Exported Water	Good	Good	Good	Good	Good	Good	Good
Agricultural Use	Poor	Fair	Fair	Fair	Fair	Fair	Fair
Municipal & Industrial Use	Poor	Fair	Poor	Fair	Fair	Fair	Fair
Native Vegetation Use	Poor	Fair	Poor	Fair	Fair	Fair	Fair
Other Use	Poor	Fair	Poor	Fair	Fair	Fair	Fair

Table 3.2 (cont.)
Data Quality by Division

	1	2	3	4	5	6	7
Storage Changes:							
Reservoir Storage	Good	Good	Good	Good	Good	Good	Good
Ground Water Storage	Fair	Fair	Fair	N/A	N/A	N/A	N/A
Soil Storage	Poor	Fair	Poor	Fair	Fair	Fair	Fair
Other Key Internal Balance Terms	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Surface Water Diversions	Fair	Fair	Fair	Good	Good	Good	Good
Ground Water Pumping	Poor	Good	Poor	N/A	N/A	N/A	N/A
Surface Water Returns	Poor	Good	Poor	Fair	Fair	Fair	Fair
Deep Percolation	Poor	Good	Poor	Fair	Fair	Fair	Fair
Stream/Aquifer Flux	Poor	Good	Poor	Fair	Fair	Fair	Fair
Irrigated Acreage	Poor	Fair	Poor	Fair	Fair	Fair	Fair

The above ranking system is subjective. For example, in Division 2, stream flow records were ranked ***Good*** to recognize the general availability of mainstem records, even though many tributaries are not gauged. Similarly in Division 1, pumping records were ranked ***Poor*** since such estimates are generally unavailable but might be developed with significant effort. Divisions 2, 4, 5, 6, and 7 were generally ranked higher than Divisions 1 and 3 to reflect the significant effort devoted to obtain basic data for the Kansas v. Colorado lawsuit (Division 2) and the Colorado River Decision Support System (Divisions 4 through 7). In fact, when CRDSS is complete most of the water budget components could be rated as good. However, they are indicated as fair to emphasize the need for a program to maintain them in the good category. Section 4.0, Plan and Schedule, describes a prioritized procedure to obtain missing information throughout the state.

Table 4.1
Plan

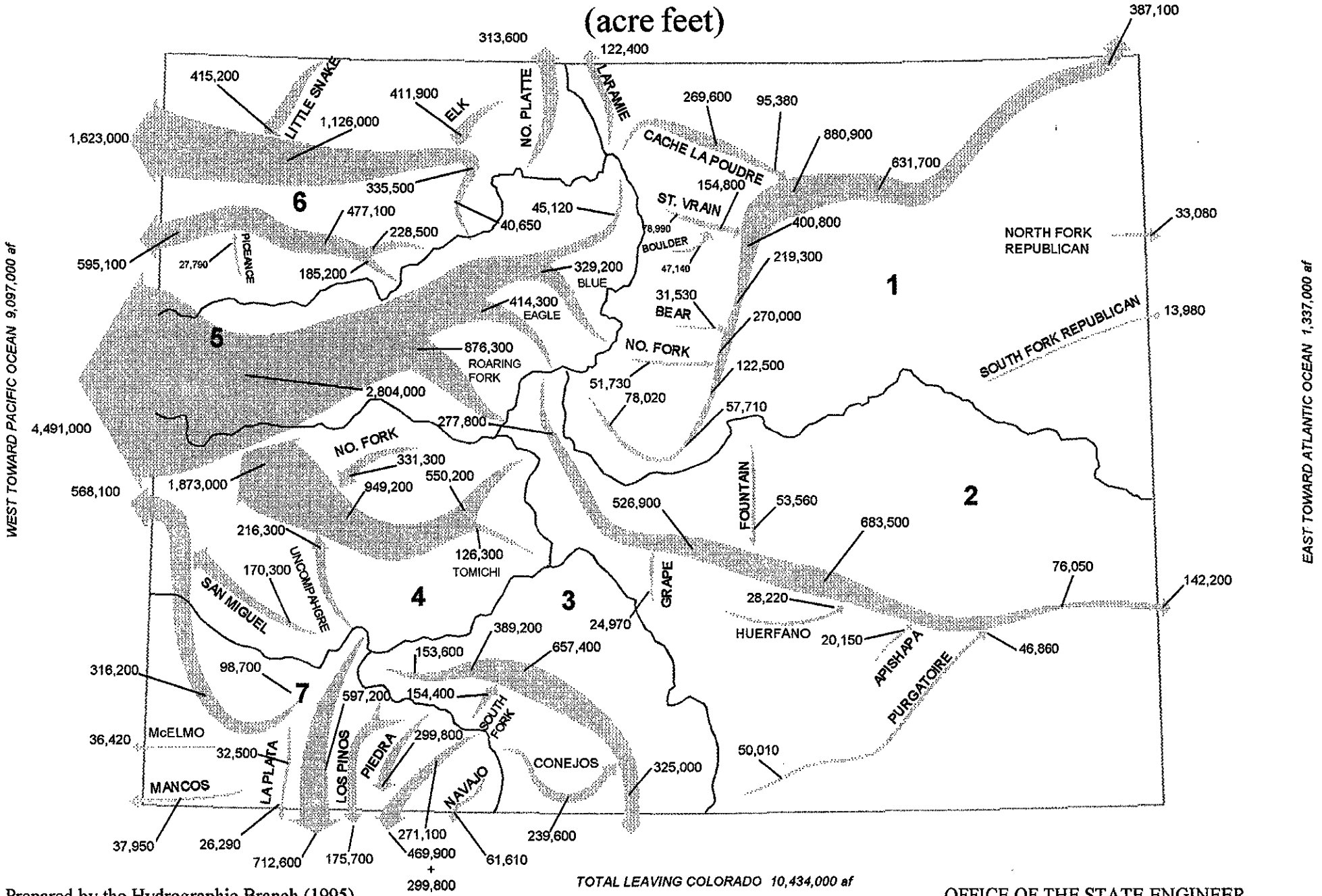
1.0	Data Development	Comment	Cost Estimate ($1,000)
1.1	Irrigated Acreage in Divisions 1, 2, & 3 for one year	Irrigated acreage was developed as part of CRDSS in Divisions 4, 5, 6, & 7 in cooperation with the USBR in that they provided aerial photography. Costs were minimized in that effort due to that cooperation. Future updates, required every 5 years should be part of a maintenance program and are not included in the cost estimate.	1,800
1.2	Additional stream, climate and lysimeter gauges	Additional gauges would be valuable across the State. Additional stream gauges are required to assist in river administration and compact requirements in Divisions 1, 2, and 7. Additional climate and lysimeter gauges are required to effectively administer the "Law of the River" in the Colorado River Basins (Divisions 4, 5, 6, & 7). The cost presented was estimated to be a combination of 10 gauges at approximately $10,000 per gauge. For a satellite stream gauge, the cost is approximately $15,000 per gauge.	100

2.0	Data Collection and Access	Comment	Cost Estimate ($1,000)
2.1	Centralized computer access to historic stream flow and climate data for Divisions 1, 2, & 3	Historic data was developed as part of CRDSS in Divisions 4, 5, 6, & 7. It would also have to be developed for any statewide effort.	300
2.2	Centralized computer access to spatial data for Divisions 1, 2 & 3 such as topography, hydrography, soils, gage locations, etc.	Spatial data was developed as part of CRDSS in Divisions 4, 5, 6, & 7 and would have to be developed in any statewide effort.	300
2.3	Pumping data for Divisions 1 & 3 for a 10 year historic period and/or amend statutes to require well owners to provide.	Large scale well development is relatively insignificant in Divisions 4, 5, 6, & 7. Pumping data was developed in Division 2 as part of the Kansas v. Colorado litigation. However, it would take a significant effort to develop this data in Divisions 1 and 3.	1,000

Table 4.1 (cont.)
Plan

3.0	Management Tools	Comment	Cost Estimate ($1,000)
3.1	Statewide Area Network for Divisions 1, 2 and 3.	Communication system required to maintain a centralized data management system. Funding for Divisions 4, 5, 6 & 7 is expected to be part of CRDSS.	400
3.2	Implement a Statewide Database (HydroBase) for all Divisions. Includes water rights, diversions, well permits, dams & stock ponds	All State data except wells were included as part of CRDSS in Divisions 4, 5, 6 & 7	450
3.3	Planning Tools for Divisions 1, 2 and 3. Include Consumptive Use, Water Rights Planning and Ground Water.	Planning tools were developed as part of CRDSS in Divisions 4, 5, 6, & 7 and as part of the Kansas v. Colorado litigation in Division 2. However, to use the tools developed in the Kansas case would take some refinement of the models to maintain statewide consistency.	1,100
3.4	Administration Tools for Divisions 2 and 3	An administration tool was developed for Division 1 as part of the SPWRMS. Administration tools are planned as part of CRDSS in Divisions 4, 5, 6, & 7.	300
Total	**(Includes approximately 15% for contingency, etc.)**		**6,400**

COLORADO
HISTORIC AVERAGE ANNUAL STREAM FLOWS
(acre feet)



WEST TOWARD PACIFIC OCEAN 9,097,000 af

EAST TOWARD ATLANTIC OCEAN 1,337,000 af

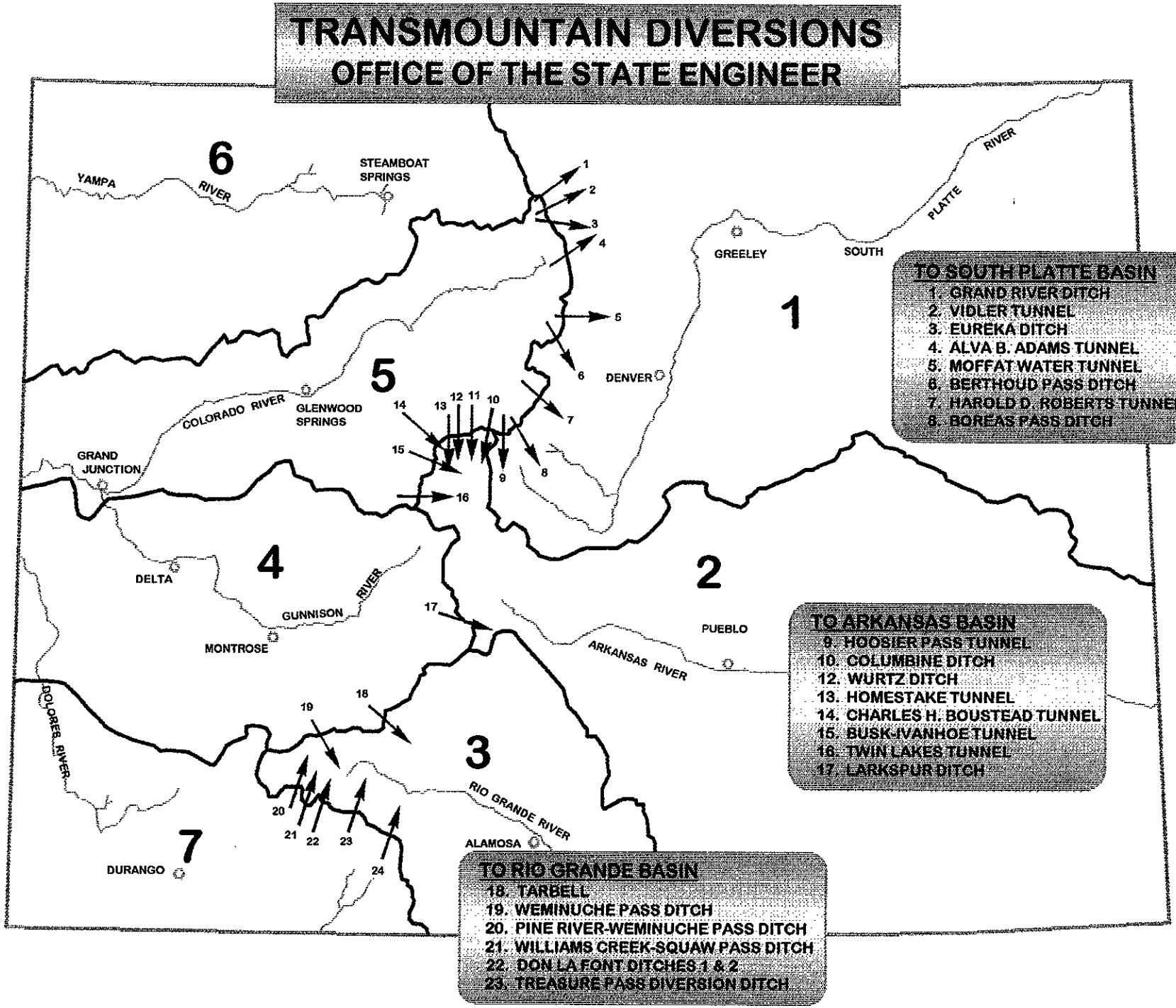
TOTAL LEAVING COLORADO 10,434,000 af

Prepared by the Hydrographic Branch (1995)
Historic averages obtained from USGS Water-Data Report CO-93

Figure 1.1

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

Appendix B
Figures


TRANSMOUNTAIN DIVERSIONS
OFFICE OF THE STATE ENGINEER
6
YAMPA
RIVER
STEAMBOAT SPRINGS
1
2
3
4
5
6
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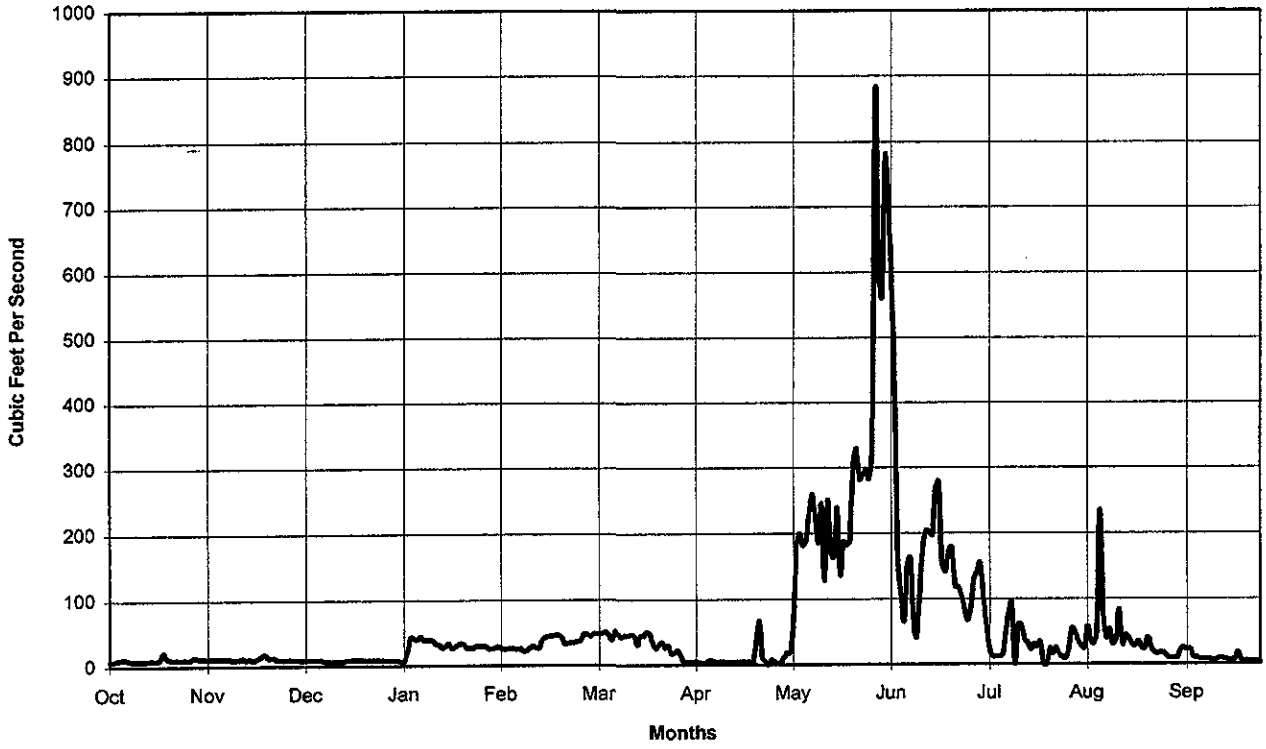
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
GREELEY
SOUTH PLATTE RIVER
1
DENVER
5
COLORADO RIVER
GLENWOOD SPRINGS
GRAND JUNCTION
4
DELTA
GUNNISON RIVER
MONTROSE
2
PUEBLO
ARKANSAS RIVER
DOLORES RIVER
3
RIO GRANDE RIVER
ALAMOSA
7
DURANGO
TO SOUTH PLATTE BASIN
1. GRAND RIVER DITCH
2. VIDLER TUNNEL
3. EUREKA DITCH
4. ALVA B. ADAMS TUNNEL
5. MOFFAT WATER TUNNEL
6. BERTHOUD PASS DITCH
7. HAROLD D. ROBERTS TUNNEL
8. BOREAS PASS DITCH
TO ARKANSAS BASIN
9. HOOSIER PASS TUNNEL
10. COLUMBINE DITCH
12. WURTZ DITCH
13. HOMESTAKE TUNNEL
14. CHARLES H. BOUSTEAD TUNNEL
15. BUSK-IVANHOE TUNNEL
16. TWIN LAKES TUNNEL
17. LARKSPUR DITCH
TO RIO GRANDE BASIN
18. TARBELL
19. WEMINUCHE PASS DITCH
20. PINE RIVER-WEMINUCHE PASS DITCH
21. WILLIAMS CREEK-SQUAW PASS DITCH
22. DON LA FONT DITCHES 1 & 2
23. TREASURE PASS DIVERSION DITCH

Figure 1.2

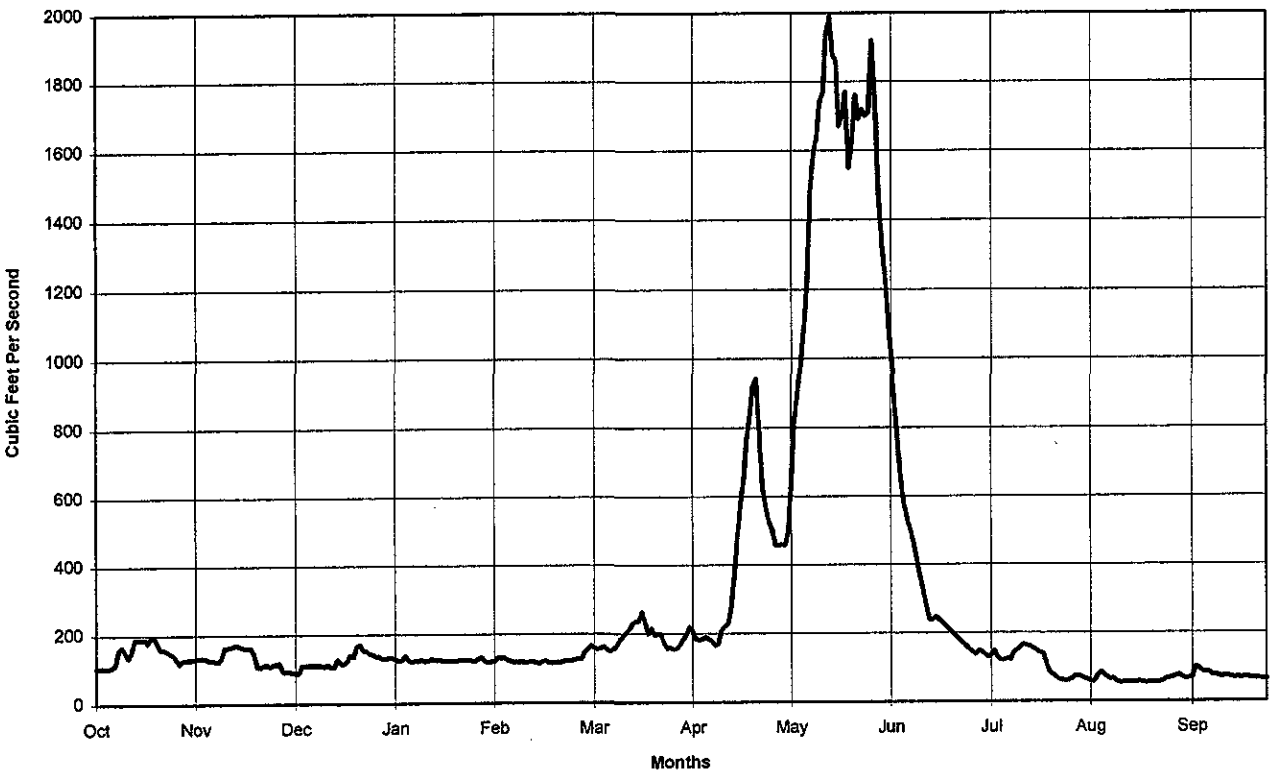
Figure 1.3

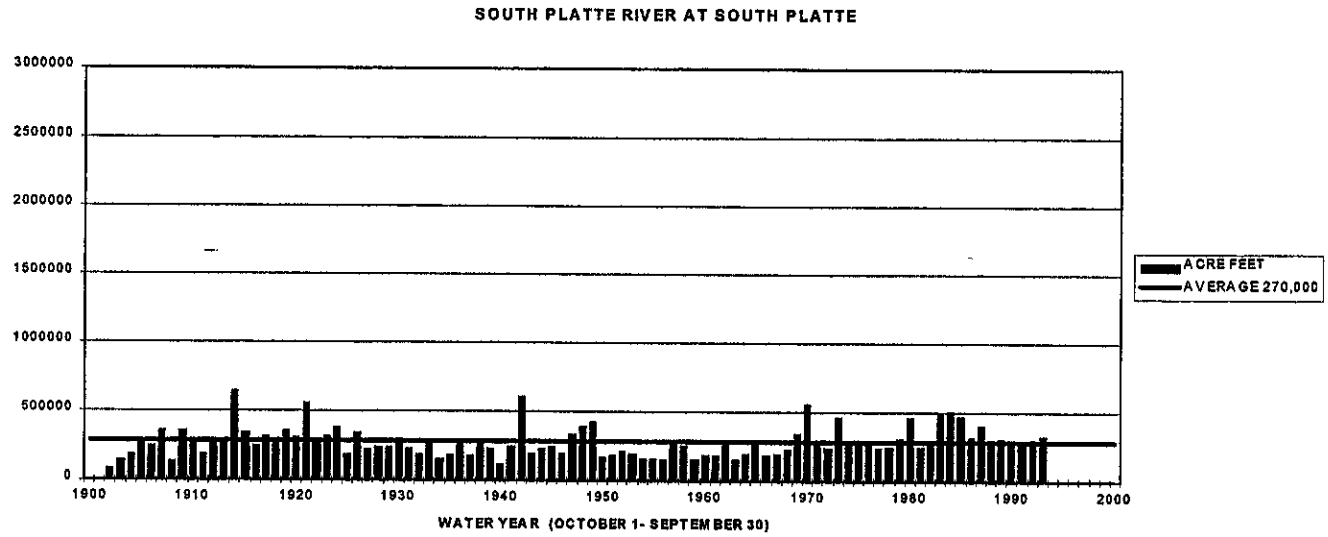
TYPICAL HYDROGRAPHS

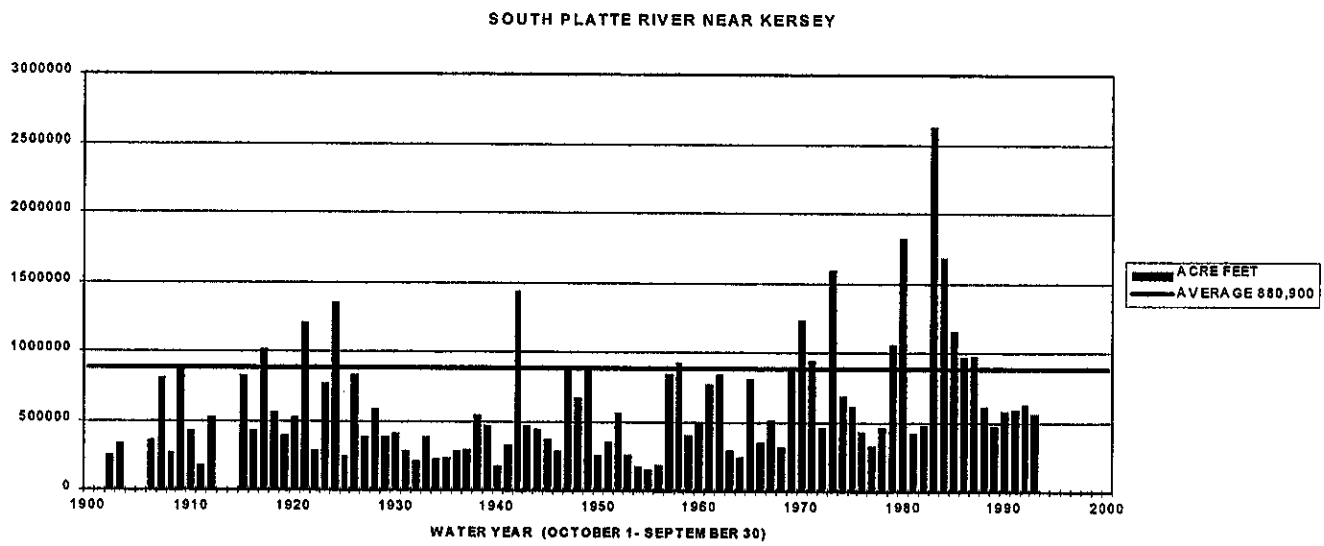
CACHE LA POUDRE RIVER AT FORT COLLINS



YAMPA RIVER AT STEAMBOAT SPRINGS




SOUTH PLATTE RIVER AT SOUTH PLATTE
3000000
2500000
2000000
1500000
1000000
500000
0
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
WATER YEAR (OCTOBER 1- SEPTEMBER 30)
ACRE FEET
AVERAGE 270,000


SOUTH PLATTE RIVER NEAR KERSEY
3000000
2500000
2000000
1500000
1000000
500000
0
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
WATER YEAR (OCTOBER 1- SEPTEMBER 30)
ACRE FEET
AVERAGE 880,900

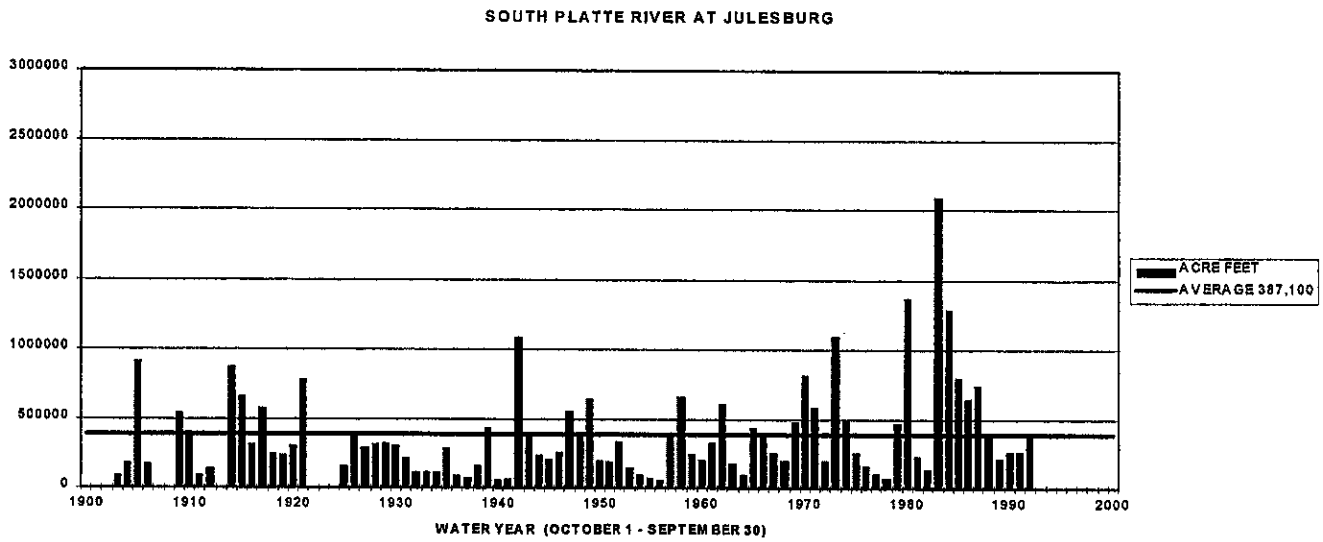
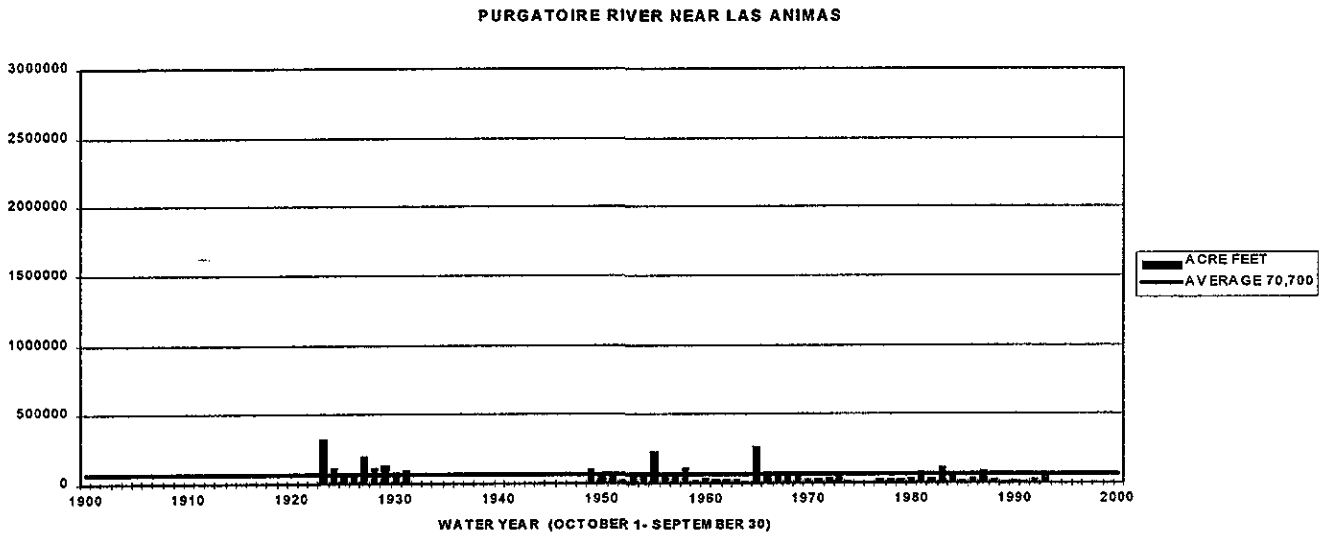
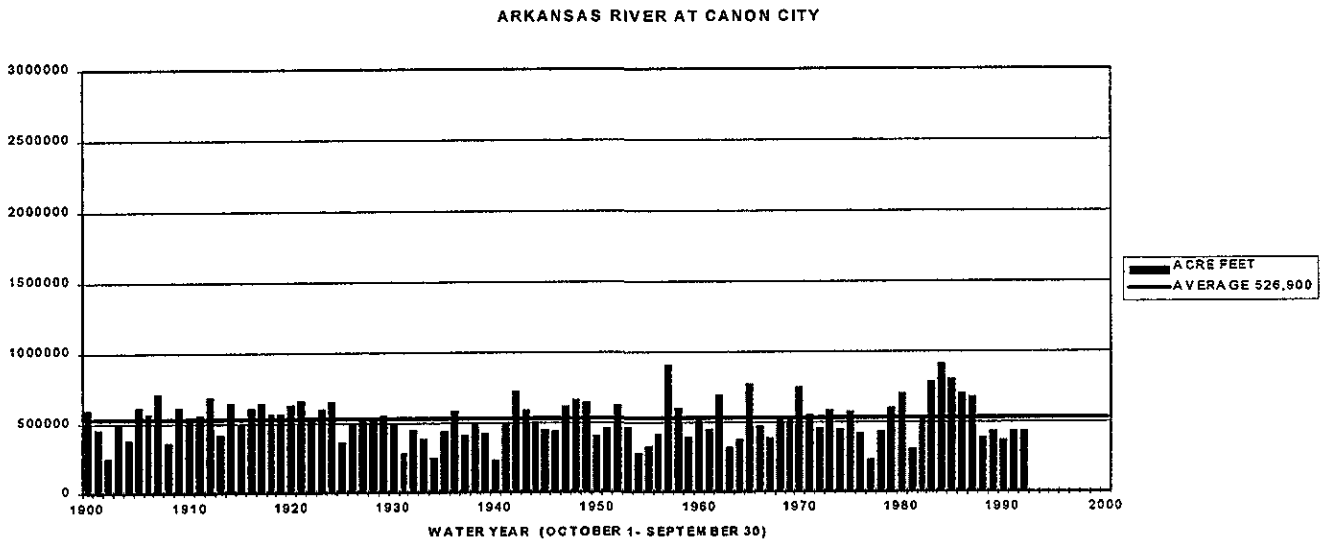

SOUTH PLATTE RIVER AT JULESBURG
3000000
2500000
2000000
1500000
1000000
500000
0
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
WATER YEAR (OCTOBER 1 - SEPTEMBER 30)
ACRE FEET
AVERAGE 387,100

Figure 2.1


PURGATOIRE RIVER NEAR LAS ANIMAS
3000000
2500000
2000000
1500000
1000000
500000
0
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
WATER YEAR (OCTOBER 1- SEPTEMBER 30)
ACRE FEET
AVERAGE 70,700


ARKANSAS RIVER AT CANON CITY
3000000
2500000
2000000
1500000
1000000
500000
0
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
WATER YEAR (OCTOBER 1- SEPTEMBER 30)
ACRE FEET
AVERAGE 526,900

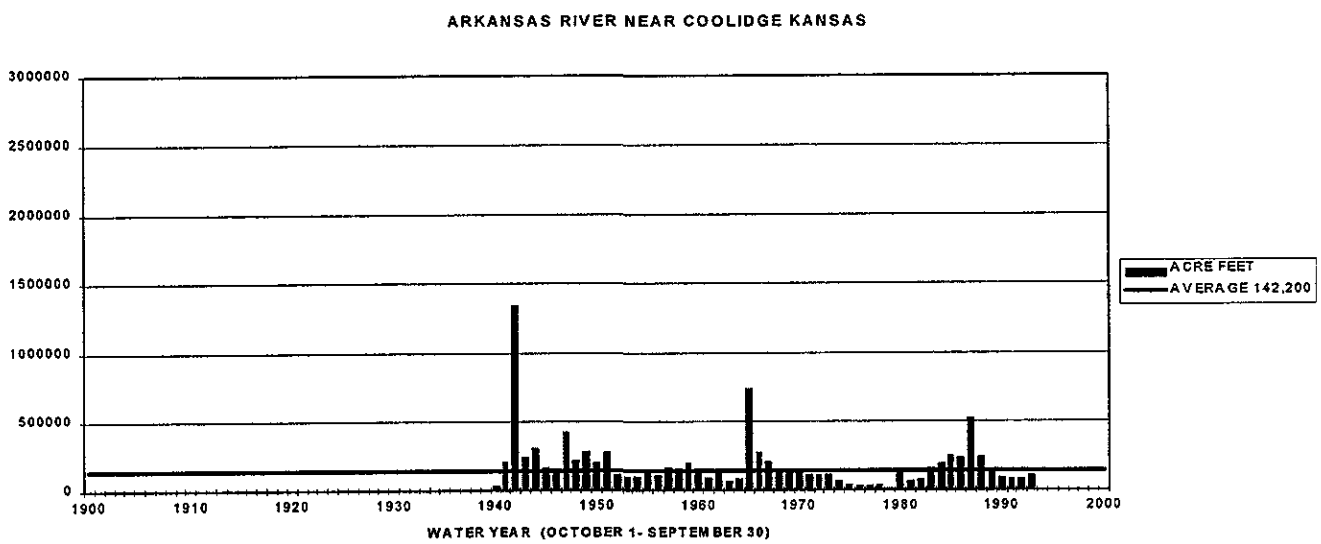
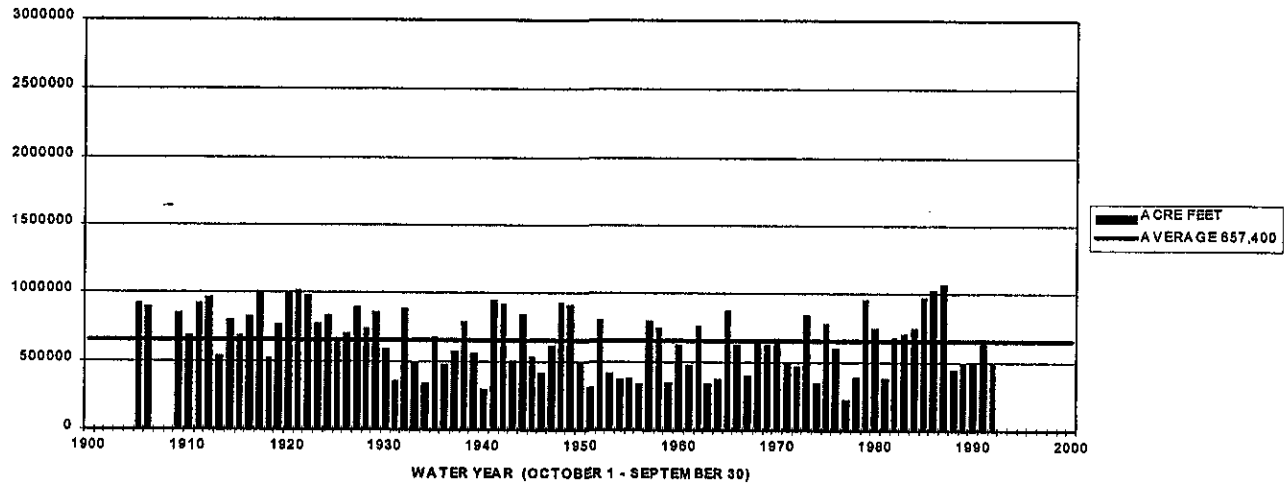
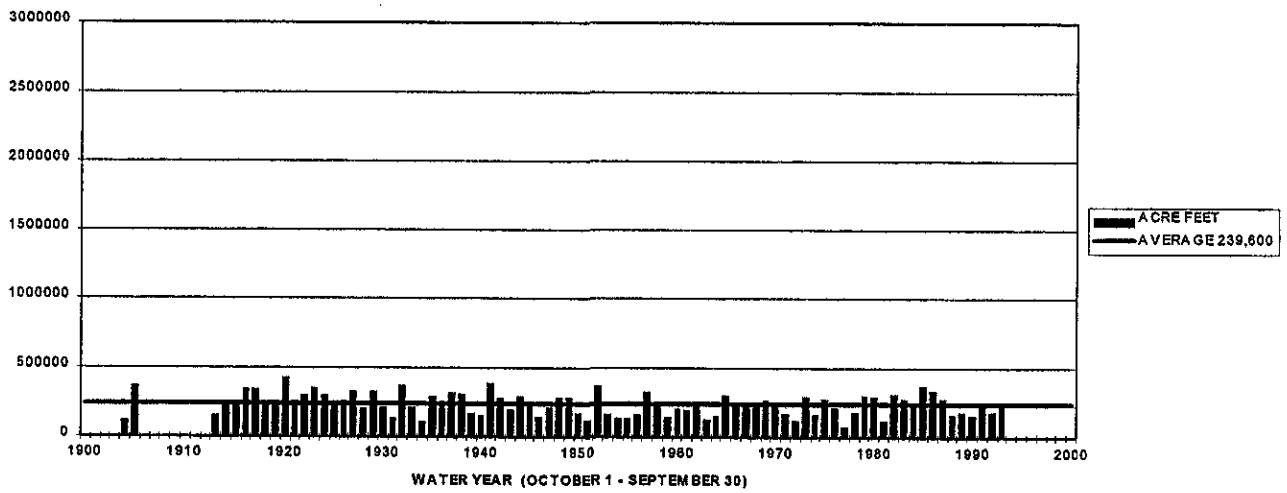

ARKANSAS RIVER NEAR COOLIDGE KANSAS
3000000
2500000
2000000
1500000
1000000
500000
0
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
WATER YEAR (OCTOBER 1- SEPTEMBER 30)
ACRE FEET
AVERAGE 142,200

Figure 2.2

RIO GRANDE RIVER AT DEL NORTE



CONEJOS RIVER NEAR MOGOTE



RIO GRANDE RIVER AT LOBATOS

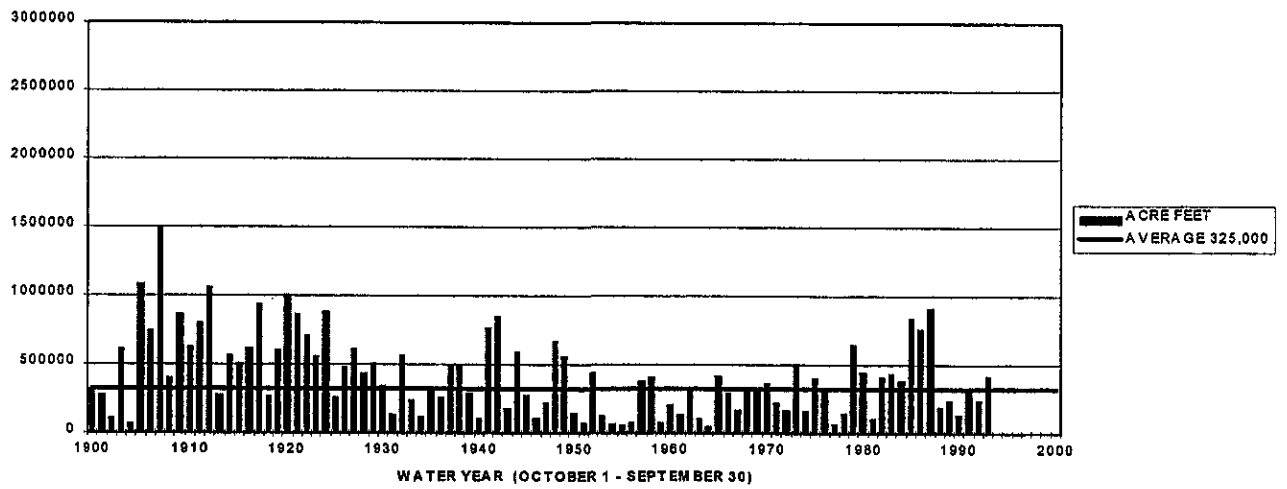
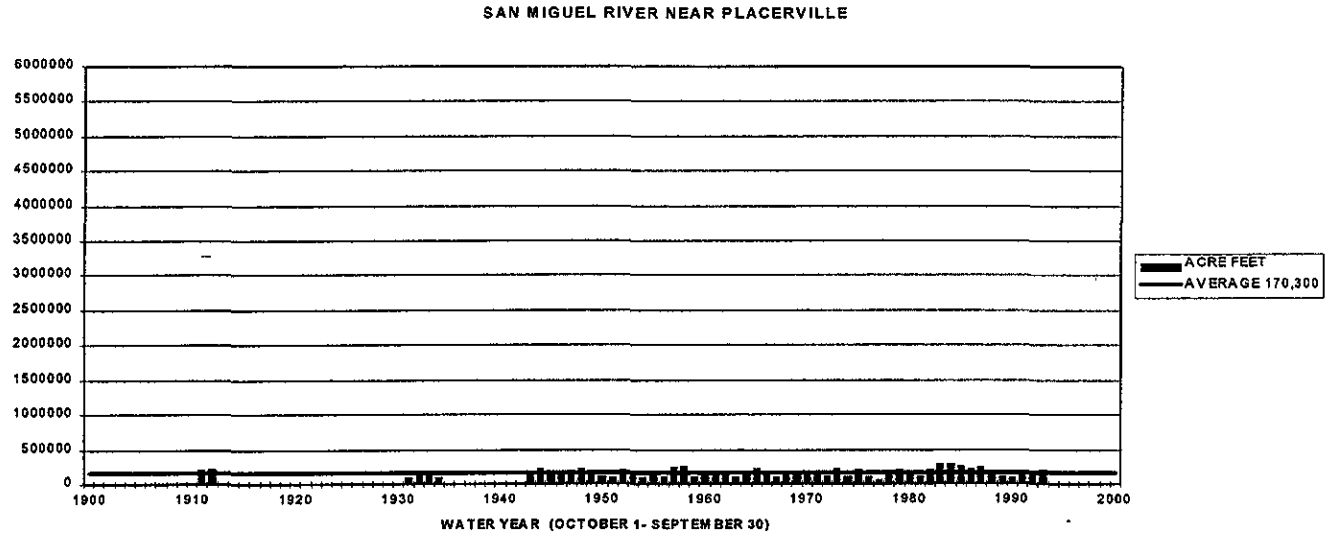
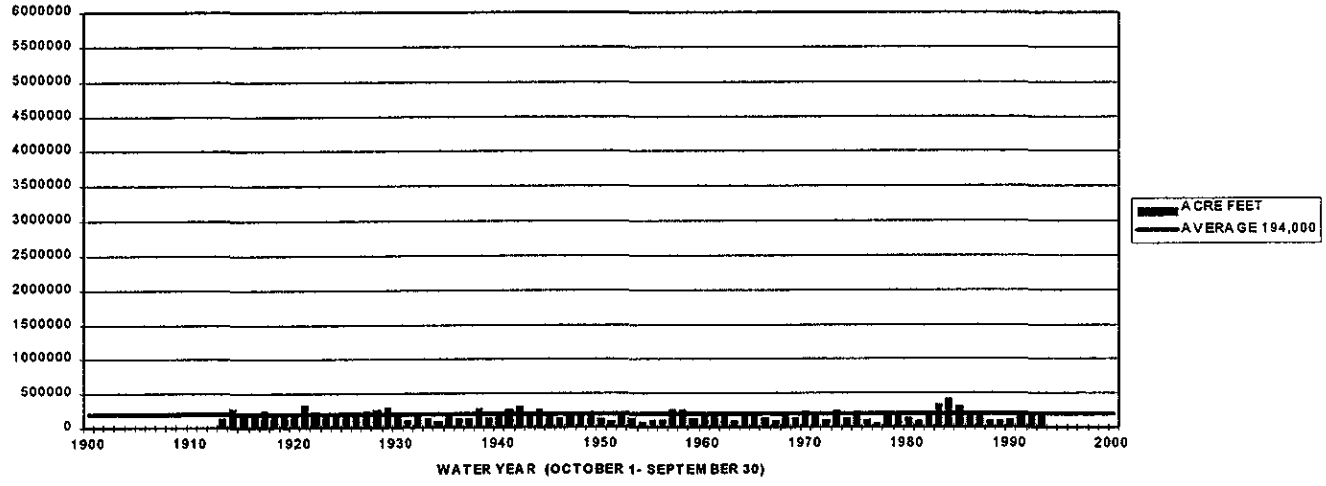


Figure 2.3


SAN MIGUEL RIVER NEAR PLACERVILLE
6000000
5500000
5000000
4500000
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
WATER YEAR (OCTOBER 1- SEPTEMBER 30)
ACRE FEET
AVERAGE 170,300


UNCOMPAHGRE RIVER AT COLONA
6000000
5500000
5000000
4500000
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
WATER YEAR (OCTOBER 1- SEPTEMBER 30)
ACRE FEET
AVERAGE 194,000

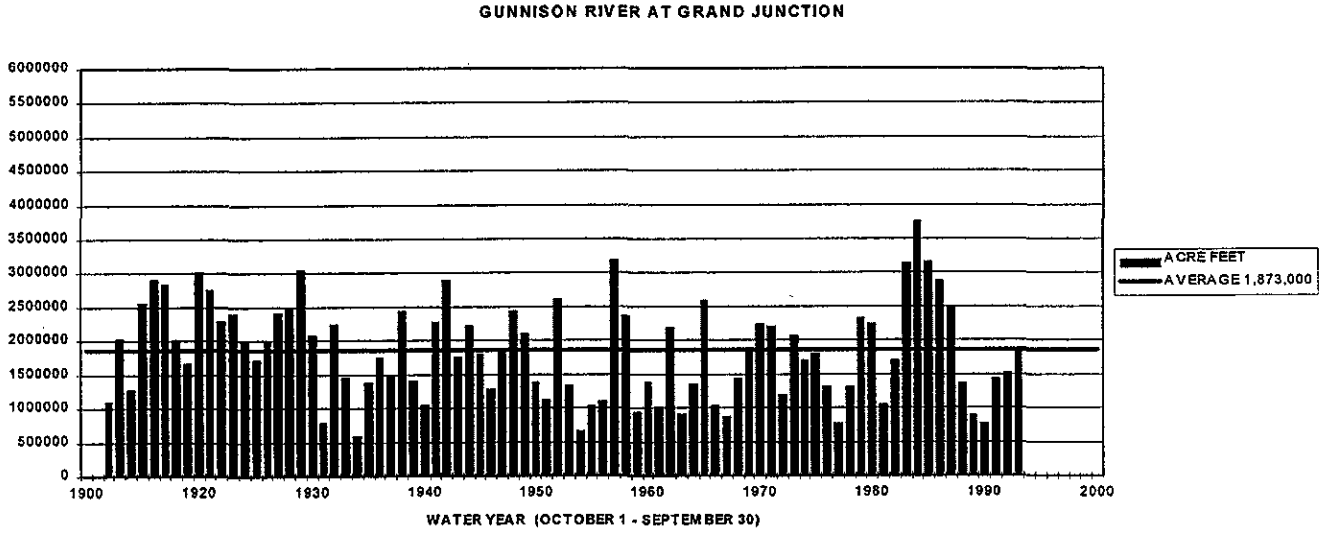
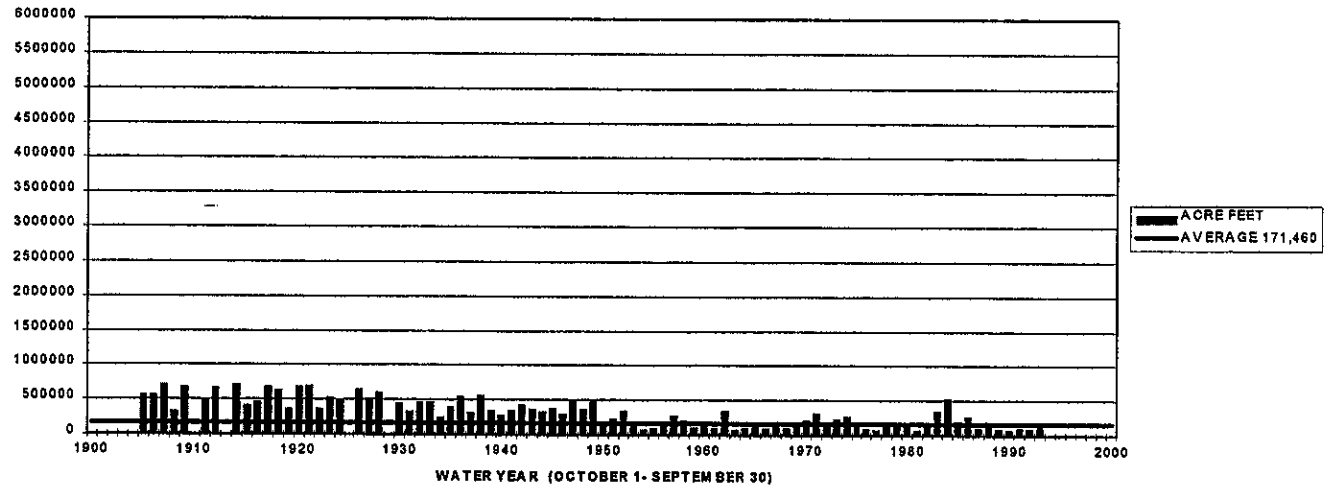
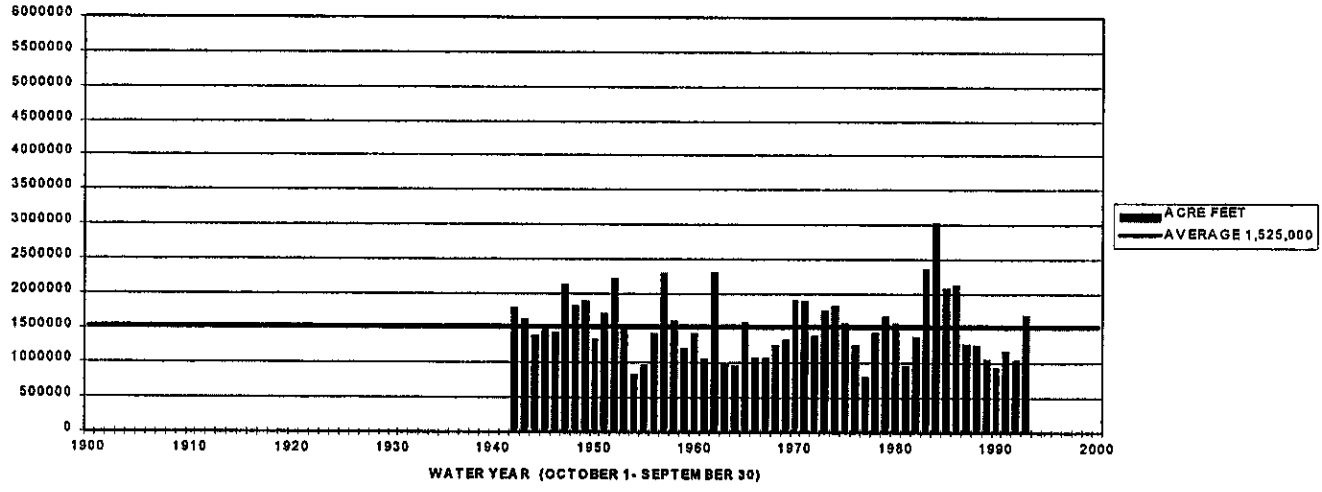

GUNNISON RIVER AT GRAND JUNCTION
6000000
5500000
5000000
4500000
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
1900
1920
1930
1940
1950
1960
1970
1980
1990
2000
WATER YEAR (OCTOBER 1 - SEPTEMBER 30)
ACRE FEET
AVERAGE 1,873,000

Figure 2.4

COLORADO RIVER AT HOT SULPHUR SPRINGS



COLORADO RIVER NEAR DOTSERO



COLORADO RIVER NEAR CAMEO

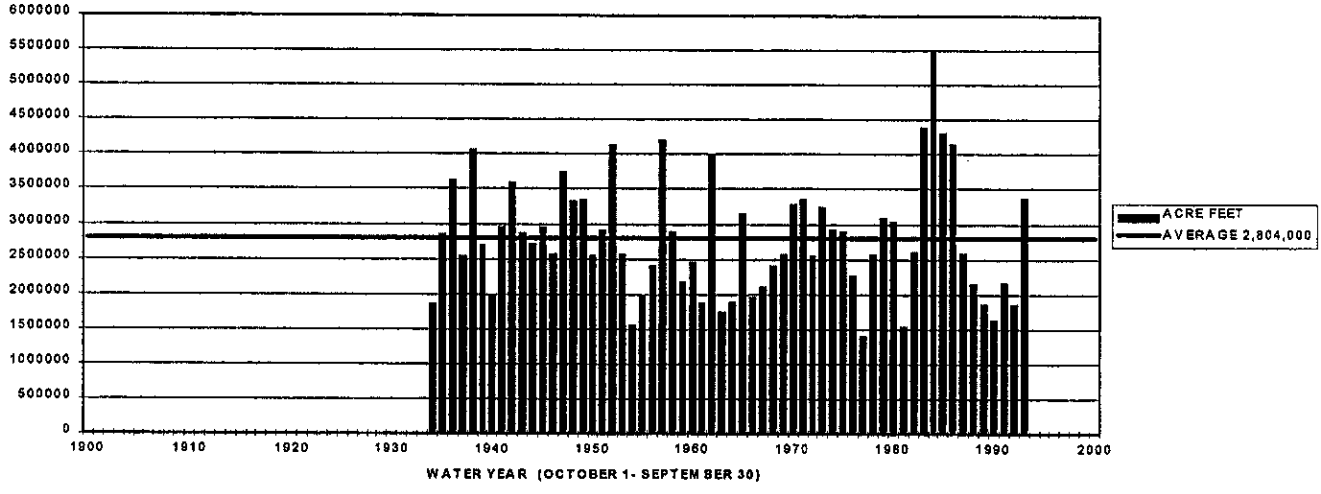
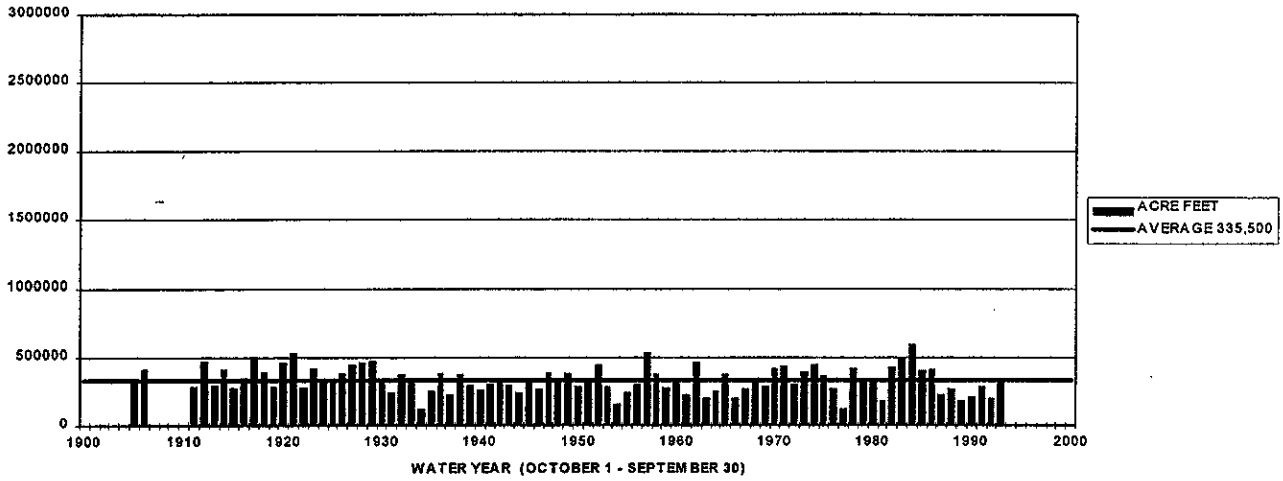
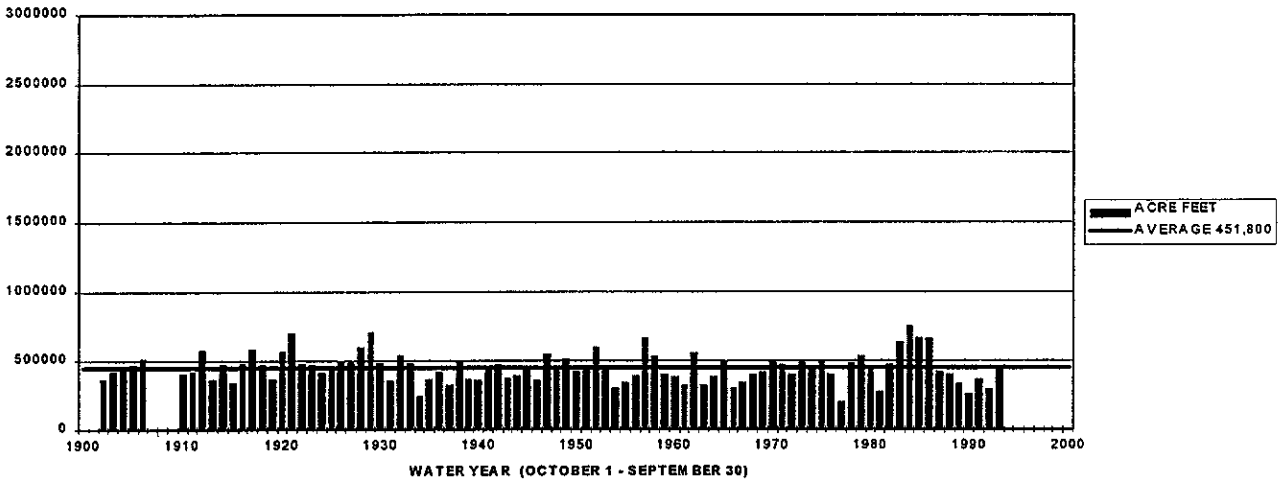


Figure 2.5

YAMPA RIVER AT STEAMBOAT SPRINGS



WHITE RIVER AT MEEKER



YAMPA RIVER NEAR MAYBEL

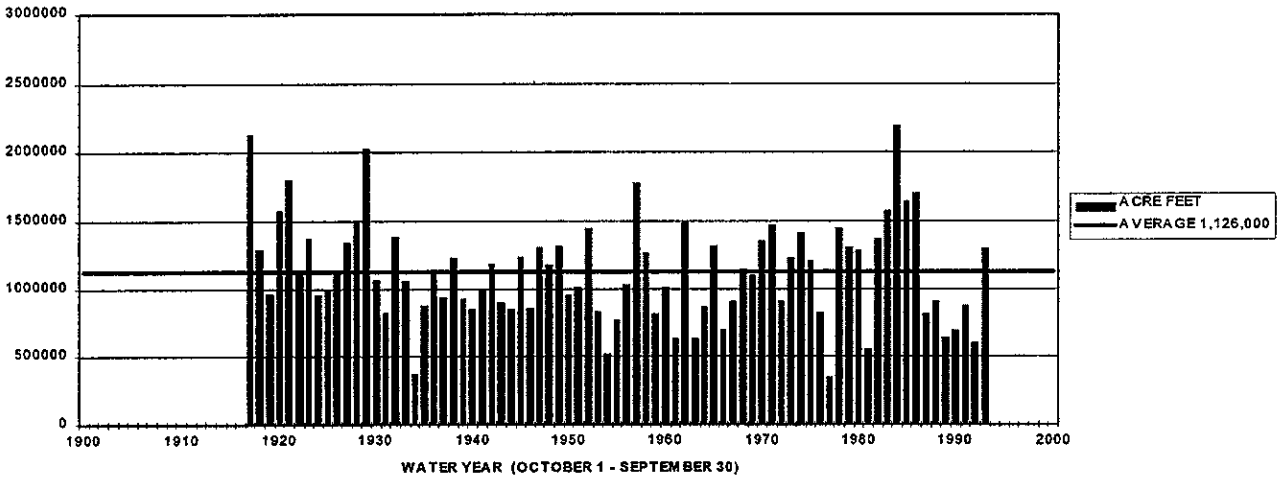
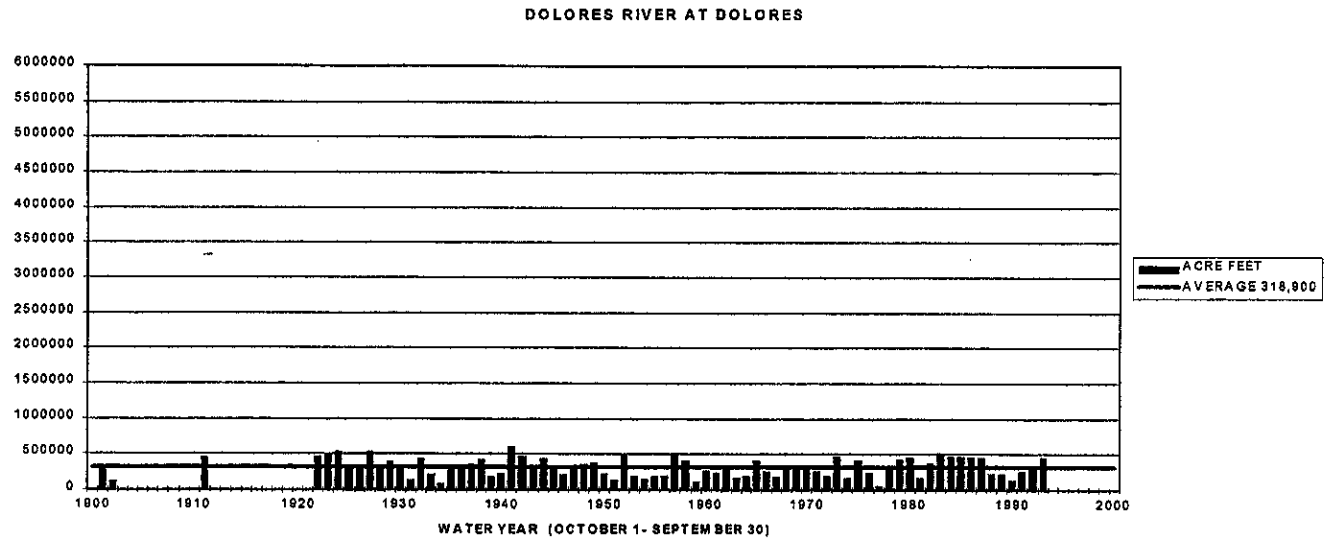
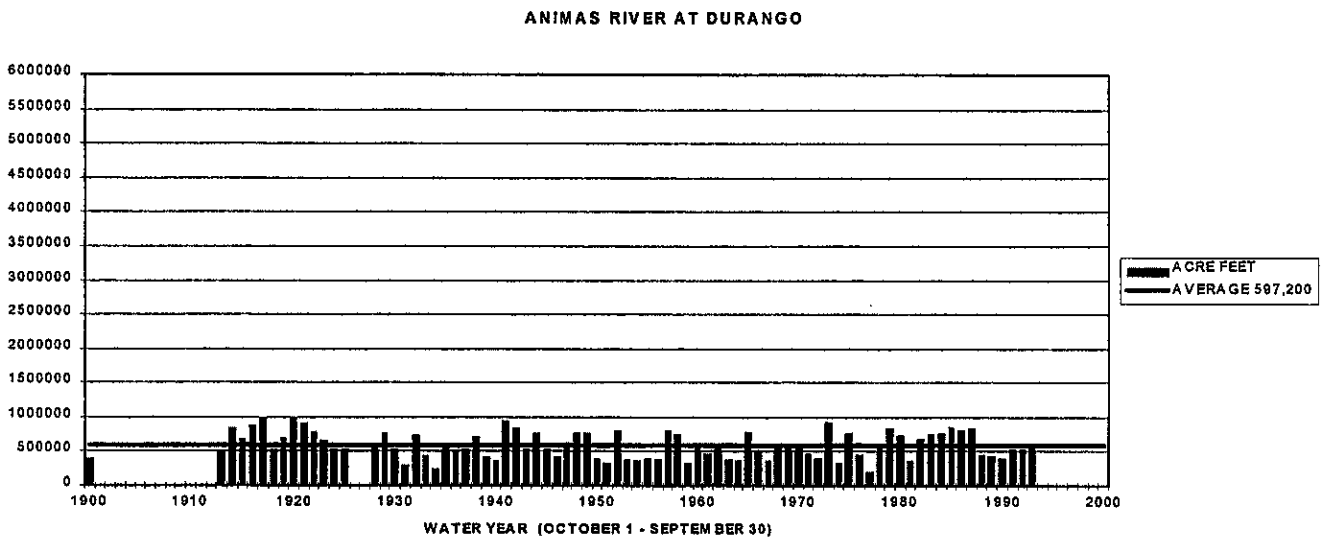


Figure 2.6


DOLORES RIVER AT DOLORES
6000000
5500000
5000000
4500000
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
WATER YEAR (OCTOBER 1- SEPTEMBER 30)
ACRE FEET
AVERAGE 318,900


ANIMAS RIVER AT DURANGO
6000000
5500000
5000000
4500000
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
WATER YEAR (OCTOBER 1 - SEPTEMBER 30)
ACRE FEET
AVERAGE 597,200

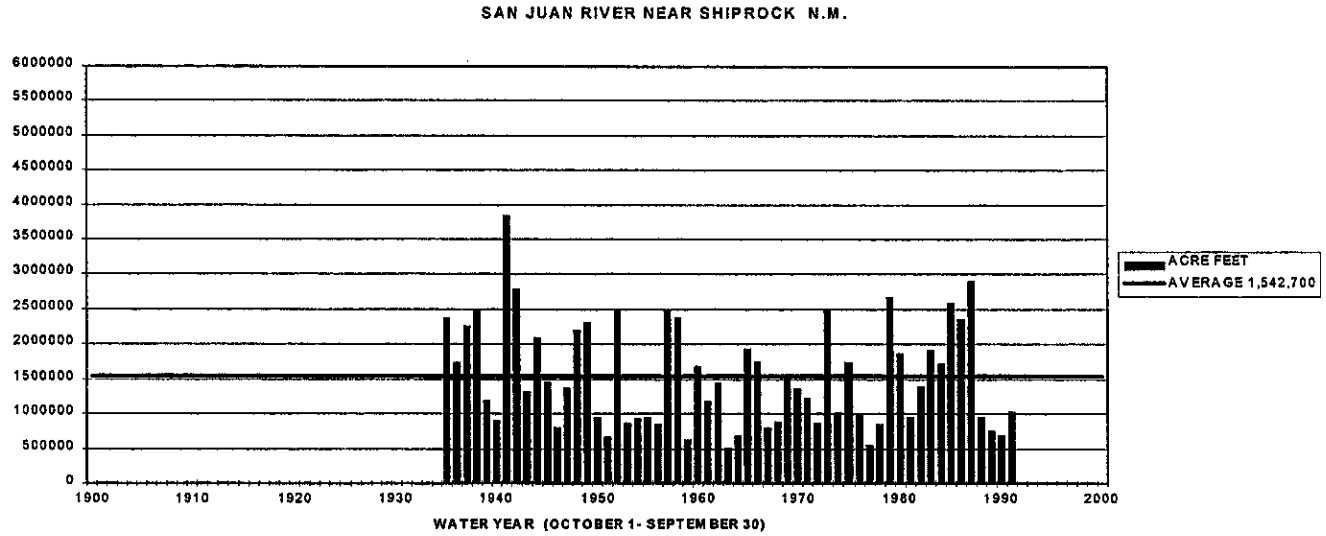

SAN JUAN RIVER NEAR SHIPROCK N.M.
6000000
5500000
5000000
4500000
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
WATER YEAR (OCTOBER 1- SEPTEMBER 30)
ACRE FEET
AVERAGE 1,542,700

Figure 2.7

STATE OF COLORADO

Area: 104,247 square miles

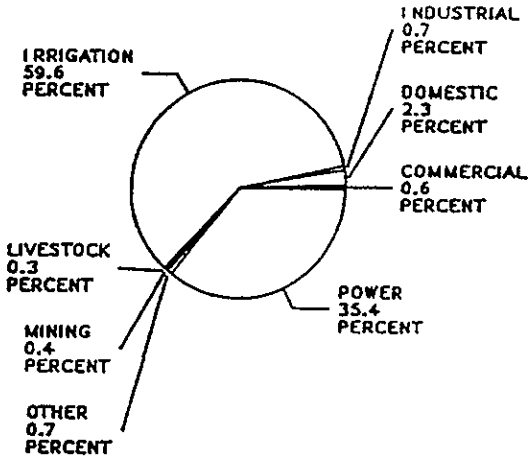
Irrigated land: 3,354,000 acres

Population:

Public supplied	3,010,000
Self supplied	222,000
Total	3,232,000

Population density:
31.00 persons per square mile

LOCATION MAP



Estimated water use

Use category	Water use (million gallons per day)
Commercial	120
Domestic	473
Industrial	138
Irrigation	12,430
Livestock	61
Mining	91
Power:	
hydroelectric	7,270
thermoelectric	123
Other	138
Total	20,844

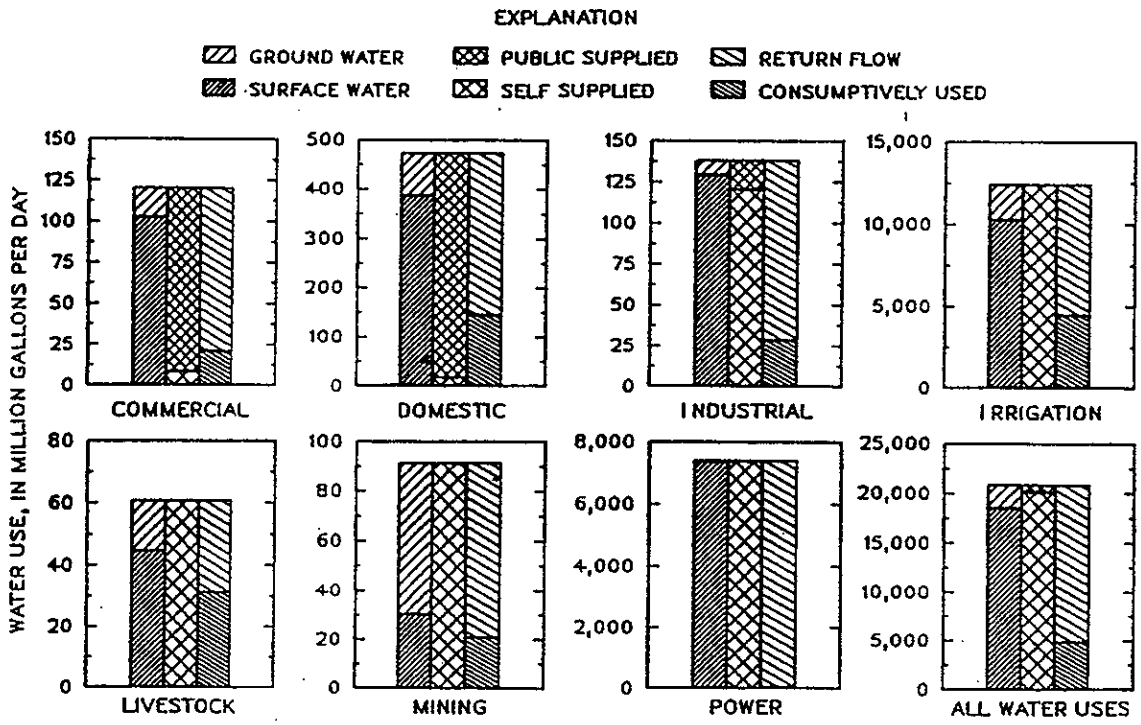


FIGURE 2.8

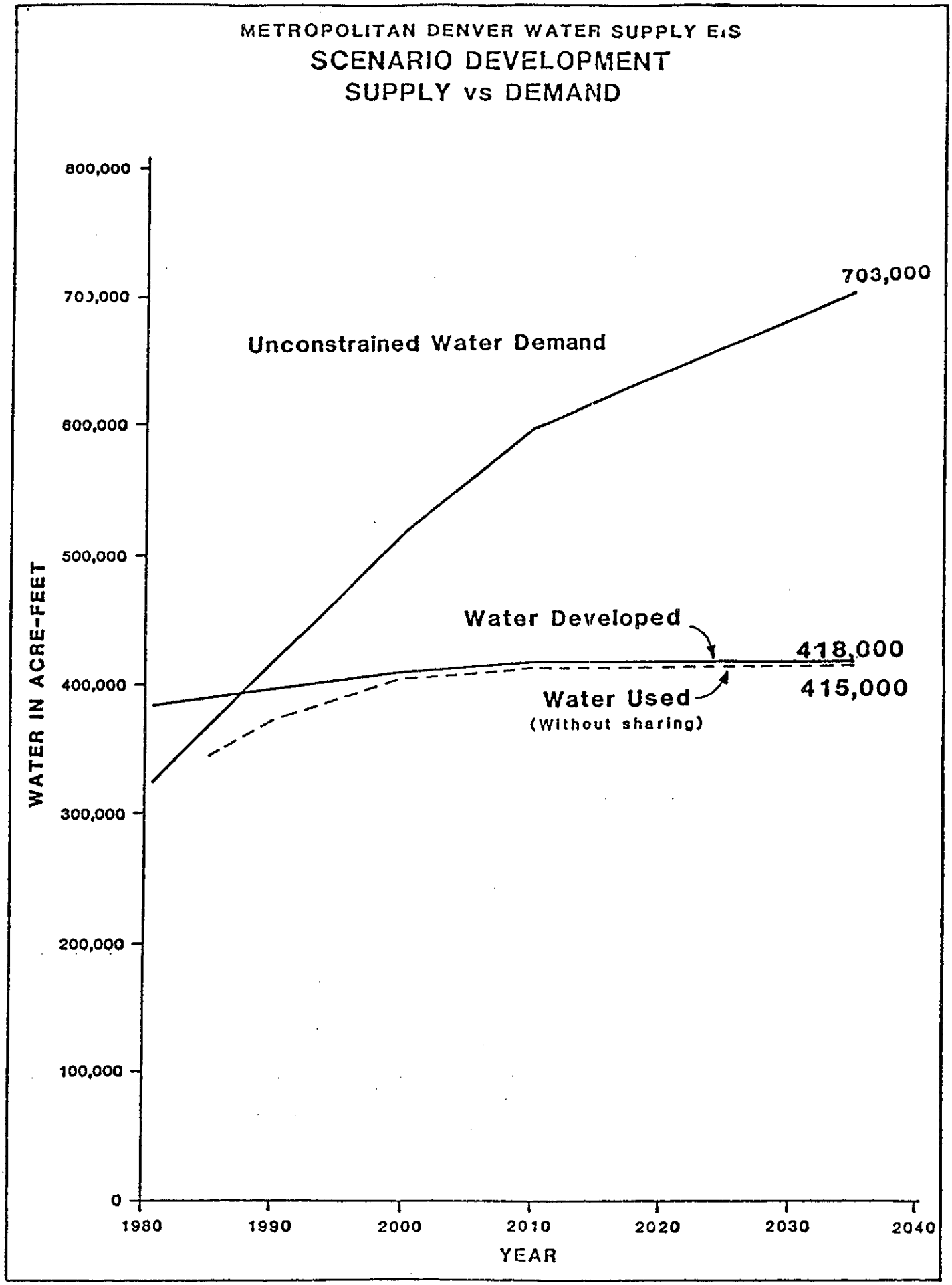

METROPOLITAN DENVER WATER SUPPLY EIS
SCENARIO DEVELOPMENT
SUPPLY vs DEMAND
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
WATER IN ACRE-FEET
Unconstrained Water Demand
703,000
Water Developed
418,000
Water Used
(Without sharing)
415,000
1980
1990
2000
2010
2020
2030
2040
YEAR

FIGURE 2.9

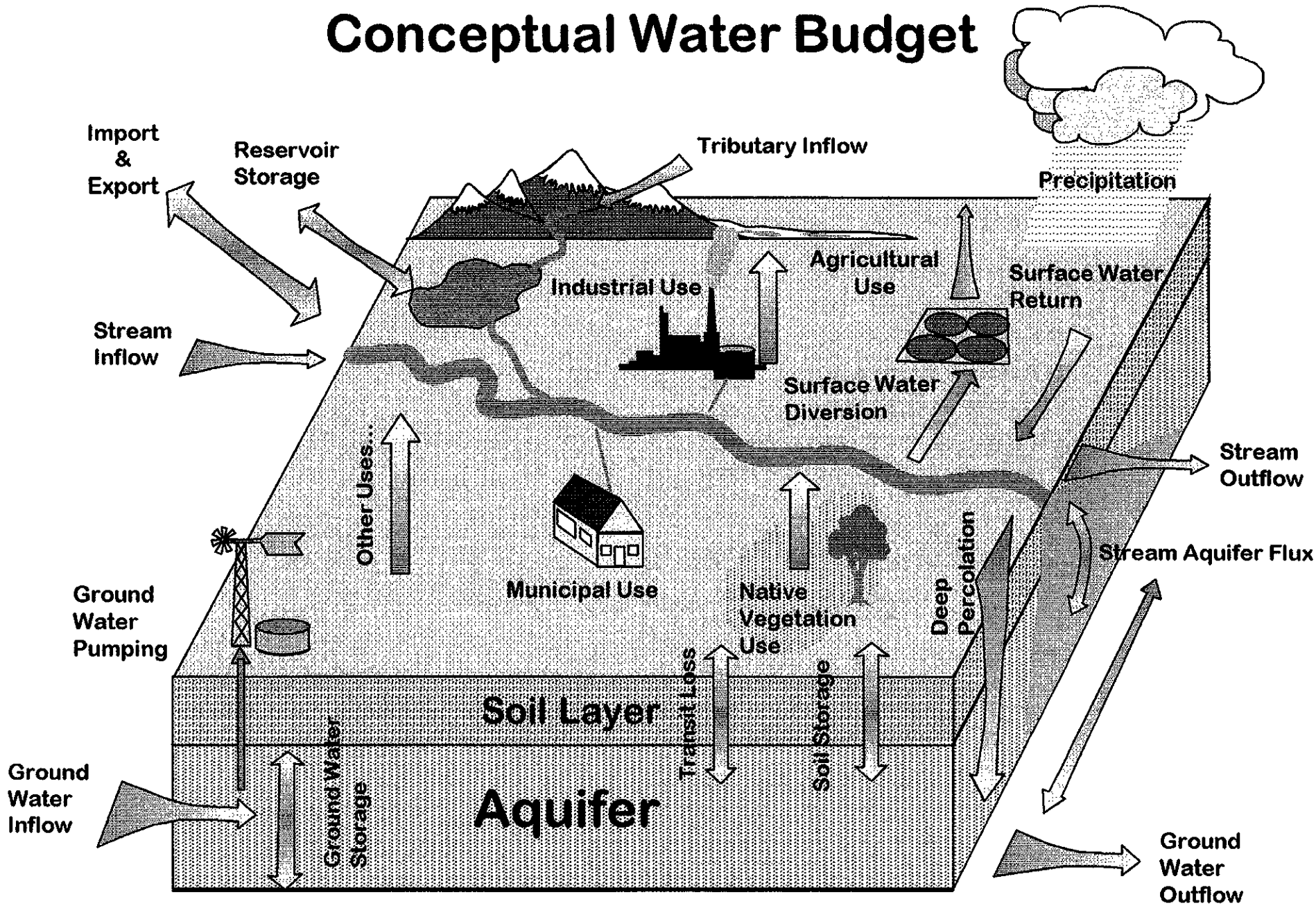
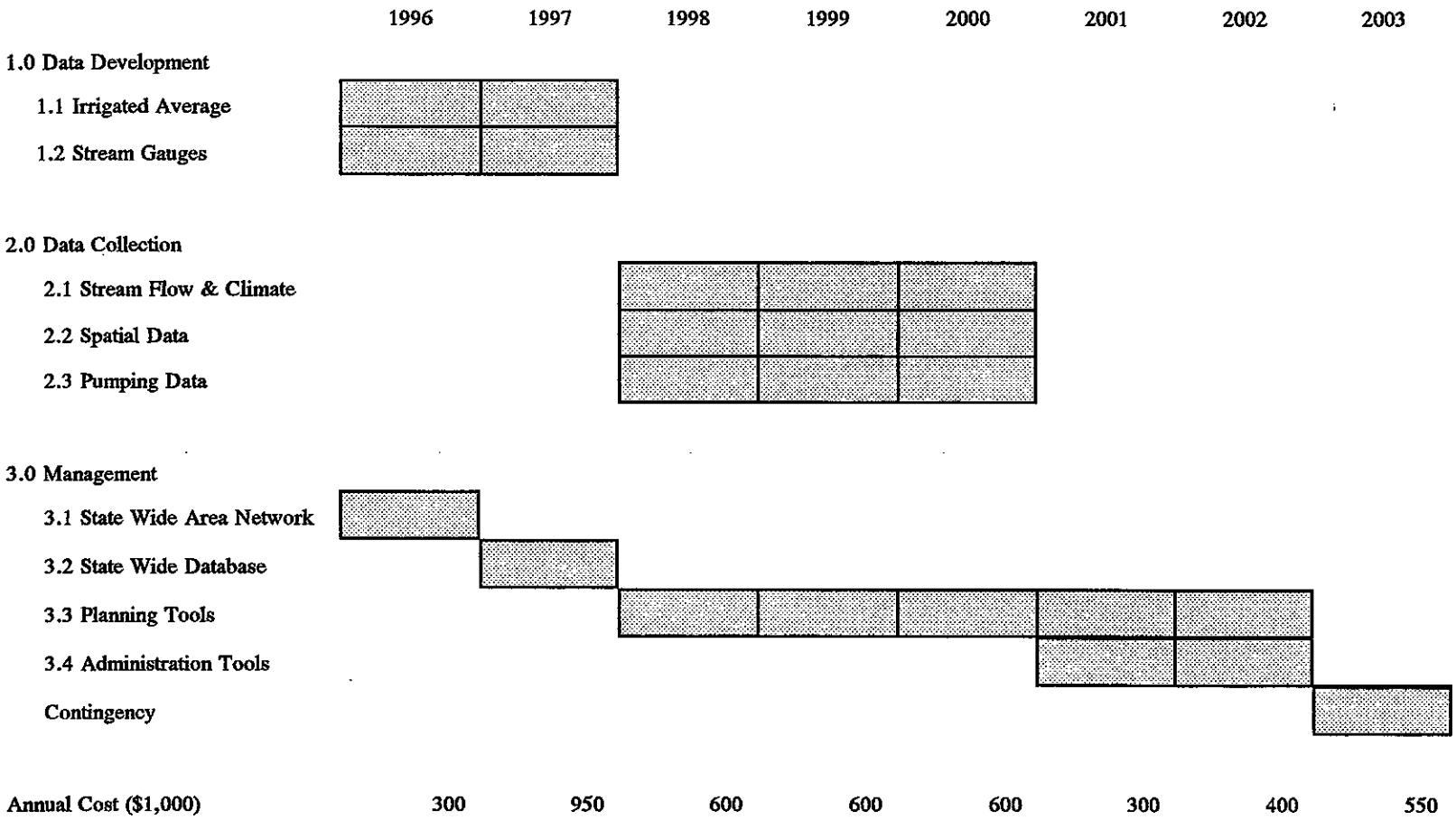

Conceptual Water Budget
Import & Export
Reservoir Storage
Tributary Inflow
Precipitation
Agricultural Use
Surface Water Return
Industrial Use
Stream Inflow
Surface Water Diversion
Stream Outflow
Other Uses...
Municipal Use
Native Vegetation Use
Deep Percolation
Stream Aquifer Flux
Ground Water Pumping
Soil Layer
Transit Loss
Soil Storage
Ground Water Storage
Aquifer
Ground Water Inflow
Ground Water Outflow

Figure 3.1

Figure 4.1
Schedule



SENATE JOINT RESOLUTION 94-32

BY SENATORS Cassidy, Bird, Bishop, Blickensderfer, Gallagher, Hopper, Johnson, Lacy, Mares, Martinez, Mendez, Norton, Pastore, Peterson, L. Powers, R. Powers, Rizzuto, Roberts, Ruddick, Schroeder, Tebedo, Thiebaut, Traylor, Wattenberg, and Wham; also REPRESENTATIVES Foster, Acquafresca, Adkins, Anderson, Benavidez, Eisenach, Entz, Gordon, Moellenberg, Reeser, and Taylor.

CONCERNING THE MANAGEMENT, CONSERVATION, AND PRESERVATION OF THE WATER RESOURCES OF THE STATE OF COLORADO.

WHEREAS, The State's water supplies are subject to interstate compacts and equitable apportionment decrees so that Colorado must allow large amounts of water arising within its borders to flow downstream to other states; and

WHEREAS, The State may not impermissibly burden interstate commerce, as indicated in **Sporhase v. Nebraska**, 458 U.S. 941 (1982); and

WHEREAS, Prolonged and extreme droughts have occurred and will continue to occur in the State; and

WHEREAS, The health, safety, and welfare of the present citizens of the State and future citizens of the State depend upon continuous and reliable supplies of clean, healthful water; and

WHEREAS, The principal supply of water available to meet the needs of the citizens of Colorado comes from annual precipitation in the form of rain and snowfall, and Colorado is a demonstrably arid state; and

WHEREAS, The State's ability to meet its present and foreseeable water needs requires efficient management, conservation, and preservation of water; and

WHEREAS, Studies made of the water supply and water needs of various portions of the State need to be collected and considered as a whole for the efficient management, conservation, and preservation of the water resources of the State; now, therefore,

Be It Resolved by the Senate of the Fifty-ninth General Assembly of the State of Colorado, the House of Representatives concurring herein:

That a joint report be prepared by the State Engineer and the Colorado Water Conservation Board, which joint report shall:

(1) Inventory the information readily available for each water division of this State on the following matters:

(a) The water supply currently available to meet existing needs and the historical and existing levels of water use and the extent of reliance on renewable and nonrenewable supplies of water;

(b) The record of drought periods and the amount of water supply available in times of drought;

(c) The anticipated shortages in water supplies in times of extended drought to meet the existing and reasonably projected water needs of the State's citizens;

(d) The extent to which existing and reasonably anticipated future needs of the State as a whole are not or cannot be met by water apportioned to the State by interstate compacts or equitable apportionment decrees;

(e) Any other information that is reasonably available and that would assist the State in making informed decisions about the efficient management, conservation, and preservation of its scarce water resources;

(2) Identify the nature and extent of the information needed to enable the State to make informed decisions regarding efficient management, conservation, and preservation of its scarce water resources;

(3) Set forth a plan with cost estimates and timelines to obtain the information identified in subsection (2).

Be It Further Resolved, That a copy of the joint report be given to members of the General Assembly and to the Governor no later than July 1, 1995.

Be It Further Resolved, That a copy of this Resolution be sent to the State Engineer, the Colorado Water Conservation Board, the Colorado Water Resources and Power Development Authority, and to Governor Romer.

Tom Norton
PRESIDENT OF
THE SENATE

Charles E. Berry
SPEAKER OF THE HOUSE
OF REPRESENTATIVES

Joan M. Albi
SECRETARY OF
THE SENATE

Judith M. Rodrigue
CHIEF CLERK OF THE HOUSE
OF REPRESENTATIVES

Appendix D
Colorado River Basin and Compacts

Colorado River Basin and Compacts

The Colorado River and its tributaries drain portions of seven western states. Colorado's use of these waters is apportioned pursuant to the Colorado River Compact (1922), the Upper Colorado River Compact (1948), the La Plata River Compact and the Animas-La Plata Project Compact. In addition, certain treaties, federal statutes, and judicial decisions also control the allocation and use of the waters of the Colorado River. In combination, these various compacts, treaties, federal statutes and judicial decisions are referred to as the "Law of the Colorado River."

In Colorado, the "Law of the Colorado River" impacts Water Divisions 4, 5, 6, and 7. The following are generally considered to be the major legal documents comprising the "Law of the Colorado River" but are by no means all of them:

1922 Colorado River Compact
1928 Boulder Canyon Project Act (Hoover Dam and Lake Mead)
1940 Boulder Canyon Project Adjustment Act
1945 Water Treaty with Mexico
1948 Upper Colorado River Basin Compact
1956 Colorado River Storage Project Act (CRSP or CRSPA)
1964 Supreme Court Decree in Arizona v California
1968 Colorado River Basin Project Act
1970 Coordinated Long Range Operating Criteria--Colorado River Reservoirs
1974 Colorado River Basin Salinity Control Act

The background for each of the above laws are described in numerous books and papers.[1] A basic understanding of these documents and their impact on Colorado is important because they influence the amount of water available for consumptive use in Colorado.

The following discussion briefly describes each of the major legal documents in chronological order:

- **The Colorado River Compact (1922)**

The Colorado River Compact divides the Colorado River into Upper and Lower Basins with the division being at Lee Ferry on the Colorado River one mile below the Paria River in Arizona. The Lower Basin states are Arizona, California, and Nevada, with small portions of New Mexico and Utah that are tributary to the

[1]One of the most complete and concise documents on the subject of the Colorado River was prepared in 1978 by Nathonson, U.S. Bureau of Reclamation, "Updating the Hoover Dam Documents."

Colorado River below Lee Ferry. The Upper Basin states are Colorado, New Mexico, Utah, and Wyoming, with a small portion of Arizona tributary to the Colorado River above Lee Ferry.

Article III of the Compact apportions the waters of the Colorado River to the Upper and Lower Basins as follows:

1. The Compact apportions the right to exclusive beneficial consumptive use of 7.5 million acre-feet (maf) of water annually from the "Colorado River System" in perpetuity to the Upper Basin and the Lower Basin.

2. The Compact allows an additional 1.0 maf per year of increased beneficial consumptive use to the Lower Basin.

3. It provides water for Mexico pursuant to treaty. Water must first come from any surplus over the waters allocated to the states in Article III(a) and (b). If that surplus is insufficient, then the burden of that deficiency shall be shared equally by the Upper and Lower Basins.

4. The Compact provides that the Upper Basin states will not cause the flow of the river at Lee Ferry, Arizona to be depleted below an aggregate of 75 maf for any period of ten consecutive years beginning with the ratification of the Compact.

5. It provides that the Upper Basin states will not withhold water and the states of the Lower Basin shall not require delivery of water which cannot reasonably be applied to domestic and agricultural uses.

- **Boulder Canyon Project Act (1928)**

This Act authorized the construction of Hoover Dam and the All-American Canal to the Imperial Valley in California. It also, in effect, apportioned the Lower Basin states allocation under the Colorado River Compact giving California 4.4 maf, Arizona 2.8 maf, and Nevada 0.3 maf. Arizona was also given exclusive beneficial use of the Gila River outside of the mainstem allocation of 2.8 maf. In making these allocations the Act provided protection against unlimited development in the lower basin. The further provides some assurances that the Colorado River Compact will not be nullified.

- **Mexican Treaty (1944)**

In 1944, the United States and Mexico signed a treaty concerning the waters of certain international rivers, including the Colorado River. The treaty guaranteed a scheduled annual delivery of 1.5 maf to Mexico (except in the event of an

extraordinary drought or serious accident) and up to 1.7 maf per year in years of surplus on the Colorado River.

- **Upper Colorado River Compact (1948)**

In 1948, the Upper Basin states entered into a compact which apportioned among themselves the waters of the Colorado River available to the Upper Basin by the 1922 Colorado River Compact. The 1948 Compact apportioned to Arizona 50,000 acre-feet per year while the other Upper Basin states received a percentage of the remaining apportionment as follows:

Colorado	51.75%
Utah	23.00%
Wyoming	14.00%
New Mexico	11.25%

Under this formula, if 7.5 MAF were available to the Upper Basin annually, Colorado's apportionment would provide for the consumptive use of 3,855,375 acre-feet of water annually.

The 1948 Compact also provides that consumptive uses under the 1922 La Plata River Compact shall be charged to the apportionments made to the states under Article III of the 1948 Upper Colorado River Compact. It also apportions water between Colorado and Wyoming on the Little Snake River in a manner that gives preference to pre-Compact water rights. Further, it requires that Colorado will not cause the flow of the Yampa River at the Maybell gaging station to be depleted below an aggregate of 5 million acre-feet for any period of ten consecutive years reckoned in a continuing progressive series beginning in 1949, and provides that any of the Upper Basin states may exceed the basic apportionment provided that it does not deprive another state of its apportionment.

- **Colorado River Storage Project Act (1956)**

After the ratification of the Upper Colorado River Compact, Congress was receptive to approving this Act which authorized the construction of Glen Canyon, Flaming Gorge, the Aspinall Units (Curecanti), and Navajo dams. This Act also established the Upper Colorado River Basin Fund to which operating revenues would be credited and used to help pay for the projects. The Act further authorized the investigation and development of several "participating projects" specifically aimed at helping the Upper Basin States develop their compact apportioned waters.

- **Arizona v. California 373 U.S. 546 (1963)**

Arizona brought suit under the original jurisdiction of the U.S. Supreme Court

in 1952 to resolve its dispute with California over rights to use the Lower Basin apportionment of the Colorado River Basin Compact. Much to California's dismay, the Supreme Court held that by passing the Boulder Canyon Project Act, Congress had, in effect, apportioned the mainstem of the Colorado River with California receiving 4.4 maf, Arizona 2.8 maf, and Nevada 0.3 maf. Furthermore, the Court found that the Boulder Canyon Project Act allowed Arizona and Nevada the exclusive use of their tributaries, which did not support the Upper Basin states' position that the Mexican Treaty obligation should be satisfied from flows in the Lower Basin in excess of their apportionment, much of which was intended to come Lower Basin tributaries.

- **Colorado River Basin Project Act (1968)**

With the decision from Arizona v. California in its favor, Arizona sought Congressional authorization of the Central Arizona Project (CAP) in 1963. After several years, the Act was approved in 1968 with many features, including authorization of the CAP, five authorized projects in Colorado (Animas-La Plata, Dolores, Dallas Creek, West Divide and San Miguel), the investigation of methods for augmenting the flow of the Colorado River, computation of consumptive uses by the Secretary of the Interior, and development of operating criteria for the coordinated long-range operation of reservoirs constructed and operated under the Colorado River Storage Project Act and the Boulder Canyon Project Act (Lake Mead) by the Secretary of the Interior.

- **Coordinated Long Range Operating Criteria--Colorado River Reservoir (1970)**

The Coordinated Long-Range Operating Criteria for Colorado River Reservoirs were promulgated pursuant to Section 602(a) of the 1968 Colorado River Basin Project Act by the Secretary of Interior and noticed in the Federal Register on June 10, 1970. These operating criteria control the coordinated long-range operation of storage reservoirs and projects in the Colorado River Basin constructed under the authority of Colorado River Storage Project Act (i.e. Powell, Flaming Gorge, Aspinall Unit, Navajo and participating projects), the Boulder Canyon Project Act (i.e. Lake Mead) and the Colorado River Basin Project Act (i.e. Central Arizona Project).

The operating criteria require a determination by the Secretary of Interior of the amount water required to be in storage in order to assure that beneficial consumptive use of water in the upper basin is not impaired ("602(a) storage requirements"). If active storage is less than 602(a) storage requirements or if active storage in Lake Powell is less than active storage in Lake Mead, then the objective release from Lake Powell for the coming year will be 8.23 maf. However, if Lake Powell storage exceeds 602(a) storage requirements and is higher than Lake Mead's,

then releases greater than 8.23 maf will be made to maintain the active storage in Mead and Powell at approximately equal amounts (equalization).

The operating criteria also provide for the release of water from Lake Mead to meet Mexican Treaty obligations, reasonable consumptive use requirements of mainstem users in the Lower Basin, net river losses, net reservoir losses and regulatory wastes. Until such time as these demands exceed 7.5 maf in the lower basin a normal water supply condition exists in the Lower Basin. Criteria for determining surplus and shortage conditions are also contained in the criteria.

It has been demonstrated that the yield of the Colorado River System is less than what the 1922 compact negotiators originally believed. At Lee Ferry the yield only averages 15.0 million acre-feet annually. To the Upper Basin this means that its compact entitlement may be reduced by one-half the Mexican Treaty obligation or 750,000 acre-feet. While the Upper Basin states do not agree with this interpretation, the operating criteria still contain a minimum annual objective target release for Lake Powell of 8.23 million acre-feet annually. When Reclamation further considers the yield to the Upper Basin during the critical period of record (drought period) the yield to the Upper Basin may only be 6.0 million acre-feet annually. A Upper Basin yield of only 6.0 million acre-feet means Colorado would only be entitled to consumptively use 3.079 million acre-feet annually.

- **Colorado River Basin Salinity Control Act (1974)**

Mexico had been complaining about the increasing salinity of Colorado River waters reaching its border. As a result, after years of negotiations and interim agreements, the nations signed Minute 242 of the International Boundary and Water Commission which committed the United States to deliver water to Mexico from the Colorado River containing no more than 115 parts per million of salt than the salt content of the water diverted to the All-American Canal at Imperial Dam (Imperial Valley). With this obligation, the CRBSCA was passed to initially fund four salinity control projects. The Act has subsequently been amended to include a number of other projects.

State water right administration in Divisions 4, 5, 6, and 7 includes consideration of the limitations imposed by the "Law of the Colorado River" in addition to the "appropriation doctrine." As of 1985, Colorado only beneficially consumed an average of 2.3 million acre-feet of Colorado River water annually, thus, limitations imposed by the Colorado River Compacts have not been a significant concern yet. However, as Colorado approaches full utilization of its compact apportionment it will become more important to closely monitor Colorado's consumptive use of water on the west slope. The Colorado River Decision Support

System (CRDSS) is designed to accomplish this, but it will still be necessary to collect basic data on river flow, irrigated acreage, reservoir levels and other parameters needed to determine consumptive use and provide them as input to CRDSS in order to fully monitor compliance with terms of the "Law of the Colorado River."