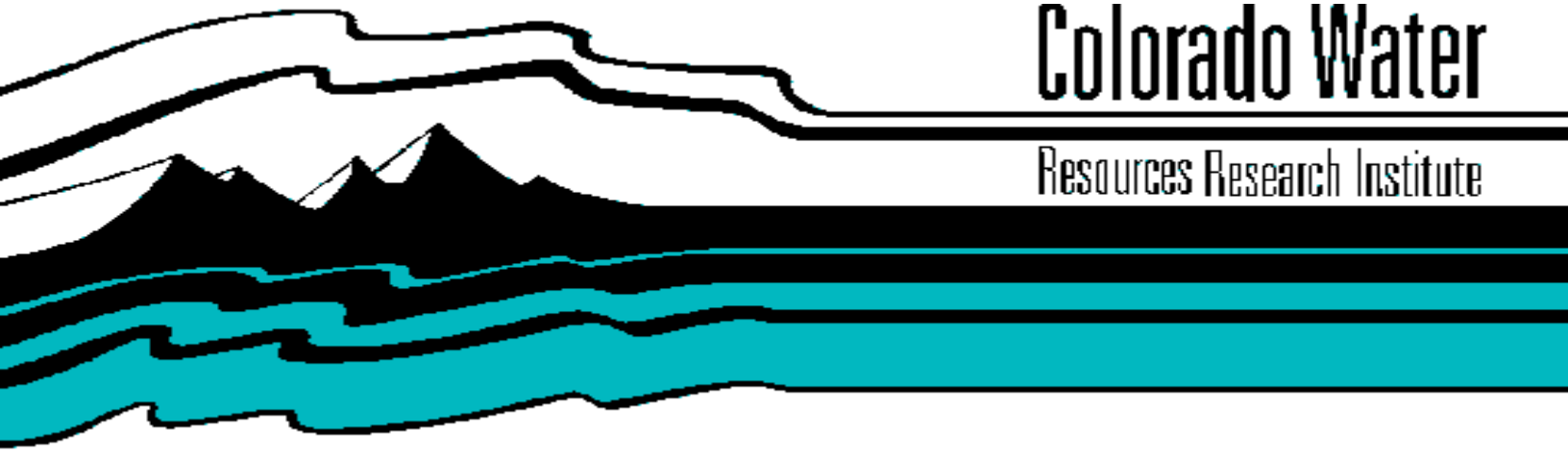
Institutional Arrangements For Effective Water Management in Colorado

By

Phillip O. Foss



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Colorado State University

INSTITUTIONAL ARRANGEMENTS FOR EFFECTIVE WATER MANAGEMENT IN COLORADO

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by

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WATER RESOURCES RESEARCH INSTITUTE
Colorado State University
Fort Collins, Colorado

Norman A. Evans, Director

Anybody who can solve the
problem of water will be worthy
of two Nobel prizes -- one for
peace and one for science.

John F. Kennedy

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I am, of course, alone responsible for any errors of fact or interpretation that may appear in this study and for the conclusions drawn and options presented.

Phillip O. Foss

ABSTRACT

Rapidly increasing population and industrial growth in Colorado have sharply increased demands for water. In the face of these increasing demands, water supply is relatively fixed. Present occasional or isolated shortages will soon become chronic. The study attempts to develop politically acceptable institutional arrangements for increasing the supply and for more efficient methods of utilizing present supplies.

Among the options for increasing supply are: reevaluation of Colorado's commitments to downstream states; construction of additional storage developments with state funds or consortiums of sub-state units; increased state support for precipitation augmentation; increased state support for watershed management; increased groundwater withdrawals; and an expeditious resolution of Federal Reserved Rights and Indian claims.

Options for increasing efficiency of present supply by institutional methods include: discourage population growth; integrate land and water planning; employ the zoning concept to regulate water use; integrate water quantity and water quality management in the same agency; integrate ground and surface water management; encourage conservation methods in irrigation and municipal use; facilitate temporary transfers including a state "water bank;" integrate management of all water supply units in a single state water board.

The basic criteria used in evaluating possible options were: equitability; responsiveness to democratic values; recognition of social values of water; efficiency in utilization of water; stability without rigidity; and political acceptability.

While the study is oriented toward the State of Colorado, most of the options for institutional adjustments to improve water management may be applicable to other arid and semi-arid states.

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CHAPTER I

INTRODUCTION

> To pass from a state of resource abundance to a condition of resource scarcity can be a severe experience for an individual biological organism--- and for a nation as well.[1]

The Basic Problem

Colorado has moved from a state of relative water abundance to a condition of water scarcity. Even in the days of relative water abundance the uneven distribution of precipitation created a problem: the people were where the water was not. Over the years the discrepancy between areas of water abundance and water scarcity has intensified. By 1970, eighty percent of the state's population was located in the ten counties along the eastern edge of the Front Range -- in the rain shadow of the Rocky Mountains.

Not only is the population concentrated in an arid region, but that population is growing rapidly. During the decade 1960 to 1970, the population of the United States increased 13.4 percent; Colorado's population increased 24.8 percent; and the population of the Front Range urban counties increased 33.8 percent. A considerable portion of this rapid population increase was the result of migration into the state. Since Colorado migrants are likely to be younger people,

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[1]Fish and Wildlife Service, U.S. Department of the Interior, Cooperative Instream Flow Service Group: The First Year, (U.S. Government Printing Office, 1977), p. 1.

we can expect that they will have more children and a lower death rate. The rapid rate of population increase can therefore be expected to continue--both as a result of "natural increase" and continued in-migration.[2] This expectation of continued rapid population growth is in agreement with projections of the Colorado State Division of Planning which forecasts a "lowest" growth of 871,000 for the period 1970 to 2000 and a "highest" growth estimate of 2,036,000.[3] This last would approximate a doubling of the population in a 30 year period.

Total numbers of people to be served by government constitutes a problem but the problem is compounded if that population is growing rapidly. A rapidly growing population, like a rapidly growing child, will have more problems, make more demands, and be more expensive to sustain. By contrast, an area of static population growth can function at lower costs because streets, schools, hospitals, and utilities are in place, operational, and possibly already paid for.

While it is obvious that more people will require more water, what is not so obvious is that the water demand per person is rapidly moving upwards. Partly because of rising affluence and partly because of rapidly increasing industrial demands, per capita uses of water have risen sharply. In 1975, the U. S. Geological Survey

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[2]Edward Knop and Kenneth Berry, "Analysis of Population Systems: Perspectives on the Colorado Case," in Phillip O. Foss, ed., Environment and Colorado, (Environmental Resources Center, Colorado State University, 1973), p. 20.

[3]Colorado Division of Planning, Colorado Population Trends, vol. 5, no 1, (Denver, Colorado: Colorado Division of Planning, Winter 1976).

estimated that the average per capita use of water in the United States was 1900 gallons per day--up 100 gallons a day from 1970.

In addition to increased water demand because of increasing population, energy production from coal and oil shale development will make additional demands for water supplies.

Finally, tourism and outdoor recreation activities are rapidly escalating. Much tourism (one of the state's major industries) is related to opportunities for outdoor recreation. In addition to the demands of tourists, the residents of Colorado are increasingly interested and involved in outdoor recreation activities requiring large amounts of relatively pure water. This demand is naturally highest near major population centers where water is in scarce supply and where water quality is likely to be lowest.

The foregoing commentary has been a summary of present and projected demands for water in Colorado. The supply side of the problem can be summarized more quickly. While estimates vary somewhat, it is generally agreed that most of the dependable surface water in Colorado has already been appropriated or over-appropriated.

To state the problem in the simplest possible terms: water demands in Colorado are expected to increase rapidly but there is no more water. That being the case, water must be used more effectively or we will experience an increasing number of water crises of increasing severity.

Objectives of the Study

The stated general objective of this study is "to improve the effectiveness of water management in Colorado through improved

institutional arrangements and administrative practices of Colorado water agencies."

This is, admittedly, an ambitious undertaking. If it was easy to do it would already have been done. Furthermore, as William Lord has pointed out, "One of the characteristics of water resource conflict is that it does not develop until most of the means of successfully resolving it have been foreclosed."[2] Nevertheless, the problems are urgent and we must assume that they are not insoluble. The study was undertaken on that optimistic premise.

The study also recognizes and concurs with a National Academy of Sciences statement that:

> . . . change is the most predictable feature of future developments in the field of water resources. While the prediction of rapid change has become almost a cliche, it is true, nevertheless, that changes in the interest and demands upon the water resource by society, coupled with changes in scientific knowledge and technology, place continuing pressure upon both the natural and social sciences to provide better information and understanding not only on how the natural water system works but on how society can reconcile the system and its demands.[3]

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[2]William B. Lord, "Conflict in Federal Water Resource Planning: A Discussion Paper", Mimeo. Institute of Behavioral Science, University of Colorado, November 3, 1977.

[3]National Academy of Sciences, National Research Council, Alternatives in Water Management, Publication No. 1408, Washington D.C., 1966, p. 41.

Specific Objectives

The specific objectives of this study are listed below.

1. Identify and describe the institutional structure and inter-relationships of state and local water agencies in Colorado.
2. Examine the relationships between Colorado state and local water agencies and Federal water-related agencies and activities.
3. Specify institutional development and trends over time in functions, objectives and organizational arrangements and their affects on the water management system.
4. Delineate the functional responsibilities of Colorado water agencies and assess their corresponding financial, administrative and legal capabilities.
5. Isolate, define and analyze Colorado's major water management problems.
6. Recommend alternative institutional changes and managerial arrangements for more effective water management in Colorado.
7. Appraise the obstacles that are likely to be encountered in seeking desirable institutional changes.

Improving the Effectiveness of Water Management

There are two general approaches to improving the effectiveness of water management: improvements in water use technology and improvements

in institutions for administering the water system. These two approaches are not mutually exclusive; they are, in fact, interdependent. As an example, water could not have been transported by tunneling through the Continental Divide unless the technology for such works had been in existence. At the same time the technology could not have been utilized unless institutions had also existed to obtain the water, finance the intermountain diversion and beneficially use the water on the eastern slope. Furthermore, changes in one category will stimulate changes in the other. A significant change in technology will cause institutional changes and vice versa.

In a democratic society, changes in either technology or in institutions must be politically acceptable. The term "acceptable" does not necessarily mean overwhelmingly popular -- it simply means acceptable. We should note that technological solutions may be just as politically sensitive as institutional changes. A technological solution for supplying water to the east slope by interbasin diversions is obviously a politically sensitive matter. So is a Narrows Dam.

The acknowledged interdependence between technology and institutions notwithstanding, for purposes of exposition, this study will concentrate on institutional arrangements for effective management of the Colorado water resource.

Institutions

The term "institutional" has been variously interpreted. In many cases, organizations have been considered to be institutions. That may, or may not, be the case. Norman Wengert's definition seems most useful and appropriate.

> "It is most useful to distinguish between "institutions" and "organizations", although in some usages the two seem to be regarded as virtual synonyms. The position taken here, then, is that the simple decision setting up an organization may not be sufficient to create an institution. At the same time, it seems reasonable to assert that most organizations may become institutions. The point is that institutions are not simply structure. They involve people in patterned behavior; they involve identifiable expectations; they influence or establish sets of social norms and affect the views and values of those associated with them. To become an institution an organization develops relationships with people -- clients interests, groups, a community -- and these relationships with people have a momentum and continuity independent of the constituting authority."[4]

Wengert goes on to suggest that most institutions evolve over time by a process of accretion. As will become evident, the concept of the slow evolution of institutions seems particularly applicable in the case of water institutions. However, the decisions taken in this process of "accretion" do not occur in a vacuum. They are the result of people's values, goals, and views of the world. Furthermore, as Vincent Ostrom has pointed out,

> "All aspects of administration and of economic development are based upon the assumption that efforts to control events

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[4]Norman Wengert, "Societal Institutions and Institutional Processes and Urban Water Management", A paper presented at the Midwest Political Science Association, April 1971.

> will produce some greater benefits than if the events were not controlled. The initial problem . . . is to determine which set of events is to be controlled in relation to some value reflected in the consequences to be realized."[5]

Values, Goals, and Views of the World

Values, goals, views of the world, and preferred "sets of events" do not necessarily develop through the logic of reason or through the application of scientifically derived data. They are most likely to be a legacy from the experience of the past--which may or may not be appropriate to the present situation. Dean Mann has identified three pervasive sets of values that have a profound effect on water institutions and preferred "sets of events". They are: the preference for private decision making as compared with governmental decision making; the tendency to view the nation's resources as inexhaustible, both in quantity and in quality; and a preference for local management and control of governmental institutions.[6] To these basic sets of values, we might add the common belief that, since water is necessary to sustain life, people have a right to "adequate" supplies of water and the related subsidiary concept that, since rain is free (or has been until the advent of weather modification), water should also be a free good. There is, of course, a difference between precipitation and water in the tap or in the irrigation ditch. Kenneth Boulding has

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[5]Vincent Ostrom, "The Water Economy and its Organization," Natural Resources Journal, (Univ. of New Mexico, Albuquerque) April 1962, p. 69.

[6]See Dean E. Mann, "Political and Social Institutions in Arid Regions," in Carle Hodge, ed., Aridity and Man, (Baltimore: American Association for the Advancement of Science, 1963), p. 397-398.

noted that "Rain is no more water than grass is milk."[7] The institutionalization of these basic values is considered in ensuing chapters.

The Transition from Development to Management

It has been repeatedly asserted that the West has now passed the stage of water development and that the emphasis of the future must be on more effective management. Blair Bower's statement is typical:

> ". . . the United States is now entering a period in which water resources administration rather than water development as such will be the major task. To put it another way, administrative activity with respect to water resources in the future will be weighted more toward manipulation of developed supplies than toward development of new supplies."[8]

Colorado's Governor Lamm has expressed similar views:

> ". . . it seems clear to me that we are in a transition period moving from the development and storage of water to a period which will be characterized by increasing conflicts between agricultural use of water and the transfer or attempted transfer of agricultural water to municipal, industrial, recreational,

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[7]See "Rain is Free, Water Isn't," Life, September 3,1965, p. 4.

[8]Blair T. Bower, "Some Physical, Technological, and Economic Characteristics of Water and Water Resources Systems: Implications for Administration," Natural Resources Journal (October 1963): 215.

and other environmental uses. We will not be as preoccupied with the development of new water supplies as we have been in the past."[9]

This study proceeds on the same premise with the qualification that some additional supplies can yet be developed in Colorado and that weather modification will also increase the total supply. There also exists the remote possibility that supply can be increased through modification of interstate compacts and revision of Supreme Court decisions in interstate water disputes. The development and evolution of interstate water rights will be considered in a subsequent chapter on "Intergovernmental Relations Affecting Colorado Water Resources."

The Appropriations Doctrine and the Water Market

The two most basic institutional arrangements for water management in Colorado are the appropriations doctrine and the water market. Through the appropriations doctrine, people were able to "homestead" water in somewhat the same manner as they homesteaded land. As regards the water market, it is said that water flows towards money. Stated differently, the allocation of water depends upon the price system.

In any discussion of a state water policy plan, many people will maintain that we already have one (the appropriations doctrine and the water market) and that it has served the state well for over a century. They may be right. The unseen hand of the market may be

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[9]Governor Richard D. Lamm, "Colorado, Water, and Planning for the Future," Denver Journal of International Law and Policy, vol. 6, (Special Issue, 1976), p. 443.

the best way to allocate water -- and that means the uses of water. Furthermore, a basic change in the system for allocating water would cause so much disruption and conflict that, in the words of one legislator, it would be "horrendous to contemplate."

However, the treatment of water as just another commodity creates some problems. In the first place, water is hard to package and sell. We really don't buy and sell water -- we buy rights to use the water. Secondly, water does not stay in place -- it moves. Even in the so-called consumptive uses, water is not totally consumed -- some of it finds its way back into the water courses either as surface water or ground water.

Furthermore, many people contend that water is too important in Colorado to be allowed to flow unimpeded towards money. They assert that the continuation of the present system will seriously injure irrigated farming, fish and wildlife values, tourism, and outdoor recreation generally. These and related problems are discussed in considerable detail in the chapter entitled "Water: Characteristics, Concepts and Doctrines."

The Politics of Water Management

There are two basic control systems in the United States; the competition of the market place and the competition of the ballot box. We have traditionally preferred to solve problems and allocate scarce resources through the market place. But when an influential segment of the public believes that market allocations are unacceptable, we have turned to the political system to distribute or adjudicate values. We might note in passing that the two basic systems are becoming increasingly intertwined and interrelated.

As will be discussed in a subsequent chapter, when demands for water exceed the available supply, the allocation of water rights becomes increasingly politicized. The politics of water management is, for various reasons, exceedingly sensitive and volatile. The history of the Rocky Mountain West has been mainly a history of conflicts over water. The innumerable novels, movies and TV shows about the "Wild West" have centered around conflicts over land, or more precisely, over land with water on it. The longest court case in the history of the United States (Arizona v. California, 373 U.S. 546) was a conflict over water rights. Persons who wish to change, or otherwise "tamper" with existing water management systems must proceed with extreme caution if their efforts are to have any chance of success.

Governmental water policies are developed within the context of a national system for policy formation. The basic elements of that process of policy formation are considered in Chapter II.

While all governmental policies develop as the result of political action, each major policy area tends to develop a somewhat different form of political activity. Chapter Three is therefore restricted to the politics of water policy formation in arid and semi-arid regions.

Orientation and Scope of this Report

This report takes a somewhat parochial view of water problems in that much of it is restricted to the state of Colorado. It is also admittedly parochial in that the options presented for mitigating

water problems are confined to Colorado. It should also be understood that what is good for Colorado may, or may not, be good for other states. Nevertheless, many of the concepts examined and management options analyzed should be applicable to other arid and semiarid regions of the United States.

CHAPTER II

THE POLICY SYSTEM IN THE UNITED STATES: SOME BASICS

Governmental Policy

A governmental policy is an enforceable decision(s) that determines who gets what, when and how.[1]

"Who" may be a single individual, a group, a state, a section of the country, or "the general public". Most policy proposals are advanced for the "good of the public" or to "protect the public interest" but such proposals will ordinarily benefit one or a few groups more than the rest and it will be these high beneficiary groups that will be most active in supporting the proposal. Such high beneficiary groups will attempt to concentrate the benefits on themselves and diffuse the costs as widely as possible.

We should note in passing that policies are formed by people for people. There are really no such things as water policy or agricultural policy; there is only people policy as regards these particular matters.

"What" is not restricted to material things; it may include such intangibles as freedom or justice -- or the lack of them. It may also include symbolic rewards or deprivations.

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[1]See Harold Lasswell, Politics: Who Gets What, When, How, Meridian Books, 1936, 1958.

"When" seems self explanatory. It does make a difference whether water moves through the Continental Divide in 1878 or in 1978. It makes a difference to the farmer when the irrigation water is "turned in."

"How" goals or objectives are carried out obviously makes a difference. How we go about trying to maintain military superiority may decide whether or not we are successful in that effort. How we allocate the scarce water supply of Colorado makes a tremendous difference.

We have all heard the term "policy vacuum". In fact, there can never be a policy vacuum -- there always exists some policy. Governmental policies need not be articulated in laws, regulations, executive orders or court decisions. Until recent years, for example, it was the policy of the Federal government to allow individuals and industries to pollute the atmosphere without cost or penalty but there was no official declaration of such a policy.

Thomas R. Dye has suggested that, "Today it seems that politics centers about 'Who <u>feels</u> what, when and how.'" Dye goes on to say

> The smoke-filled room where patronage and pork were dispensed has been replaced with the talk-filled room, where rhetoric and image are dispensed. What governments <u>say</u> is as important as what governments <u>do</u>. Television has made the image of public policy as important as the policy itself. Systematic policy analysis concentrates on what governments <u>do</u>, why they do it, and what difference it makes. It devotes

less attention to what governments say.

Perhaps this is a weakness in policy analysis.[2]

Dye is probably correct. However, I assume that what people feel and say has a direct relation to what government does or does not do.

Dye goes on to assert that there is a difference between policy impact and policy output. "Policy impact is not the same as policy output. It is important not to measure benefits in terms of government activity. We cannot be content with measuring how many times a bird has flapped its wings, we must assess how far the bird has flown."[3]

As we have previously noted, institutions develop over time through a process of accretion. The same can be said for governmental policy decisions. A currently popular poster carries the caption "Today is the first day of the rest of your life". While this is an appealing and perhaps inspirational thought, what we do today is determined mainly by what we did yesterday and all the yesterdays before that. And so it is with policy formation. We never "start from scratch". We start from where we are. Policy decisions are not isolated islands in time. The process of policy formation is a continuum in that each policy decision builds upon, or is influenced by, previous policy decisions and it, in turn, influences

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[2]Thomas R. Dye, Understanding Public Policy, (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1972):296.

[3]Ibid., p. 292.

the course and direction of future policy decisions. In theory at least, there can be no "final" policy decisions.

Politics

In a democratic system, politics is the process of forming governmental policy. All the activities that we commonly include under the term "politics" are carried on with the ultimate objective of influencing policy. Campaigns and elections, for instance, are held to choose the players for the "policy game".

Well meant recommendations that "politics" should be taken out of government in general, or out of water management in particular, are about as logical as suggesting that we take farming out of agriculture.

Politics is the mill that grinds out policy or policy changes.

Policy Makers for the People: Who Makes Governmental Policy?

The General Public

As children we learned that a democracy is a system in which "the people rule". Probably to most Americans, this connotes a town hall kind of system in which each individual has a "say" in the policies being considered. However, even the most casual observer understands that such a system cannot work in a highly complex society of 220 million people. There is simply too much to know, the problems are too many and too complex for the average citizen to cope with. Such a system

can function effectively only in a small town or other small jurisdiction where problems are few and easily understood.

It seems obvious that the general public does not make policy except in a negative sense. Someone else makes the shoe, but they wear it. Consequently, they supposedly know best where the shoe pinches or if it is wearable at all. If they are dissatisfied they exert a veto by refusing to comply, by voting out incumbent officials and by similar methods. This veto power exists not only after the fact but before a decision is made policy planners must take into account the anticipated limits of public tolerance.

If the general public does not make policy except in a negative sense, who does?

Political Elites

Political elites make government policy. They always have except in very small jurisdictions and presumably they always will. I define political elites in a very loose sense as those persons who are most influential in shaping government policy. Actually our system of representative government is an elite system. When we elect a person to a responsible public office he becomes, at least potentially, one of the political elite. There are obviously great variations in the influence of the various elites but I shall not try to grade them in terms of power. I shall, however, attempt to describe two kinds or categories of elites; the generalist elites and the specialized elites.

The President is probably the best example of a generalist elite in the United States. Governors and legislators also fall into this

category but their interests are often more specialized. We should also notice that there may be generalist elites in very small jurisdictions. Thus a political boss in a small town may be a generalist elite.

Most political elites are specialized elites. That is, they are likely to be influential in only one or a few policy areas. Practically all interest group leaders and agency executives fall into this category. George Meany, President of the AFL-CIO, expresses his opinion on many matters but he is mainly influential in labor policy. The Director of the Colorado Water Conservation Board may have ideas on many policy issues but he is likely to be most influential in the area of water policy matters. It also frequently happens that a person who is assumed to be a generalist elite may turn out to be one of a specialized elite. Thus, a legislator from a mining district might conceivably be interested and influential only in mining policy.

In the foregoing discussion it has been suggested that governmental policies are formed by political elites and that such elites fall into two rough categories -- generalist elites and specialist elites. Let us attempt now to be more precise in classifying and describing the governing elites. More simply stated, in addition to the very rough category of political elites, who are the policy makers for the people?

Elected Executives and Their Staffs

Presidents, governors, other statewide elected executives, mayors in strong mayor cities, and, to some extent, county commissioners

fall into this class. We learned in elementary school that executives execute (carry out) the laws, but they do much more than that. They and their staff people do much of the innovating, the compromising and the organizing to obtain policy changes. These executives have varying degrees of appointment power and influence on budgetary allocations. They have easier access to the mass media and consequently can generate support or opposition "back home". Finally, the President and most governors have veto power which can only be overridden by a two-thirds vote of both houses. The President and the various governors may not be "chief executives" in fact but they most certainly are chief legislators -- which means chief policy makers.

Interest Groups

An interest group is an organized body of persons who seek to advance their objectives through governmental action. Such objectives may be selfish or they may be altogether altruistic. We should notice that no interest group thinks of itself as "bad guys". All of them assume they wear white hats. Interest groups and interest group officials are the principal innovators, promoters, organizers and fighters in the process of public policy formation. They originate most policy proposals and they furnish the energy to get them adopted as official public policy. Presumably no group ever gets all it wants but few, if any, are destroyed. They are permitted to live on and fight another day. So the policy battle never ends.

Administrative Agencies of Government

Governmental agencies are second only to interest groups in innovating, promoting, organizing and fighting for the adoption of given policies. Actually, they function in much the same way as interest groups as regards policy formation. If agency executives believe in the mission of the agency, one can expect that they will lobby for more or better agency activities. The head of a state penal system for instance, can be expected to support better, if not more, prisons. Similarly, the Denver Water Board can be expected to promote more and better quality water for the City of Denver.

Legislative Bodies

Congress and the state legislatures are generally assumed to be the policy-making organs of the society. It seems likely, however, that legislatures act more as formalizers or "pronouncers" or policy than as architects of policy.

To further delineate the role of legislative bodies it would appear that they function primarily in a negative sense as the representatives of the public. That is, that the legislative body as a whole does not actively function in policy formation except to exercise a veto over the policy proposals of individual members or of particular committees. Even in the committees there is little innovating of policy but there is considerable organizing and promoting and some fighting. But the principal role of the committees seems to be that of judging the probable political reception of policy proposals and of negotiating among interest groups, administrative

agencies and other committees and with individual legislators.

Some congressional and legislative committees are specialized in a subject matter area that is of principal interest to legislators from particular districts. Naturally legislators try to obtain assignments to the committees whose work deals most directly with the interests of their constituents. Thus the Senate Committee on Interior and Insular Affairs is composed primarily of Westerners. Such committees, then, tend to become small, specialized congresses that are <u>not</u> representative of Congress as a whole. But unless the Congress, as a body, uses its veto power over committee policy proposals, such proposals do become official policy. The same can be said for state legislatures.

To summarize, it frequently happens that an influential interest group(s), a government agency, and the members of a legislative committee may all represent the same special interest. Within certain broad limits, they make public policy for the United States or for their particular state in their area of primary interest.

It is sometimes held that while legislative bodies do not ordinarily innovate in policy matters that they do act as catalysts, synthesizers, and argument settlers; that they choose from among the claims of contending groups or that they attempt to develop workable compromises among the contenders. There is undoubtedly much truth in this concept. However, there also exists a strong tendency to avoid argument settling and even to avoid compromising.

Probably the two principal methods for such avoidance are postponements of decision and "giving in" to both or all the contenders. In the latter instance it appears that everybody wins.

Politically Powerful Single Individuals

Quite frequently, single individuals are influential in forming policy. Ordinarily such individuals are influential mainly because of the position they hold in an interest group or in government. Occasionally a single individual will be influential in his own right and aside from the position he holds. Even in these rare instances of personal influence the individual is likely to be influential mainly because of a position he formerly held.

The personally powerful individual is likely to be a symbol and a rallying point for one or more prevailing ideologies. He is also likely to be a "popularizer", and explainer and a publicist for the ideology. He is frequently in the "inner circle" of the interest group -- government agency -- legislative committee triumvirate. The late former Colorado Governor and United States Senator "Big Ed" Johnson may be an example of the personally powerful individual.

The Courts

One definition of a law might be "a formal statement of public policy". The doctrine of stare decisis (the use of precedents) simply means that the courts interpret a given policy in terms of past interpretations of public policy decisions. Furthermore, the

courts are especially careful in choosing precedents which point toward decisions that do not violate prevailing ideologies.

Finally, we are a legalistic people so we frequently clothe policy problems with legal terminology and transfer them to the courts for policy decisions. These policy decisions are set forth as legal concepts or decisions by the courts and are then translated back into policy decisions. Such decisions have no more finality than other policy decisions and are a part of the continuum of policy formation.

It is altogether possible that the most important and far-reaching policy decisions of the last two decades may have been made by the Courts.

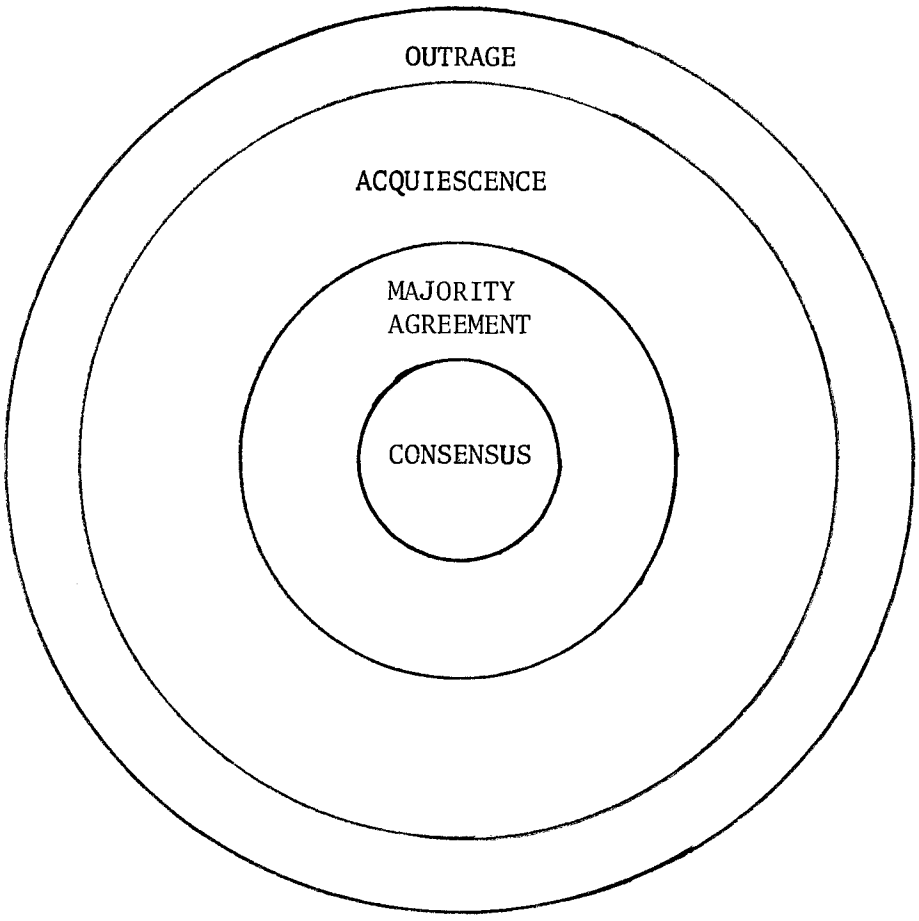
Zones of Consensus, Majority Support, Acquiescence, and Public Outrage

Most Americans support the concept of majority rule -- not because they have much faith in the majority but because they have more faith in a majority than in a minority -- especially a small minority. They also make the concommitant assumption that a policy decision requires majority support. This last idea requires two important qualifications or reservations if it is to be applied to the real world. First, when we speak of a majority, we must define the geographical or jurisdictional limits we are talking about. A majority vote in Mississippi on school desegregation might be different than a majority vote on the same question in Colorado. Similarly a majority vote in Mississispi might be different than a vote on the same

issue in the United States as a whole. To extend the examples farther, a majority vote in the AFL-CIO would probably be different than a majority vote of the membership of the National Association of Manufacturers. These distinctions are known to everyone but we sometimes lose sight of them when we glibly speak of majority rule. In brief, we need to ask, "Where is the majority?"

A second commom fallacy in thinking about majority rule is the assumption that every policy decision must have the support of the majority. This is simply not true. On most policy issues most of the public don't know and don't care. One could not expect it to be otherwise; there is too much to know and many policy decisions have such minor effects on most citizens that they are altogether rational in not knowing and not caring. On a highly publicized issue like the Viet Nam War, most Americans did know something about it and did care. By contrast when President Nixon was considering devaluation of the dollar he was asked what effect such action would have on the Italian lira and allegedly responded, "I don't give a (expletive deleted) about the lira". Probably most of us would respond in much the same way; we don't know what effect dollar devaluation would have on the lira, and whatever the effects, they would very likely have little impact on our personal lives.

We suggest that government policies fall into four general zones in terms of public acceptance: consensus, majority agreement, acquiescence, and outrage. A simple diagram of these zones appears below.



ZONES OF PUBLIC ACCEPTANCE OF GOVERNMENT POLICIES

Consensus is most likely on basic matters such as free speech, majority rule, the secret ballot and so on. Majority agreement (when it exists) is likely to concern matters which are highly publicized, easily understood and having a direct and perceivable effect on the personal lives of the people. Majority opinion to "get out of Viet Nam" may have been an example of this kind of policy reaction.

It is my guess that most government policies fall within the zone of acquiescence. Acquiescence, as I use the term, does not mean agreement. It simply means compliance. People comply mainly because they are ignorant of the issue, because the stakes are not high enough to be worth an opposition struggle, or because they believe they have no chance of winning. If we were queried, most of us would be opposed to a tariff on filberts if we knew that it would increase the price of filberts. But, after all, each of us spends only about 30¢ a year on filberts so an increase of three or four cents a year is not worth fighting about -- except to the filbert growers. Hundreds of similar examples could be cited. On most issues we don't know and we don't care. Let us not make the mistake, however, of assuming that only relatively obscure or trivial decisions fall within the zone of acquiescence. In opposing the Civil Rights Act of 1964, Governor George Wallace said, "I challenge the President and the Congress to submit this proposed legislation to the people as a national referendum. I promise you that you will get the shock of your life because the people of this country will overwhelmingly

reject this encroachment upon their right to own and enjoy property."[4]

At the time Wallace spoke, such a referendum could very well have been defeated by the American people yet the bill passed both houses of Congress by better than a two-thirds majority.

A more comprehensive analysis of the relationship between public opinion and public policy was conducted by Frank Munger. Munger obtained national survey data from all the 50 states on five highly publicized and easily understood issues: state lotteries, capital punishment, right-to-work, public accomodations and gun controls. He then correlated these state-by-state opinion polls with the various state laws on these policy issues. His findings were that the index of agreement between state laws and public opinion was only 58 percent.[5]

We can only conclude that the public will comply with a vast array of policies with which they disagree.

Finally, we come to the zone of public outrage or rebellion. On some policy matters an overwhelming majority will rebel in some way or other because they strongly believe the policy is ridiculous, unfair or unacceptable for other reasons. Such widely held feelings bring forth what I have called the "public veto".

A Slow Moving System?

People frequently complain about the slowness of the American system in making policy changes. It was deliberately planned that way!

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[4]U.S. Congress, Senate, Committee on Commerce, Hearings on S. 1732, 88th Cong., 1st Sess., p. 443.

[5]Adapted from Thomas R. Dye, Understanding Public Policy, (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1972), p. 268-271.

Why? Mainly to prevent hasty judgments (and probable costly mistakes) and to prevent tyranny by a system of "veto points". The slowness of the process also supposedly gives more groups and more individuals access to the system or at least a chance to express their views.

We have all heard that ours is a system of checks and balances as well as the further cliche that there are "more checks than balances". That is probably correct. The system of separation of powers is so designed that each branch of government has some veto power over the other two branches. Stated differently, each branch has "got its nose in the other's business". The president can veto acts of congress but the congress can override the president's veto by a two-thirds vote. Acts of congress and executive actions can be declared unconstitutional by the supreme court. The president nominates supreme court justices but such nominations must be approved by the senate. We could lengthen this list by several pages. All of these veto points can, and frequently do, slow down the decision process. This system also tends to maintain the status quo because it is easier to stop something than to start it.

On important and highly publicized controversial matters, decison makers are inclined to delay decisions because policy decisions are never neutral; usually somebody gains and somebody loses -- and the losers don't like it. When policy makers cannot delay a decision on a controversial matter, they will ordinarily next try to compromise. Compromise usually means getting "half a loaf" or part of one. It also means that the policy change will be limited and, in that sense, the change will be slowed down.

Even when a consensus is reached on what to do, there may be disagreement on how to do it. As we move from the general to the specific, we are more likely to disagree -- and disagreements in a democratic society slow down the decision process.

Do we want to change the system to speed up the policy process? Probably most of us would say "yes" -- if we can do so without losing any of the safeguards that are built into the system. But that would be exceedingly difficult. As the society becomes more complex (and the policy problems become more complex) the governmental policy process will probably slow down rather than speed up. We should also note that changes in a long established policy-making system are more difficult to accomplish than changes in specific policy areas. That is because most people probably think the system itself is a good one (even when it may be populated by scoundrels) and because so many influential individuals and groups have a vested interest in maintaining the present system.

Having said all this, let us recognize that we are not living in a static society. Governmental policies do change and do adapt to changing needs and values. Real public concern over the state of the natural environment probably dates from about 1965. Since that time there has been a long list of significant policy changes to maintain or enhance the environment. During the decade of the '60's, the median income of Blacks nearly doubled. During the same period, seven times as many women earned over $10,000 per year as compared with the previous decade. So things do change and sometimes at a rapid rate.

Permanent and Temporary Policy Changes

As we have previously observed, in theory at least, all policy decisions are temporary. We should note, however, that some policy decisions tend towards greater permanence than others.

Most of us, as individuals, seek as much stability as possible in an unstable world. The society as a whole, also requires considerable stability if individuals, business firms, and other organizations (both public and private), are to plan for the future and invest time, effort and resources in those predictable futures. Nevertheless, those policy decisions that tend toward permanence are likely to foreclose other alternatives which might become more attractive with the passage of time.

The slow moving policy system of the United States, which we have alluded to above, tends to provide the stability desired by the American people. To this general statement, we should add the qualification that even though stability is generally desired, some of us may advocate rapid change on particular policy matters. When that happens, we become impatient with the policy system. In those cases, we view stability as rigidity.

To return to the matter of the finality of policy decisions, the optimal stance should be a continuing effort to develop policies that are stable over time but such decisions should not foreclose opportunities for change if a new or different situation makes such changes desirable. This is all easy to say but difficult to accomplish. Any major policy decision involves sunk costs of time, resources,

reputations, expectations, sustenance patterns, and modes of life in general. For example, in some abstract sense, it may be desirable to jettison the appropriations doctrine in Colorado but to do so would create disruptions and dislocations of great magnitude.

To conclude, we can assert that policy makers must function in a continuing policy dilemma; how to maintain stability without closing off opportunities for needed change.

CHAPTER III

THE POLITICS OF WATER MANAGEMENT IN ARID REGIONS[1]

The population of arid regions may be divided into two rough categories: a diffused and scattered population living in the hinterlands and a concentrated population living in oases. Such oases may be small villages or large cities. Water may be present "naturally" in these oases or it may be imported. All the major population centers along the front range in Colorado fall into this oasis category. Los Angeles, Tucson, and Salt Lake City are other examples of larger oasis-type cities.

The diffused population will be sparse but such concentrations as do occur will be along streams and around springs. In terms of sustenance objectives, water will be the over-riding concern. Much of the politics of the hinterland will tend to be centered around methods and devices for acquiring, protecting, and transferring water rights.

The population of oases is likely to expand rapidly until it approaches the limits of the available water supply. When that point is reached, competition for water between oasis cities and rural areas will intensify and with the increased competition will come

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[1]This analysis is based upon Phillip O. Foss, "Politics of Water," in Harold E. Dregne, ed., Arid Lands in Transition, American Association for the Advancement of Science, 1970.

This chapter is intended to be a general commentary on the politics of water management in arid regions. It is not specifically directed toward any particular state or region.

intensified political involvement in water matters. If irrigated agriculture has preferred rights to water under doctrines developed in earlier times, irrigation interests will naturally attempt to maintain the status quo. Such a stance is not a matter of cultural or political lag but simply a rational effort to protect a preferred position.

The Hinterland Areas of Diffused Populations

The sparse population of the hinterlands of arid regions is likely to remain static or decline. Venture capital will be limited and, since persons operating close to a subsistence level will prefer to "play it safe" rather than gamble on new or experimental methods, the rate of innovation and increased production is likely to be slow.

There will be some out-migration but little in-migration with the result that social class lines will become stabilized.

Politics will also become stabilized and will tend to become primarily concerned with maintaining the status quo.

Such technological innovations as are introduced into the area are likely to have the affect of reducing the population by making it possible for a smaller number of persons to effectively manage the resources of a given area. During the last three decades the population of most of the arid, rural counties of the United States has declined.

While the population of the arid hinterlands of the world has remained static or declined, the population of urban centers (including oases) has continued to increase. As a consequence, the population of the hinterlands has declined as a proportion of the total and along with it their political influence has also declined. In the

United States (and possibly in some other countries) the residents of the arid hinterlands exert a disproportionately large political influence but, as their relative numbers continue to decline, this influence will be less and less significant. The politics of arid lands will thus increasingly come to mean the politics of oasis communities although most of the observations set forth herein also apply to the arid hinterlands.

The Allocation of Water Resources

There appears to be three primary methods for allocating water in areas of scarcity:

1. Through the use of force;
2. Through a market system;
3. Through the political system.

The use of force is probably the oldest method for allocating resources, but it is by no means restricted to primitive peoples. Force is the ultimate sanction for enforcing political judgements. It is still used extensively although modern man may make more effort to camouflage force than did his ancestors. Force is commonly applied in conjunction with economic and political pressures and when the initial allocation by force has been accomplished, the resource may be reallocated in the market or through the political system or both. Furthermore, there will ordinarily be attempts to legitimatize and protect a previous forceful acquisition through political action.

The market process has been, and will continue to be, a major device for allocating water. But water is difficult to handle through the market. Water is difficult to package; it is sometimes considered

to be a public good (like air); it tends to fall into the natural monopoly category; and it may require high capital investments and low, or slow, possibilities for profit taking. For these reasons, and possibly some others, water perhaps more than any other resource, has come to be allocated through the political process. When a water market is used it ordinarily operates through the opportunities provided, and/or the constraints imposed, by the political system.

For analytical purposes, the political water system, can be thought of as consisting of five basic elements: the environment, the inputs, the authoritative decision making centers, the outputs, and the feedback. The environment generates demands (inputs) on decision making centers which respond with policy changes (outputs) which, in turn feed back into the environment.[2]

Some observations on each of the major elements of the political water system follow.

The Environment

As demands approach current capacity, water will come to have increasing significance in the lives of people. Water rights, however acquired, will be protected by legal doctrines and custom and tradition will be invoked to buttress positions in water controversies. High incentives will be offered for innovations that expand existing limits of water

Individuals and groups will attempt to obtain larger shares of the water resource by maximizing short-run values, often at the expense of

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[2]This concept of the political water system was suggested by the writings of David Easton in A Framework for Political Analysis (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1965) and A System Analysis of Political Life (New York: John Wiley and Sons, Inc., 1965).

long-run community benefits. If ground water is the source, each user or using group will attempt to get all he can "while the getting is good" because he knows that if he doesn't get it, someone else will.

While this intense competition is going on, people will tend to attach mystical qualities and attributes to water and begin to think of it in terms of a God-given right.

If the oasis comes to be populated mainly by persons from humid areas, they will transfer their modes of life and their expectations to the arid region. Stated differently, they will attempt to change the environment to suit their wants and expectations rather than adapt to it. There is, or course, nothing new in such behavior. Men have always tried to change their environment to meet their wants. The building of fire for warmth by primitive man was an attempt to change his immediate environment. However, it goes without saying, that the transplanting of humid area modes of living to a region of water scarcity will accelerate the demand and intensify the competition for water.

If the oasis community is able to obtain substantial quantities of additional water and undergo consequent growth, it will become increasingly disassociated from the hinterland. Large oasis communities tend to become increasingly independent of the hinterland for raw materials, labor or markets. Their principal contacts, identifications, rewards and deprivations will be with the "outside world." To speak of the politics, economics or sociology of arid lands assumes a homogeniety that does not exist.

To many Americans, growth and progress are synonymous terms and almost all of us are committed to progress. This developmental or "booster" idealogy may be especially strong in the American West.

When oasis communities recognize that their "progress" is limited by water shortages, the developmental drives will further accelerate and intensify the already strident demands for more water.

Under the banner of progress, campaigns to bring "new industry" to already water-short cities will continue and the ensuing frequent "water crises" will add real urgency to demands placed upon political decision-makers.

The Inputs

Three common inputs (demands) on political decision makers from arid regions are:

1. demands to protect existing rights;
2. demands for the encouragement of technological innovation; and
3. demands for the importation of water.

Each of these will be considered separately.

The Protection of Existing Rights and Practices

When individuals or groups first acquired water or water rights they attempted to protect and legitimatize such claims through statutes, regulations, and court decisions. Water rights were first obtained to protect the holder against competing similar users and later against competing new or different water users.

Naturally, those who hold water rights wish to continue to hold them especially when they are likely to appreciate in value. It follows then, that they also wish to maintain those legal values and practices which act to protect existing rights.

We are frequently told that political institutions and legal practices rigidify and constrain the whole process of water development and allocation. The actuality is that factors which constrain one group may protect another group; what appears to be "rigidity" to some persons

will be stability to others.

In similar vein, it is said that political and legal institutions "lag" behind societal changes and technological advances. Thus a National Academy of Sciences publication states:

> Legal, political, and administrative institutions, essential to the orderly conduct of society, evolve in response to the pressures of changing values and changing conditions. This lag, which lengthens as social and technologic change accelerates, is nowhere more obvious than in the water-resources field.[3]

If we accept the statement that a lag does exist, we should add that it exists because politically influential groups desire that the lag continue. In the words of Irving K. Fox,

> It is abundantly evident to those working in the water resources field that the configuration of forces tending to maintain the status quo on water resources policy are enormous.[4]

The Politics of Technological Encouragement

One of the major inputs of the political water system has been the demand that government encourage and subsidize research and innovation in water development. While some such research has been funded by local industries and governments, the most common demand has been for Federal support of water research.

This situation is not peculiar to the United States. Water short areas in other parts of the world have made similar demands on their national governments and on foreign governments and international organizations.

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[3]Committee on Water of the National Research Council, Water and Choice in the Colorado Basin, National Academy of Sciences Publication 1689, Washington, D.C., p. 96.

[4]Irving K. Fox, "Policy Problems in the Field of Water Resources," Water Research, edited by Allen V. Kneese and Stephen C. Smith (Baltimore, Maryland: The Johns Hopkins Press, 1966), p. 287.

Demands for the subsidization of water research are explained and rationalized, in part, on the grounds that they aid in the advancement of science; that unplanned "spin-off" benefits are almost certain to occur; and that resultant breakthroughs will increase national income.

Efforts to increase quantity or improve quality of water through research is ordinarily a politically viable method because no influential group is likely to be injured directly; the costs are widely distributed throughout the society; and threats to existing water rights are likely to be minimal--at least in the short run.

The Importation of Water

Perhaps the most dramatic input into the water system has been the demand for the importation of water. As the technology of storing and moving water has advanced, demands have grown for larger quantities of water and its transportation over greater distances. Ordinarily such demands have been justified in terms of averting or solving a water crisis, adding to national income, or both.

The Authoritative Decision Making Center

As the number of governmental decisions to be made has increased, the decision making process has naturally become specialized. So there is in actuality, not one, but several authoritative decision making centers. Each of these specialized decision making centers is ordinarily composed of elected representatives, administrative officials, and interest group executives who all have a particular interest in the same activity and/or area. The specialized decision making centers have available to them the services of even more specialized experts, technicians, and scientists.

Ordinarily, the policy proposals of a specialized center are accepted by the other specialized centers and become public policy for all the publics. The members of each specialized center are not representative of the general public but they do, in effect, make policy for the general public as long as their decisions do not exceed the limits of public tolerance. Stated differently, the general public and/or other specialized centers may have a veto over policy decisions of a given specialized center. This veto power exists not only after the fact but before a decision is made policy planners must take into account what the public and other specialized centers will tolerate.

Authoritative decisions on water policy are made by several such specialized centers. These water centers may be competitive or they may complement each other, depending upon the issue. It is also fairly common for the same person to be a member of more than one such center.

We cannot examine here the intricacies of the decision process within each water decision center except to note that members will attempt to advance the objectives of their constituents within the limits of their conception of public acceptability and in consideration of the extraneous influences that may be exerted upon them. These influences (extraneous to the center) may affect their behavior with reference to water. Thus support for a gun control measure might be traded for support of a water proposal. We should add that the limits of public acceptability may be extended through the use of such devices as benefit-cost ratios and multiple-purpose impoundments.

The Outputs

The outputs of the decision centers are policy changes or decisions not to change existing policy. We should note that policy decisions are never neutral: somebody gains, and somebody loses, or conceivably everyone gains or everyone loses. A policy decision determines who gets what and who pays for it.

Policies which concern political and legal institutions for water allocation change slowly. Even if the decision centers privately agree that such institutions are overly-rigid and lagging, the costs of change in terms of public acceptance will ordinarily be considered to be excessively high. Technological innovation or water importation are much preferred as methods for alleviating water shorages because they may not require changes in basic methods for allocating water rights.

Policies which encourage technological innovation and water importation will attempt to concentrate the benefits and diffuse the costs. By this method, supporters can be mobilized and dissenters (or potential dissenters) discouraged and dispersed. In such instances the "critical mass" will be supportive.

If water importation encounters opposition, it is not likely to be based on technological inability, high cost or negative benefit-cost ratios: it is more likely to be based on the reluctance of the losing areas to give up their water. As an alternative to giving up water, these areas will ordinarily favor the subsidization of research to increase efficiency in water use, water conservation and reuse, de-salinization methods and weather modification.

The Feedback

The importation of massive quantities of water, the increasing feasibility of recycling and reuse, weather modification, and other advances in water technology will produce significant changes in the environment. Some of these changes will be:

1. Rapid growth of oasis communities.
2. Intensification of the problems of population concentration.
3. The development of new uses (and demands) for water.

Rapid Growth of Oasis Communities

When an oasis community receives a substantial input of additional water it will ordinarily grow rapidly. The process of rapid growth creates problems, especially for government, roughly in proportion to the rapidity of the growth. The urgent need for new schools, hospitals, roads, utilities and other public services will generate new demands on the political system.

Intensification of the Problems of Population Concentration

In some discussions of the problems of people in arid and semi-arid regions we have been concerned with what has been called the "social costs of space (distance)". These are real and serious problems for the people in the hinterlands but the people in large oasis communities have a different set of problems which might be characterized as the "social costs of population concentration". The very act of congregating large numbers of people into restricted geographical areas creates problems that do not appear among more dispersed populations. Some of the more obvious problems created by congestion include: health hazards, waste removal,

water distribution, law enforcement, housing, inter-urban transportation and traffic control, recreation, and fire hazards. It has been said that the major problems of the United States are urban problems. In over-simplified terms, one can say that additional inputs of water to oasis communities create additional urban problems which, in turn, generate additional demands upon the political system.

The Development of New Uses for Water

New industrial processes and products will continue to accelerate the demand for water and some of these processes make the re-use of water more difficult. Increased affluence and the rising expectations of people create greater demands for water for domestic use and for outdoor recreation. The greater and more varied the uses of water, the more serious will become problems of water pollution. As the number of uses for water increases, we can expect that conflicts over water will rise roughly in the same proportion.

An affluent society is not only a society with high consumption rates--it is also a society with high expectations. When these expectations are frustrated, additional demands are placed upon the political system.

Summary

The principal outputs of the water decision centers are maintenance of the status quo with regard to political institutions and legal practices; the encouragement of technological innovation; and the importation of water into areas of scarcity. These outputs will change the environment of oasis communities by causing rapid growth, creating

problems associated with congestion, encouraging the development of new industrial uses for water, raising living standards with consequent additional consumption of water for domestic and outdoor recreation use.

This new environment can then be expected to generate new and additional demands upon the political water system.

CHAPTER IV

WATER: CHARACTERISTICS, CONCEPTS, AND LEGAL DOCTRINES

Characteristics of Water

The Hydrologic Cycle and the Total Water Supply

The amount of water in the world is apparently fixed and finite. The total supply does not increase or decrease as a result of uses by man. Through the hydrologic cycle, water evaporates from water bodies, ground surfaces, snow, and from plants and animals. This water vapor eventually condenses and falls to the earth's surface again in the form of rain or snow. Water is therefore a renewable resource in the sense that, through the hydrologic cycle, it can be reused an infinite number of times. On a worldwide basis, it follows that there can be no such thing as a waste of water.

However, the uses of water by man are "site specific." Water is needed at particular sites and at particular times to be of maximum value. The rain that falls upon the oceans or the snow that drifts down on the polar ice-caps has little immediate value to people---at least at the present stage of the technology. Most of the water on the earth's surface is seawater; some estimates run as high as ninety-seven percent of the total. An estimated three-fourths of the fresh water is frozen into polar ice-caps and glaciers. Most of the rest of the fresh water is in underground aquifers and much of that (with current pumping methods) is too deep to tap. That leaves the

surface waters of rivers and lakes as the principal source of useable supply plus rain and snow if it falls at the "right" place and at the "right" time.

By the year 2000, the population of the world is expected to pass the six billion mark. To survive, these six billion people will have to drastically expand industrial and agricultural uses of water. In the meantime the total supply will remain unchanged.

Uneven Distribution of Precipitation

It is no news that precipitation is unevenly distributed. If we use gross state averages, Nevada is lowest of the forty eight contiguous states at nine inches per year and Louisiana is highest with fifty-five inches. Precipitation in the Rocky Mountain states is lower than in any other major region of the United States. Average annual precipitation for each state in the Rocky Mountain area is listed below.

State	Inches
Arizona	14
Colorado	17
Idaho	18
Montana	15
Nevada	9
New Mexico	15
Utah	13
Wyoming	14

Only North and South Dakota, among the other states, falls into this arid or semi-arid category with seventeen and nineteen inches of precipitation respectively.[1]

From the perspective of individual states, the differences in precipitation may be even greater. Most of the rain and snowfall in California occurs in the central and northern parts of the state while the annual rate in the south ranges from near zero to twenty inches. The greatest contrast among the contiguous states may be in the state of Washington which has highs of over 100 inches per year on the Olympic Peninsula and lows of ten inches in the east central part of the state. Colorado, Idaho, and Montana receive greatest concentrations of moisture in the mountains with ten inches or less in some plains areas.

Uncertainty of Precipitation

The foregoing section set out gross averages of precipitation over time. Such averages are of minimal value in forecasting the precipitation for a particular future year. In addition to sharp fluctutations from year to year, there may also be substantial fluctuations within a given year. In Colorado, perennial news items concern either floods or droughts.

On a worldwide scale, the amount of precipitation is highly predictable but for any given site it is considerably less predictable. The term "site" can be used to denote a specific and restricted area such as the Weather Bureau in a particular city or it can be used with reference to a large region. Ordinarily, the more specific the site, the greater will be the variation in precipitation. Nevertheless, considerable variation does occur over large regions from

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[1]Geraghty, Miller, Van Der Ledeen, and Troise, Water Atlas of the United States, A Water Information Publication, 1973.

one season to the next. As an example, the Colorado River, which drains most of the southwestern part of the United States, had a variation in flow during the period 1922-1972 from a high of 21,428,000 acre feet in 1929 to a low of 5,640,000 acre feet in 1934. That means that the whole drainage basin had considerable variation in precipitation.

This unpredictability has led to the need to create storage facilities to regulate the water available from season to season and also for different periods within the same season. Another advantage of storage is to prevent, or reduce, damage from floods. Water storage can be accomplished both "naturally" and "artificially." Natural storage takes place in the snow packs of the mountains and in the soil. The greater the vegetative cover, the greater the ability of the soil to retain water or to slow the rate of runoff. As forests have been cut down, range lands depleted and soil compacted, natural storage capabilities have been sharply reduced. Within limits, natural storage can be replaced (and sometimes improved upon) by artificial storage. Artificial storage usually involves the construction of a dam and storage area (reservoir).

In earlier times, many individuals constructed small dams for irrigation or stock watering purposes. Some of these dams are still in existence and operational. However, most of the artificial storage that exists today has been constructed by some agency of government. Generally, the large dams have been constructed by the Federal government with the smaller dams being built by city governments or by water districts of some sort. In addition, the Soil Conservation Service has, through cost sharing provisions, aided in the construction of an incredible

1.7 million small storage reservoirs.[2] We should also mention that some "artificial" storage is accomplished by recharge of underground aquifers. Is seems likely that such storage will increase in the future.

We have noted that most artificial storage facilities have been constructed by government or with the aid of government. This has occurred because (1) Few individuals or private firms had the capital to construct the larger impoundments; (2) Amortization of the initial costs ordinarily required a longer time period than private investors considered attractive; (3) Some benefits such as flood control, fish and wildlife values, and outdoor recreation generally, were difficult to evaluate and possibly even more difficult to finance by fees or other methods; (4) Since water was considered to be a public good, people were reluctant to place it under the control of private entities. An exception to item 4 was the construction of dams by privately owned power companies. However, the primary purpose of such dams was the production of electric power rather than water storage per se. Furthermore, contruction of such dams required permission of the Federal Power Commission or some other governmental agency.

Private Goods and Public Goods

Goods and services that are highly separable and homogeneous can be freely exchanged in the market and can be thought of as private goods.

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[2]Phillip O. Foss, Federal Agencies and Outdoor Recreation, (Washington D.C.: U.S.G.P.O., 1962), p. 18.

According to Vincent Ostrom,

> Such goods and services can be packaged, contained and measured in discrete units and can be exchanged under circumstances where the potential buyer can be excluded from enjoying the benefit unless he is willing to pay the price. Such commodities should also meet the condition that their consumption fully excludes anyone else from enjoying the good. Goods which are fully separable and are subject to exclusion in possession, in exchange and in consumption can be defined as purely private goods.[3]

A public good, on the other hand, cannot practically be divided or packaged, is not the exclusive possession of any particular individual or firm, is likely to originate from a common pool, is sometimes considered to be vital to the health and welfare of the people, and may be in the nature of a natural monopoly. These characteristics make it difficult or impossible for such goods to be bought and sold in the market place. Water has some of the characteristics of both a private good and a public good. This, incidentally, is the basis for the continuing controversy as to whether or not water should be more closely controlled (as a public good) or be allowed to move more freely (as a private good) in response to market forces.

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[3]Vincent Ostrom, Institutional Arrangements for Water Resource Development, (Arlington, VA: National Water Commission, 1971), p. 9.

Water as a Private Good. Water meets some of the criteria of a private good because a given amount can temporarily be the exclusive possession of the owner of a water right. Such possession excludes other potential users during the period of temporary use. Water cannot practically be contained or packaged (as discussed below) but it can be "measured in discrete units." This ability to be measured makes it possible to transfer rights to specified amounts of water. In a strict sense, very little water meets the requirement of homogeniety but some classes of water are homogeneous enough in quality so they can be used for certain specified uses. Thus irrigation water may be considered to be suitable for irrigation purposes in different areas if the same crops are to be produced. The same irrigation water may also be suitable for some industrial uses. Furthermore, low quality irrigation water may be improved by various methods so that it may be used for other purposes which demand a higher level of quality. This relative homogeniety and the existence of economical methods (in some cases) for improving quality also tends to put water into the category of a private good.

Water as a Public Good. Like air, water is required by everyone and, in that sense, must be considered as a public good. Since precipitation is free (except for cloud seeding techniques) the public generally assumes that water should also be free except for transmission costs. The combination of these two concepts has resulted in an almost mystical belief that water is a God given right.

Since precipitation is free, water is considered to be owned by the public as far as such ownership is possible. A typical statement

of this concept appears in the Colorado statutes, "All water originating in or flowing into this state, whether found on the surface or underground, has always been and is hereby declared to be the property of the public, dedicated to the use of the people of the state, subject to appropriation and use in accordance with law."[4]

As we have noted, commodities that are bought and sold in the market ordinarily can be packaged into separate and discrete units. Even land is "packaged" in the sense that it is divided into acres, lots, or other units. Water cannot really be packaged. It can be temporarily stored in reservoirs, tanks, or even bottles, but as soon as it is released from the storage unit--it moves. To put it another way, water can be used by individuals but it cannot practically be owned. Thus no one can hold title to water but only the right to use it.[5]

In the process of using water, it is not consumed in a literal sense. Even water that evaporates is not "gone"; it will condense eventually and fall in some other place.

Water tends to be a natural monopoly in the sense that it is ordinarily impractical to have more than one supplier in a given area. It would be ridiculous for a city, for instance, to have several water companies each one with its own set of water mains, storage reservoirs and so forth from which the water user could choose. Such a situation would increase the price of water rather than decrease it as competition is presumed to do.

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[4]Colorado Revised Statutes, Ch. 1, Art. 2, Sect. 1.

[5]See Vincent Ostrom, Institutional Arrangements for Water Resource Development, op. cit.

Water retailers (municipalities, smaller irrigation companies) sometimes may have some choice of wholesalers or suppliers but, when that occurs, the choices are likely to be severely limited.

A private water supplier in a monopoly position could be expected to set water prices at a level calculated to maximize profits. Under the concept of water as a public good, however, prices are kept near the cost of distribution and, in some situations, water is provided below cost with the loss being recouped from other revenue sources. In some municipalities, for instance, water deficits may be paid by the sale of other utilities. The construction of dams by the national government, in most cases, constitutes a subsidy to the using area whether the construction costs are reimburseable or not.

All water is derived from a common pool. The size of the pool may vary (and usually does) but all users, and for whatever purpose, make withdrawals from this common pool. That being the case, there is no reason for any person or firm to conserve water or put it to its most beneficial use because each user knows that, if he does not use it, someone else will or it will remain unused. Consequently, water is commonly misused or inappropriately used, even in the most arid regions, unless water systems are placed under mandatory quantity controls or some other institutional device is used to enforce water conservation.

The common water pool is analagous to the grazing commons. In the old grazing commons of the West, there was no incentive for any stockman to conserve the range because he knew that someone else would use any grass that he left. As a consequence, western range lands were overgrazed with resultant deterioration of the range resource. This process, incidentally, has been repeated over and over again throughout the world

since before the beginning of recorded history.[6]

Since water has many uses, the concept of the common pool is especially significant. Water is used by humans and livestock for drinking, by industry in a rapidly growing number of ways, by farmers for irrigation, by fish and wildlife, by outdoor recreation enthusiasts of various kinds, and for navigational purposes. Some of these uses are compatible; many of them are not. Unrestricted use of the common pool by industry or irrigators may impair or destroy the value of the water pool for human and livestock consumption, for fish and wildlife, and for outdoor recreation generally. That being the case, numerous technical and institutional devices have been developed to control, maintain, or improve water quality. Other technical and institutional innovations have been developed to regulate the quantity of water available and to increase that quantity in specific areas. Within limits, water quality problems can be solved or ameliorated by increasing the quantity of water in the common pool.

Non-consumptive uses of water fall most clearly into the category of public goods. Examples include storage of water for flood control and the maintenance of instream flows for fish and wildlife and for navigational purposes. In these cases the benefits are at least potentially shared by everyone but the precise amount of benefit accruing to each person is difficult, or impossible, to calculate.

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[6]See Phillip O. Foss, Politics and Grass, (University of Washington Press, 1960).

Concepts and Legal Doctrines

Most water concepts and doctrines are "judge-made law." However, in many cases, possibly most, the court decision affirmed and legitimatized a commonly accepted practice, procedure, or method. Furthermore, the decisions in the lead court cases have been frequently reiterated in statutory law or in constitutional provisions. This evolutionary process is not peculiar to water law doctrines. The progression from common practices to common law and from common law to statutory law is fairly typical of legal development in many fields.

Water Rights

Since water is derived from a common pool, is difficult to contain or package, is considered to be a public good, no one can own water. He can only own the right to use a specified amount of water. In legal terminology, the owner of a water right has only a usufruct; he does not own any part of the corpus of the water body.

The Riparian Doctrine

The riparian doctrine confers water rights to owners of land contiguous to lakes and streams. This system of water rights is a legacy from British water law which was adopted (and is still used) by eastern states. A riparian right is not created by use nor is it invalidated by non-use. The riparian doctrine protects landowners from withdrawals which would unreasonably diminish either water quality or quantity. Similarly, owners of riparian lands have a right to make reasonable use of the water that is contiguous to their property.

Riparian rights are tied to the land and are transferred with the land. The right of the owner to the waters of a stream is "inseparably annexed to the soil, and passes with it, not as an easement or appurtenance, but as a part and parcel of it."[7] They remain vested with the landowner even if they are not used. Beneficial use is therefore not a condition to continued ownership. Riparian landowners may not exercise their water rights on non-riparian lands.

The riparian doctrine is obviously best suited to humid areas and is noted here mainly for purposes of comparison with the appropriations doctrine.

The Appropriations Doctrine

The appropriations doctrine (sometimes called "prior appropriations doctrine") is based upon the concept that "first in time is first in legal right." Supposedly it grew out of the ancient mining practice of "staking a claim" which meant that the claimant served notice that a mining site had been discovered by him and that it was reserved to him for mining purposes. Such practices were later formalized by the requirement that a description of the claim be filed with the county clerk or recorder or some other appropriate governmental record-keeping unit. Essentially the same practice was followed in disposing of public lands through the preemption acts and the homestead acts. "Squatters Rights" were recognized in the preemption acts and the first person to file on a surveyed tract of land under the homestead acts could, by making certain improvements and fulfilling residency requirements,

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[7] Lux v. Haggin, 69 Cal. 255.390 (1884).

receive title to the property. Another similarity between mining claims, water right claims and land claims is that they all effectuate a transfer from public property to private property.

Actually, there is nothing new or novel about "first in time is first in right." It probably was recognized by primitive peoples long before the dawn of recorded history.

Placer mining required considerable amounts of water so western miners used the same method for obtaining water as they had used to establish mining claims -- they staked a claim to the water they needed. In many cases, the placer mining site was not located in a stream or immediately contiguous to it so the miners diverted water at a higher level on the stream, dug a ditch, and transferred the water to the mining site. Thus was developed a second major concept of the appropriations doctrine: that water could be diverted from a stream and used some distance away without sacrificing the water right. The principle of contiguity, inherent in the riparian doctrine, was thus jettisoned for a more flexible mode of using water. This concept is well stated in an early (1855) California case.

> . . . water was absolutely indispensable, but as such use often necessarily involved the diversion of the water to points at a distance from the stream, from which it could not well be restored to its natural channel, as well as its substantial diminution in quantity and deterioration in quality, it was found that the common-law doctrine governing the right to the use of natural streams was inapplicable.
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> . . .

> However much the legislature has conferred the privilege to work the mines, it has equally conferred the right to divert the streams from their natural channels, and as these two rights stand upon equal footing, when they conflict, they must be decided by the fact of priority, upon the maxim of equity; "He who is first in time is first in right."[8]

If water (and a water right) could be moved away from the stream of origin, it logically followed that a water right was not tied to any particular parcel of land. Since the water right existed independently of land ownership, sale of land did not automatically include the sale of the water right. Conversely, water rights could be sold without selling land.

Since the appropriations right is based upon the date of filing and/or "reasonable diligence" in diverting the water filed upon, the senior appropriators have first call on the water. They may use all their entitlement even if it means that junior appropriators get nothing. This practice provides maximum security to senior appropriators and obviously makes their right most valuable.

We have noted in a previous chapter that some streams in Colorado (and other western states) are over-appropriated, i.e., appropriations have been filed in excess of normal stream flow. Raymond Anderson explains this phenomenon in the following commentary.

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[8]Irwin v. Phillips, 5 Cal. 140 (1855).

> Although it may seem futile to file for water rights on an already over-appropriated stream, there are good reasons for filing water rights in excess of normal stream flow. These include the hope of capturing an occasional flood flow in order to intermittently irrigate pasture or hay lands; the possibility of abandonment of earlier rights that could make later rights valid; the knowledge that holders of prior rights may not draw their full appropriation during the entire season; and a chance of change in the stream flow regime (including return flows) which could provide water to late rights.[9]

Unlike riparian rights, appropriative rights may be lost by abandonment or non-use because their legal existence is predicated upon beneficial use.

The basic principles of the appropriations doctrine, as distinguished from the riparian doctrine, may be best articulated in the landmark case, Coffin et al. v. Left Hand Ditch Co.

. . .

> It is contended by counsel for appellants that the common law principles of riparian proprietorship prevailed in Colorado until 1876, and that the doctrine of priority of right to water by priority of appropriation thereof was first recognized and

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[9]Raymond L. Anderson, "The Effect of Stream Flow Variation on Production and Income of Irrigated Farms Operating Under the Doctrine of Prior Appropriation," Mimeo, (Fort Collins, Colorado: Colorado State University), Economic Research Service, U.S. Department of Agriculture.

adopted in the constitution. But we think the latter doctrine has existed from the date of the earliest appropriations of water within the boundaries of the state. The climate is dry, and the soil, when moistened only by the usual rainfall, is arid and unproductive; except in a few favored sections, artificial irrigation for agriculture is an absolute necessity. Water in the various streams thus acquires a value unknown in moister climates. Instead of being a mere incident to the soil, it rises, when appropriated, to the dignity of a distinct usufructuary estate, or right of property. It has always been the policy of the national, as well as the territorial and state governments, to encourage the diversion and use of water in this country for agriculture; and vast expenditures of time and money have been made in reclaiming and fertilizing by irrigation portions of our unproductive territory. Houses have been built, and permanent improvements made; the soil has been cultivated, and thousands of acres have been rendered immensely valuable, with the understanding that appropriations of water would be protected. Deny the doctrine of priority or superiority of right by priority of appropriation, and a great part of the value of all this property is at once destroyed.

. . .

We conclude, then, that the common law doctrine giving the riparian owner a right to the flow of water in its natural channel upon and over his lands, even though he makes no beneficial use thereof, is inapplicable to Colorado. Imperative

> necessity, unknown to the countries which gave it birth, compels the recognition of another doctrine in conflict therewith. And we hold that, in the absence of express statutes to the contrary, the first appropriator of water from a natural stream for a beneficial purpose has, with the qualifications contained in the constitution, a prior right thereto, to the extent of such appropriation.
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> . . .
>
> In the absence of legislation to the contrary, we think that the right to water acquired by priority of appropriation thereof is not in any way dependent upon the locus of its application to the beneficial use designed.[10]

Finally, the Colorado Constitution protects the right of appropriation in these unequivocal words. "The right to divert the unappropriated waters of any natural stream to beneficial uses shall never be denied."[11]

Beneficial Use and Priority of Uses

We should note that the above statement from the Colorado Constitution includes the requirement of beneficial use. The Constitution goes on to provide:

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[10] Coffin et al. v. Left Hand Ditch Co., 6 Colo, 443, Supreme Court of Colorado,(1882).

[11] Colorado Constitution, Article XVI, Sect. 6.

> Priority of appropriation shall give the better right as between those using the water for the same purpose; but when the waters of any natural stream are not sufficient for the service of all those desiring the use of the same, those using the water for domestic purposes shall have the preference over those claiming for any other purpose, and those using the water for agricultural purposes shall have preference over those using the same for manufacturing purposes.[12]

This is straightforward and unambiguous language but, as we will see, beneficial use is a slippery concept and subject to differing interpretations and many uncertainties. The appropriations doctrine, wherever it is used, is based upon the principle that water must be diverted for beneficial uses. If we then inquire what constitutes beneficial use, the answers are less clear. Most "appropriation states" list classes of beneficial uses in state constitutions and/or statutes, but such listings do not, in themselves, define the term. As we have noted above, the Colorado Constitution lists beneficial uses (in order of priority) as domestic, agricultural, and manufacturing. Let us examine these categories more closely.

The term "domestic use" was defined with some precision by an 1891 court which stated that the term was to include;

> housing purposes, including water for drinking, washing, bathing, culinary purposes, and the like; water for such

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[12]Colorado Constitution, Article XVI, Section 6.

> domestic animals as are used and kept about the house, such as work animals and cows kept to supply their owners and their families with dairy products; and such other uses, not being either agricultural or mechanical, as directly tend to secure and promote the healthfulness and comfort of the home.[13]

The term "agricultural" use has also been broadly defined by the courts. A frequently quoted court interpretation of the term holds it to mean any "activity incident to the cultivation of land for the growing of crops, the harvesting thereof, and the care and feeding of livestock. . . It includes tillage, seeding, husbandry, and all things incident to farming in the widest sense of that term."[14]

Industrial use or "manufacturing" appears to be the most loosely defined of the three categories -- possibly because it is last in the list of priorities of use. Apparently it includes almost any industrial use.

Let us now return to "domestic use." In practice, domestic use in most instances, turns out to be municipal use. Municipal use includes the uses set out in the Armstrong case quoted above but it also includes street sprinkling, fire fighting, and public swimming pools. More importantly, for our purposes, it also includes lawn watering (an agricultural use) and industrial use. Lawn watering is a form of irrigation and hence could be classified as an agricultural

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[13]Armstrong v. Larimer County Ditch Co., 27 P. 235, 236 (1891).

[14]Billings Ditch Co. v. Industrial Comm'n., 253 P. 2d 1058, 1059 (1953).

use -- which has second priority. Very few cities have separate systems for industrial use so municipal use comes to include industrial use (which has last priority). To summarize, in practice, municipal use has come to mean a combination of domestic, agricultural, and industrial uses plus such public service uses as fire fighting.

Acting on the assumption that municipal use is the equivalent of domestic use, a few cities, through assumed powers of eminent domain, have attempted to condemn agricultural water on the basis that domestic use has higher priority than agricultural use. In light of the above discussion, such actions would appear to be of highly questionable legality.

If we look at the term "agricultural use" more closely, we are forced to ask, "Are all agricultural uses of equal importance to the society and should they all have equal priority?" Obviously this is not the case. If they are not of equal importance, how does one classify them in terms of priority within the category of agricultural uses? Since agriculture has a higher priority than industrial use, can a ditch company condemn water rights owned by an industrial firm and used for industrial purposes?

Are all industrial uses of water of equal importance to the society? Obviously not, but how does one establish priority of uses within the category of industrial uses? Should a manufacturer who produces plumbing fixtures for purely domestic uses have the highest priority?

In the past, the courts have tended to evade these perplexing questions. The statement of the Court in Denver v. Sheriff is typical:

> The term "beneficial use" is not defined in the constitution. What is beneficial use, after all, is a question of fact and depends upon the circumstances in each case.[15]

This ad hoc approach may have been good enough in the past but when water supplies become increasingly scarce and when "push comes to shove" more definite responses will be required.

In addition to the problems outlined above, the legislature enacted into law Senate Bill 97 in 1973. This act specified in part that beneficial use ". . . shall include the impoundment of water for recreational purposes, including fishery and wildlife. For the benefit and enjoyment of present and future generations, 'beneficial use' shall also include the appropriation by the State of Colorado . . . of such minimum flows . . . on natural streams and lakes as are required to preserve the natural environment to a reasonable degree."[16]

Since the Colorado Constitution does not include maintenance of in-stream flows, fisheries and wildlife, or outdoor recreation as beneficial uses, there is considerable doubt as to the constitutional validity of this act. On June 28, 1978 a state district court in Glenwood Springs upheld the constitutionality of the Act. Almost certainly, that decision will be appealed.

If the constitutionality of S.B. 97 is finally upheld or if the Constitution is amended, presumably appropriations for maintenance

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[15]Denver v. Sheriff, 96 P. 2d. at 842.

[16]Colorado Revised Statutes, Chapter 148, Article 1, Section 7.

of in-stream flows will be among the most junior of appropriators. If that is the case, will the law have any real significance?

In summary, while the concept of beneficial use appears at first glance to be a simple and reasonable idea, in practice it will become increasingly difficult to interpret and administer.

Withdrawals, Return Flow and Consumptive Use

The term "withdrawal" is ordinarily understood to mean the diversion and removal of water from a natural water course. Frequently the terms "withdrawal" and "diversion" are used interchangeably.

Return flow is that part of the withdrawn water which is not consumed and which returns to the original, or to some other, water course.

Consumptive use, in simplest terms, is the amount withdrawn minus the amount of the return flow. Water is consumed by evaporation from ground and water surfaces and from snow, by transpiration from plants, by evaporation from animals, and by incorporation into a manufactured product. Water which is absorbed by a closed aquifer (and does not return to the water course) might also be thought of as being consumed.

Consumptive use is "site specific" because, as we have previously noted, water that is vaporized will eventually condense and fall to the earth in the same, or some other, place. So in a macro sense, water cannot be consumed nor can it be wasted. Unfortunately, we are forced to deal in microcosms so the knowledge that water consumed in Colorado may eventually produce rain in Iowa is of small comfort to Coloradoans.

"Crop irrigation" is one of the largest [consumptive] uses of water.

Irrigation accounts for about 35 percent of total water withdrawals and about 83 percent of the water consumed in the United States. Over half of the water diverted for irrigation is consumed through evaporation and transpiration. . . "[17]

> Withdrawals of water by industry account for more than one-half of all withdrawals. Most of this water is used for disposing of heat or other waste, and returned to the stream. Very little water is actually consumed by industry; therefore, use of water by industry primarily affects water quality. Ninety percent of water used by industry is for cooling (principally in steam electric generating plants). Most of the remaining industrial uses are concentrated in five industries: food products, pulp and paper, chemicals, petroleum, and primary metals.[18]

Very little water (as a percentage of the total) is consumed in municipal use. A municipal water system is almost a closed system. During winter, as much as 90% of the water withdrawn may return to the water course. In summer, because of lawn watering, consumptive use is significantly higher. The flow of the South Platte river below Denver is substantially greater at present than it ever was in its natural state because water is diverted from the West Slope, "processed" through the Denver water system and released into the river. From the point of view of West Slope residents, the water is gone so it has been consumed. In a larger sense, most of it has simply

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[17]National Water Commission, Water Policies for the Future, Water Information Center, (Port Washington, New York, 1973), p. 42.

[18]Ibid., p. 43.

been diverted into the Platte river.

Return flows augment the total flow of a water course downstream where they can be diverted and used again. Water which appears to be wasted by excessive irrigation may simply flow back to the stream and be available for diversion and use again. Return flows are ordinarily of lower quality than the "original" water so, even if they augment the quantity in a stream, the quality will be diminished. Thus, the salinity content of the Colorado River increases as the water moves southward -- partly from evaporation but also as a result of return flows. The basic intent of sewage treatment plants is to raise the quality of the return flow after use by municipal water systems. Ordinarily, return flows are subject to appropriation by downstream users.

Water Wastage

Let us note again that, when we speak of wasting water, we are referring to a specific site or a particular area. When water is wasted in a municipal system, most of it goes back into the water-course (below the city) as treated sewage and is available for reuse, so is the effluent from industrial plants and the runoff from irrigated farms.

Nevertheless, we are again dealing with microcosms. A common problem for water managers in a water short area is that they have a limited amount of water to supply a particular city or irrigation district. When the demand exceeds that limited supply, efforts are

made to reduce water wastage. Factors that appear to encourage inefficient use of water include: loose or lax interpretations of beneficial use, perpetuity of water rights, and under pricing of water. The problem of water wastage and possible solutions to the problem will be considered in some detail in a later chapter.

Ground Water

Ground water is that water which exists below the land surface but usually is not understood to include soil moisture and suspended water which is located in the zone of aeration. The total amount of ground water in the United States is thought to be about eight times as much as the total supply of surface water. Obviously, this is a most important resource.

Ground water aquifers are charged, or recharged, by precipitation and by absorption from lakes, streams and other surface water. In previous times, ground water was considered to be the property of the overlying land owner. However, with the development of more efficient pumps and power to operate them, it came to be recognized that ground water rights at a given site could not be unlimited because a "pumper" at one site could deplete or lower the water table for surrounding wells. With high volume pumps, we came to understand that ground water, like surface water, was a common pool resource and that extraction of water by one pumper could reduce the amount available for the rest. Representative Ronald Strahle has noted that the ground water problem is similar to that encountered by several people, each equipped with a straw, who attempt to get a drink out of the same ice cream soda.

In addition, well water operators have come to realize that the level of ground water is related to the amount of surface water in a given area. Depletion of surface water can lower the ground water table and, similarly, pumping of ground water can reduce the amount of surface water. A water well located adjacent to a lake or stream can literally suck the water out if the geologic substructure is sufficiently permeable.

When it became recognized that ground water and surface water were integrally related physically, efforts were made to coordinate their use. The preamble to the Colorado Water Rights Determination and Administration Act of 1969 declares, "It is the policy of this state to integrate the appropriation, use and administration of underground water tributary to a stream with the use of surface water in such a way as to maximize the beneficial use of all waters of this state."[19]

Probably no one would quarrel with this general objective but, as we shall see, accomplishment of the objective is exceedingly difficult.

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[19]C.R.S. § 37-92-102.

CHAPTER V

WATER RESOURCES DEVELOPMENT IN COLORADO

The term "development," as it is used with reference to water, is understood to mean the use of devices and methods by which water is separated in some way from its natural environment for use by man. In this sense, all water systems are man made methods for withdrawing, storing or distributing water. Even the simple action of dipping water from a stream with a bucket is a man made, "artificial" method of withdrawing, storing, and possibly distributing water. Any water development, then, can be thought of as changing the natural environment. There is nothing new or novel about this idea. Man has always tried to improve his immediate environment at least in terms of food and shelter. Probably most animals do the same thing. Rodents, for example, disturb the environment by digging holes in the ground---at least partly for shelter. These remarks are not meant to be a defense of environmental degradation by man. They are simply to explain the meaning of the term "water development" as it is commonly used.

Early History

The historical sequence of water development in the Rocky Mountain States has generally been: first, an emphasis on water for mining; second, water for agriculture; third, water for municipal and industrial use; and, most recently, water for outdoor recreation.

In some cases, the first three phases occurred almost simultaneously but mining was usually the impetus.

Water development in Colorado followed roughly the same pattern except that the very earliest developments were for agricultural purposes. There is evidence that the cliff dwellers constructed irrigation systems ages ago in the Colorado area. The first known attempt at irrigation in Colorado by Europeans was a colony established by the governor of the Spanish province of New Mexico in 1787. This colony was located about eight miles east of the present city of Pueblo. After a year or two it was apparently abandoned. Other early irrigation efforts were initiated by the Bent brothers at Bent's Fort on the Arkansas River in 1832, an enterprise at the present city of Pueblo in 1841, and the construction of the John Hatcher Ditch near the present city of Trinidad in 1846.[1]

Some time later a group of Spanish-Americans moved into the San Luis Valley and built a ditch system known as the San Luis People's Ditch. This ditch ". . . has the distinction of being the oldest ditch in Colorado in continuous use, with a decreed priority date of April 10, 1852."[2] By 1859, at least forty ditches had been constructed in the San Luis Valley. In that year the mining boom hit Colorado. Water was needed in large quantities for both placer and hard rock mining. Since there was no organized government in Colorado at that time, the miners formed mining districts which devised rules for filing mining and water claims and also carried on other basic functions of government.

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[1]A.W. McHendrie in A Hundred Years of Irrigation in Colorado, Colorado Water Conservation Board and Colorado A. and M. College, 1952, pp. 14-15.

[2]G.E. Radosevich, et al., Evolution and Administration of Colorado Water Law: 1876 - 1976, Water Resources Publications, Fort Collins, Colorado, 1976, pp. 3-4.

As we noted in Chapter Two, governmental policy is a continuum in which each policy decision builds on past policy decisions. Established policies have a monentum and an inertia which tends to keep them going in the same direction. If California and Colorado had been organized as states prior to the gold rushes of 1849 and 1859, very likely they would have adopted some variation of the riparian doctrine. However, since there was no organized government, the miners improvised governments and policies to fit their peculiar situation. One result was the development of the appropriations doctrine. Claims filed under the mining districts were later recognized by the territorial government and later by the state government.

Spanish-Americans and other early settlers diverted water from streams during spring and early summer (when the river was high) on to what was actually the flood plain. Such irrigated land was used mainly for growing vegetables and hay.

In 1869, Horace Greeley established the Union Colony which began operation in 1870 and eventually developed an irrigation system of some 30,000 acres. This was the first large scale irrigation enterprise in Colorado. Greeley Canal No. 2 was 36 miles long and 32 feet wide.

After the Civil War, Colorado had a rapid increase in population and also a rapid increase in attempts at irrigated agriculture. By this time, most of the bottom lands along the rivers had been taken up so the new settlers had to establish their farms on higher ground. That meant that they had to move higher up the river to divert water to get a sufficient "head" to irrigate their farms. The days of simply digging a ditch to the river bank and flooding the bottom lands were gone.

Diverting water from higher elevations on the river meant that ditches had to be constructed from the diversion point to the area of use. Ordinarily, these high point diversions and transport ditches required more capital and labor than a single farmer had available. To meet this problem, two or more would-be irrigators pooled their resources and formed mutual ditch companies. The mutual ditch company arrangements were later formalized as corporations. Stockholders owned shares of water and had votes in the corporation in accordance with the number of water shares owned. Shareholders were also assessed the costs of maintaining and operating the system according to the number of shares they owned. Sometimes these assessments were paid off with labor or by the loan of horses and equipment. Naturally, the more shares of water an individual owned, the more water he had a right to use. These mutual ditch companies were not cooperatives in the usual meaning of the term. They were private corporations and had the same characteristics and the same legal standing as other business corporations. Some of these corporations were very small with only a few stockholders while others issued several thousand shares of stock. Many of these old ditch companies are still in existence today.

By the 1880's the demand for water in the most heavily populated areas of Colorado could no longer be met by ditch diversions. As previously mentioned, these diversions were effective mainly when the river was high -- in spring and early summer. To provide a more constant water supply and to more fully utilize the total flow of the river, reservoirs began to be constructed. The reservoirs captured

and held some of the excess water that had not been appropriated and would otherwise flow out of the area of use. Stated differently, the reservoirs supposedly did not injure the senior appropriators who had previously established rights to specified amounts of water.

Reservoir construction, and sometimes still longer ditches, obviously sharply increased capital requirements far above the capabilities of the old ditch companies. Consequently, dams, reservoirs, and major ditches were constructed by Federal agencies, by a municipality or a combination of municipalities, or by one of the more recently formed water conservancy districts.[3]

Federal Assistance in Colorado Water Development

In his annual message to congress in 1873, President Grant recommended that Colorado be admitted to the Union as a new state and that an irrigation canal be constructed from the eastern slope of the Rocky Mountains to the Missouri River. Neither recommendation was acted upon at that time but, in 1877, Congress passed the Desert Land Act. This was the first of the land laws to recognize that an acre of land in the arid West would not produce as much as an acre in the humid East. The Act provided for the sale of plots of 640 acres at $1.25 per acre with the provision that the land be irrigated within three years. According to the Commissioner of the General Land Office, some cattle companies built irrigation ditches from points where no water existed to other points where the topography would have prevented irrigation. Another provision of the Act made it possible to pay a twenty-five cents an acre entry fee, hold the land for three years,

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[3]The above summary of the early development of irrigation systems in Colorado was drawn mainly from an interview with State Representative and Speaker of the House, Ronald Strahle. Any misinterpretation of his remarks is, of course, my responsibility.

and then relinquish it to some friend or partner. Of the total of 32,464,599 acres originally entered under this act, only 8,380,652 acres were actually purchased. It is likely that these eight million acres were key range tracts or were tillable (not desert) lands. Generally speaking, the Act invited fraud and was a failure in stimulating the development of irrigation systems.[4]

The Desert Land Act was an attempt to encourage irrigation in the West through individual enterprise. When that failed, the Congress next tried to promote irrigation through state efforts by the Carey Act of 1894. This act provided that individual states could apply for as much as one million acres of the public domain provided it was "reclaimed" by irrigation in a ten year period. The Carey act was also considered to be a failure. The eligible states were apparently unable or unwilling to invest the funds necessary to develop viable irrigation systems.

In his first message to Congress, President Theodore Roosevelt urged that the Federal governmemt directly undertake the reclamation of the arid lands of the West. A bill introduced by Congressman Newlands of Nevada was finally passed as the Reclamation Act of 1902. We cannot chronicle here the details of the Act or of subsequent amendments except to note that initial funds were to be derived from the sale of public lands and that the costs of irrigation projects were to be repaid to the government by irrigators. Thus would be established, in theory, a permanent revolving fund.

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[4]See Phillip O. Foss, Politics and Grass, University of Washington Press, 1960, pp. 23-24.

One of the first efforts of the new Bureau of Reclamation, and the first in Colorado, was the Uncompahgre project in the west-central part of the state. This project involved the construction of a six mile tunnel which diverted water from the Gunnison to the Uncompahgre river. At that time it was the longest irrigation tunnel in the United States. Total cost of construction was $12,387,000 --- which was a very large expenditure at that time. President Taft officially opened the headgate in September 1909.

The second major Bureau of Reclamation enterprise in Colorado was the Grand Valley project on the Colorado river near Grand Junction. This project was completed in 1917.

Since that time the Bureau of Reclamation has built or assisted in the construction of several major irrigation systems in Colorado.

Major flood control projects built by the Corps of Engineers in Colorado are the Cherry Creek project for flood protection at the city of Denver and the John Martin Dam and Reservoir on the Arkansas river in the southeastern Colorado. The John Martin Reservoir is the largest in the state with a storage capacity of 645,500 acre feet. In addition to flood control, the John Martin Dam provides irrigation benefits which may, in themselves, equal the project cost of some $15 million.

The Cherry Creek Dam and Reservoir is located about six miles southeast of Denver. Its major purpose is to reduce damage to the city from flash floods but it has also become a prime recreation area for Denver residents.

There are more than 1900 storage dams and reservoirs in Colorado

with an estimated total storage capacity of over 4,540,000 acre feet.[5] That's a lot of water! It represents tremendous human effort, large expenditure of dollars, the application of a high level of engineering technology, and the development of institutions capable of administering the water resource.

Transbasin Diversions

The diversion of water from west of the continental divide to the east slope has been, and still remains, probably the most controversial aspect of the development of the Colorado water system.

> "Western Colorado, with 37 percent of the total state land area, has 69 percent of the state's surface water yield; and that part of the state east of the Continental Divide, with 63 percent of the total area, has the remaining 31 percent of the state's surface water resources."[6]

But, as we have previously noted, discrepancies between land area and surface water yield are not the most serious problem: the greatest difficulty arises from the fact that most of the people are on the water-short east slope. Consequently, east slope people have tried to move water eastward across, or through, the mountains.

Apparently, the first transmountain diversion occurred in 1860 when a small ditch was built across Hoosier Pass to deliver water to a placer mine above Fairplay. The first major diversion for irrigation purposes was the Chambers Lake project on the Cache la Poudre river.

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[5]U.S. Department of the Interior, Natural Resources of Colorado, USGPO, 1963, p. 30.

[6]Ibid., pp. 27-28.

This project was completed in 1898. Other diversion projects followed.[7]

During the 1930's, three large trans-mountain diversions were constructed: the Twin Lakes Tunnel into the Arkansas river and the Moffat and Jones Pass tunnels into the South Platte. The Twin Lakes diversion was to provide 50,000 acre feet of irrigation water to be used on farms along the Arkansas. The undertaking was financed by the Reconstruction Finance Corporation. The Denver and Salt Lake Railroad had completed the pioneer bore of the Moffat tunnel in 1929. This tunnel was leased by the Denver Water Board which completed construction on it by 1938. The Moffat tunnel was supposed to provide 28,800 acre feet of water per year. While construction was proceeding on the Moffat tunnel, the Denver Water Board was also constructing the Jones Pass tunnel which diverted water from the Williams Fork of the Colorado to Clear Creek, a tributary of the South Platte. This tunnel was completed in 1940 and diverted an estimated 10,000 acre feet of water per year to the city of Denver.[8]

The Colorado-Big Thompson Project

One of the larger irrigation projects constructed by the Bureau of Reclamation was the Colorado-Big Thompson. The original ideas for such a project apparently came from citizens in Weld and Larimer counties. The drouth of the early 1930's stimulated demands for more irrigation water and the continuing fear that California and Arizona might establish claims to more Colorado River water than was allowed

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[7]George J. Bancroft, "Diversion of Water from the Western Slope," Colorado Magazine, September 1944, p. 179.

[8]Donald Barnard Cole, "Transmountain Water Diversion in Colorado," The Colorado Magazine, March 1948, pp. 59-60.

in the Interstate Compact of 1922 also encouraged Coloradoans to attempt to use as much of the upper Colorado as was permitted under the Compact. The old adage, "Use it or lose it," applied to individual appropriators so, conceivably, it could apply to states as well. For these, and other reasons, individual citizens, chambers of commerce, newspapers, farm organizations, and county and city governments pressed for the construction of a massive irrigation system which would transfer water from the west slope to Northeastern Colorado.

Various schemes were tried to obtain funding but were unsuccessful--partly because of opposition from west slope residents. Congressman Edward Taylor, from the West Slope and one of the most influential members of Congress, opposed the proposed project initially. West slope residents were finally placated with a plan which provided that the Green Mountain Reservoir (with a capacity of 150,000 acre feet) would be constructed first and at no cost to west slope people. With this concession, Congressman Taylor agreed to support the plan. To make a long story short, the project was eventually approved (1937) and funded by Congress with the Bureau of Reclamation as the construction agency. Actual construction was begun in 1938.[9]

The distribution of water in the Platte River area was to be administered by the Northern Colorado Conservancy District which was established by the state legislature in 1937. The District was also responsible for repayment of $25,000,000 to the Federal government with

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[9]William R. Kelly, "Colorado-Big Thompson Initiation, 1933-1938," Colorado Magazine, January 1957, pp. 66-74.

the balance of the construction cost to be repaid, hopefully, from power generation revenues.

An important provision of the Act authorizing the conservancy district was a clause designed to protect the West Slope:

> Any such works or facilities shall be . . . constructed and operated in such manner that the present appropriations of water, and in addition thereto prospective uses of water . . . within the natural basin of the Colorado River . . . from which water is exported, will not be impaired nor increased in cost at the expense of the water users within the natural basin.[10]

It should be noted that this restriction applied only to conservancy districts. It did not include transmountain diversion efforts of municipalities.

The project was substantially completed in 1945 with a predicted annual diversion of about 320,000 acre feet of water annually. According to the Northern Colorado Conservancy District, average flow from 1957-76 has averaged 339,533 acre feet.[11] The diversion involved construction of the thirteen-mile Alva B. Adams tunnel through the Continental Divide.

Denver Transmountain Diversions

We have previously noted the construction of the Moffat Tunnel in 1938 and the Jones Pass tunnel in 1940. The last big trans-mountain

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[10]CRS 37-45-118 (1)(b)(iv).

[11]Northern Colorado Water Conservancy District, Annual Report, 1977, p. 7.

diversion by the Denver Water Board was the completion of the Roberts Tunnel Collection System in 1963. This project roughly doubled the Water Board's storage capacity. In brief, water is collected in Dillon Reservoir, which has a capacity of 254,000 acre feet, and is then moved to the South Platte watershed through the twenty-three mile Harold D. Roberts Tunnel. This may be the last trans-mountain tunnel for the City of Denver. The next planned diversion involved collection of water in the Eagle-Piney area and transfer by gravity flow to Dillon Reservoir. This plan was apparently squelched when the Eagles Nest Wilderness was created in 1976.[12] The boundaries fixed for the Wilderness Area means that water will have to be diverted at points farther downstream than originally planned and then pumped back up to the Dillon Reservoir.

The Fryingpan-Arkansas Project

The last major trans-mountain diversion was the Fryingpan-Arkansas project which was authorized by Congress in 1962. The project involves Ruedi Dam and Reservior, Sugar Loaf Dam and Pueblo Dam. The primary benefits of the project are irrigation in the Arkansas Valley and additional municipal and industrial water for the city of Pueblo.[13]

* * *

It seems unlikely that any further major transmountain diversions will be attempted in Colorado in the foreseeable future. In 1969, the

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[12] P.L. 94-352, 90 Stat. 870 (1976).

[13] H.R. Doc. No. 130, 87th Cong., 1st Sess. (1961), and Bureau of Reclamation, Final Environmental Statement, Vol. 1, April 16, 1975, USGPO, Washington, D.C.

Colorado Water Conservation Board resolved that it would not approve any additional transmountain diversions, financed with Federal funds, until the total water requirements of the West Slope had been determined.[14] Determination of total water requirements is exceedingly difficult to accomplish and subject to great differences in opinion and differences in analysis of data available. For the present, at least, Federal funding seems unlikely so the question may be moot.

It also seems unlikely that the West Slope will voluntarily give up any more water unless compensating amounts of water are supplied to it in some manner. Environmental groups are also likely to oppose further transmountain diversions. Forest Service ownership of lands along the Continental Divide may impede acquisition of rights of way. Finally, under provision of a 1973 act, the Colorado Water Conservation Board has filed applications for instream decrees on the West Slope which will substantially decrease the amount of water available for intermountain diversions. According to Raphael J. Moses, ". . . the day of major transmountain diversion of water in Colorado has passed . . . . Any one (of the problems listed above) is probably enough. The combination is overwhelming."[15]

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This chapter has outlined the history of the physical development of the water resources of Colorado. A separate chapter will consider interstate conflict and cooperation in the development of the Colorado water system.

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[14] Minutes, Colorado Water Conservation Board, April 1969.

[15] Raphael J. Moses, "Transmountain Diversions of Water in Colorado," in Ved P. Nanda, ed., Water Needs for the Future, (Boulder, Colo.: Westview Press, 1977), pp. 105-111.

CHAPTER VI

INTERGOVERNMENTAL RELATIONS

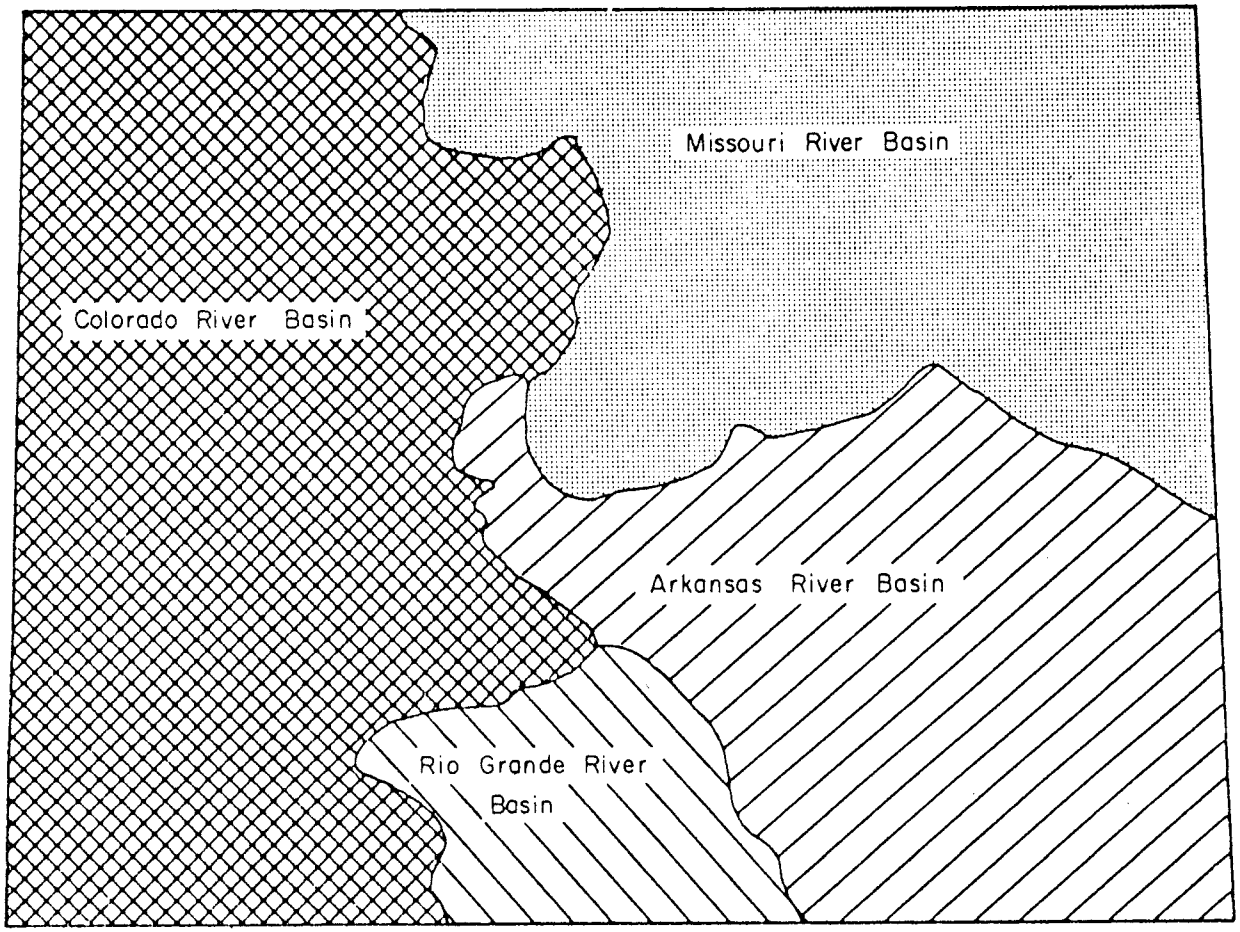
AFFECTING COLORADO WATER RESOURCES

Four major river systems originate in Colorado - the "highest state." These rivers are: the Colorado which flows in a southwesterly direction into the Gulf of California; the Arkansas runs southeast into Kansas, and east to the Mississippi; the South Platte flows northeast into Nebraska, joins the North Platte and eventually the Missouri; and the Rio Grande which flows south into New Mexico and finally into the Gulf of Mexico.

In addition, Colorado is the source of several minor drainage basins: the North Platte, Laramie, Republican, San Juan, Animas, White and Yampa rivers. No river of any size flows into Colorado except the Green River that flows in and out again. It is estimated that between 10 and 11 million acre feet flow out of the state each year and none flows in.

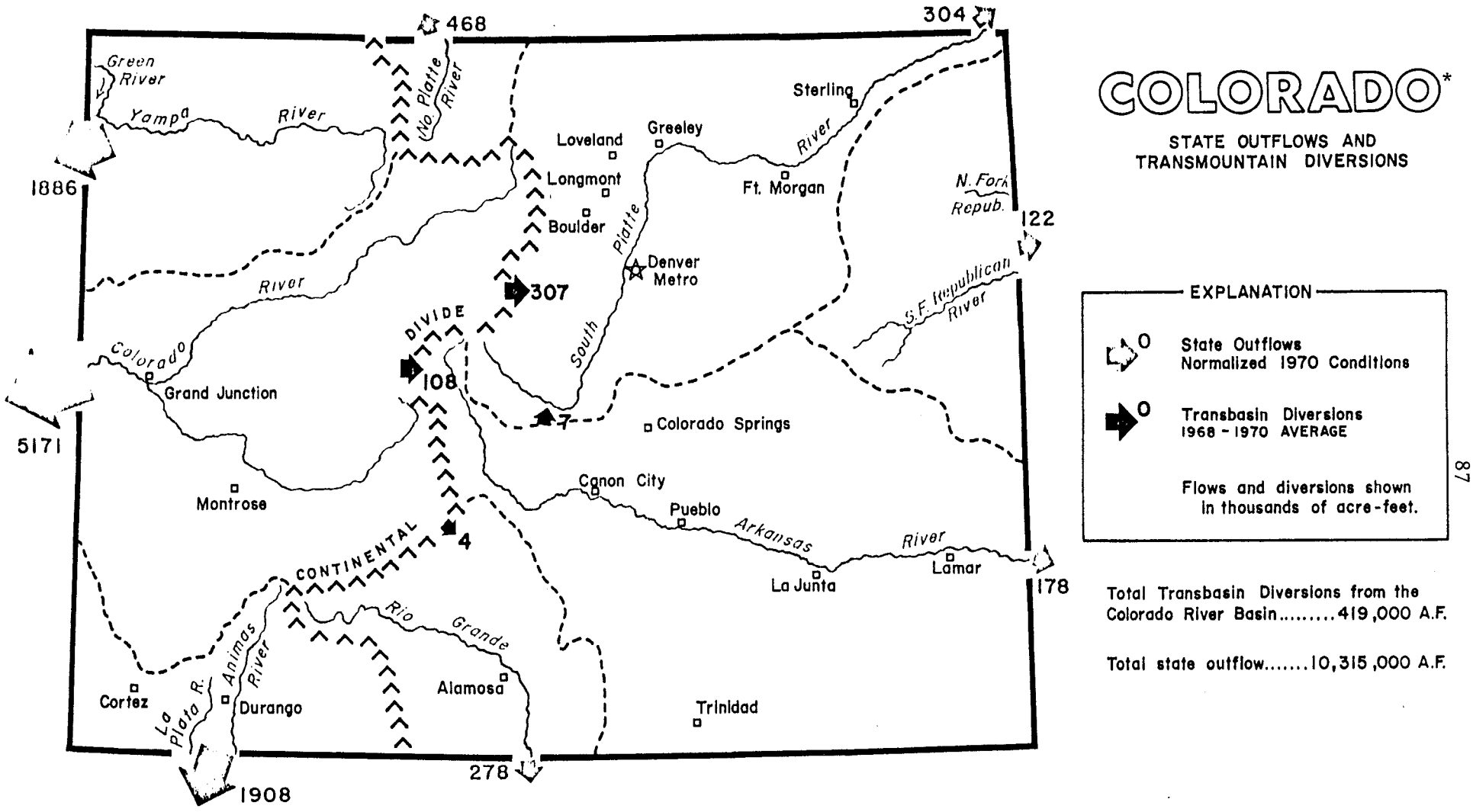
Given this situation, Colorado has tried to hold on to as much of its water as possible while other downstream states have naturally tried to get what they believed was their fair share of water originating in Colorado. These intergovernmental conflicts over water extend back in time to the beginning of the century.

In this chapter we will consider interstate compacts, treaties and agreements with Mexico, interstate adjudications, and finally, the Federal Reserve Doctrine as it applies to Colorado. In each of these



Colorado's major river systems.

Source: Walker, Ward, and Skogerboe, Evaluation of Urban Water Management Policies in the Denver Metropolitan Area, Fort Collins, Colorado: Environmental Resources Center, Colorado State University, 1973.



*U.S. Department of the Interior, Water for Tomorrow; Colorado State Water Plan, Phase I, Appraisal Report, February 1974.

categories we will summarize each event in chronological order since, in most cases, decisions were built upon, or influenced by, past decisions on the same subject.

Interstate Compacts

The constitutional authority for interstate compacts is stated in a somethat negative fashion in Article 1, Section 10 of the Constitution: "No state shall, without the consent of Congress, . . . enter into any agreement or compact with another state. . . ."

Over 200 interstate compacts have been entered into since the Pennsylvania and Virginia Boundary Agreement of 1780.

Felix Frankfurter and James M. Landis spoke approvingly of the concept of interstate compacts in a 1925 article.

> The imaginative adaption of the compact idea should add considerably to resources available to statesmen in the solution of problems presented by the growing interdependence, social and economic, of groups of States forming distinct regions.
>
> . . .
>
> The overwhelming difficulties confronting modern society must not be at the mercy of the false antithesis embodied in the shibboleths "States-Rights" and "National Supremacy." We must not deny ourselves new or unfamiliar modes in realizing national ideals. Our regions are realities. Political thinking must respond to these realities. Instead of leading

> to parochialism, it will bring a fresh ferment of political thought whereby national aims may be achieved through various forms of political adjustments.[1]

> According to Ival V. Goslin,
> A compact is similar in content and form to an international treaty. It is usually embodied in state law as a special document and is enacted in substantially identical words by the legislature of each state. If necessary, it can be enforced by suit in the U.S. Supreme Court, and it takes precedence over an ordinary statute.[2]

Since the formation of the Colorado River Compact in 1922, eighteen water compacts have been entered into which apportion the waters of interstate streams.

The Colorado River Compact

The Colorado River rises in northern Colorado and flows in a southwesterly direction into the Gulf of California. It is one of the largest rivers in the United States but it flows through some of the most arid parts of the nation. This arid condition naturally makes water especially valuable. The history of the arid west has been mainly a history of conflict over water. Much of this conflict has centered around the Colorado River.

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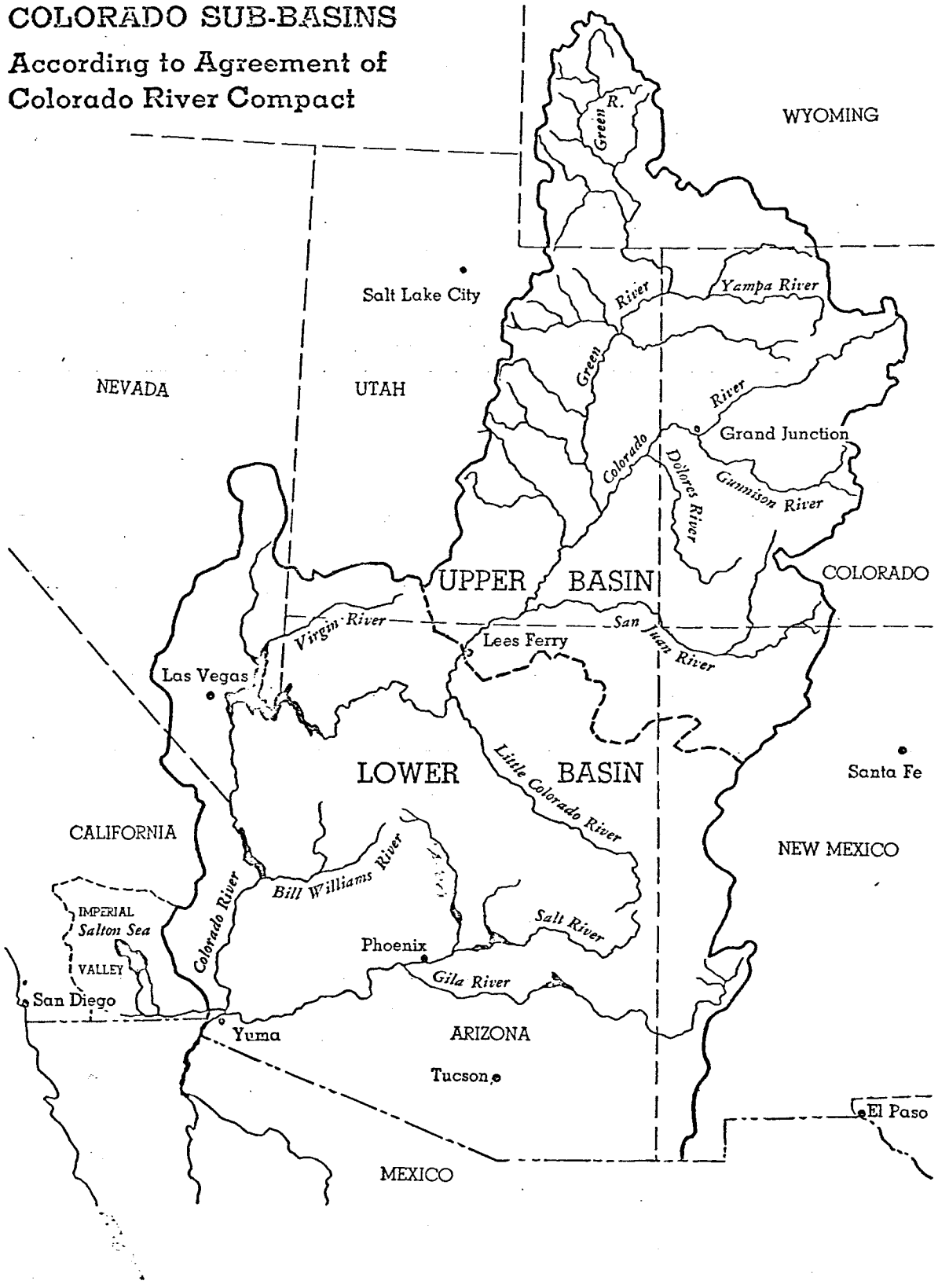
[1] Felix Frankfurter and James M. Landis, Yale Law Review, May 1925, p. 729.

[2] Ival V. Goslin, "The Interstate Compact as an Instrument for Western Water Development," in Ernest A. Engelbert, ed., Strategies for Western Regional Water Development, University of California Press, 1966, pp. 159-160.


COLORADO SUB-BASINS
According to Agreement of
Colorado River Compact
WYOMING
Green R.
Salt Lake City
Green River
Yampa River
NEVADA
UTAH
Grand Junction
Colorado River
Dolores River
Gunnison River
UPPER BASIN
COLORADO
Virgin River
San Juan River
Lees Ferry
Las Vegas
LOWER BASIN
Little Colorado River
Santa Fe
CALIFORNIA
NEW MEXICO
Bill Williams River
IMPERIAL
Salton Sea
VALLEY
Colorado River
Salt River
Phoenix
Gila River
San Diego
Yuma
ARIZONA
Tucson
El Paso
MEXICO

The Colorado River Compact of 1922 divided the flow of the river into equal shares for the upper basin states and the lower basin states. The upper basin was defined as the area which drained into the river above Lee Ferry (near the northern border of Arizona) while the lower basin consisted of the drainage area below that point. The Compact also provided that, if the United States should grant water rights to Mexico at some future time, the burden of supplying the additional water would be equally borne by the upper and lower basins.

A quick look at the map will indicate that most of the water in the Colorado comes from the states of Colorado, Utah and Wyoming. To oversimplify, in the Colorado River compact, the upper basin states gave away rougly half of their water to the lower basin states. Knowing that human nature presumably has not changed since 1922, how could they have been so generous? Why did they give away so much of the lifeblood of their states? The brief historical summary which follows may help clarify the situation which led to the adoption of the Compact.

As early as 1878, John Wesley Powell wrote of the possibilities for diverting water from the Colorado River to the valleys of California. In 1902 the Reclamation Act was passed which created the present Bureau of Reclamation. One of the first employees of the new bureau was Arthur Powell Davis--a nephew of John Wesley Powell. Davis eventually became director of the Bureau and, throughout his career, fought for a high dam on the lower Colorado. In the meantime, various schemes had been proposed for irrigating the Imperial Valley of California from the Colorado. The Imperial Valley had rich soils but hardly any

rainfall. By 1901 a canal had been built which diverted water from the Colorado just north of the border, ran through 50 miles of Mexico, and then turned north into the Imperial Valley. Eight years later about 160,000 acres were being irrigated and, by 1918, a total of 360,000 acres was being cultivated.

The Mexican-American canal, predictably, was unsatisfactory because of continuing problems with Mexico and because of recurring floods. Consequently, Californians began to press for a canal constructed wholly on the American side of the border. Because of topographical features, such a canal would be much more expensive than the old Mexican-American canal.

While the Imperial Valley was being developed, a group of Los Angeles entrepreneurs bought some 840,000 acres of land in the Colorado delta in Mexico and began to develop it for irrigated agriculture. Imperial Valley farmers feared that development below the border would jeopardize their water supply--still another reason for an All-American canal.

The Bureau of Reclamation was receptive to the construction of such a canal but only if adequate storage facilities were also constructed. Such storage would require building a dam and reservoir on the lower Colorado. Arthur Powell Davis testified that

> If 300,000 or 400,000 acres of additional land is put under irrigation without storage, it will threaten the water supply of the whole valley. Furthermore, he

argued that "If we had complete storage the flood menace would be removed."[3]

A "League of the Southwest" was formed in 1917. The League was originally a booster type organization to bring business into the southwest. However, it included eight states including Colorado. Inevitably, it became involved with water development and water rights. One of the concerns of the League was the question of the rights of states to the use of the river as opposed to those of the Federal government. In the case of Wyoming v. Colorado (considered in another section of this report) Federal attorneys maintained that "the United States is, and always has been, since the cession of the territories now comprised in those states, the owner of all the unappropriated and surplus waters." In addition, there had been for several years, a question as to whether or not the Colorado was a navigable river. If it was considered to be navigable, it was presumed that the Federal government could control the river under the commerce clause of the Constitution. In view of these considerations, one of the objectives of the League was to minimize Federal control of the river by presenting a united front against such control. At the same time, the League lobbied for Federal support and financing for irrigation projects.

Some representatives of the upper basin states were understandably apprehensive about the attention given to development of the river in the lower basin only and succeeded in getting a resolution passed at a 1919 League meeting which stated, in part, "the greatest duty of water

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[3]House Committee on Irrigation of Arid Lands, Hearings on All American Canal in Imperial and Coachella Valleys, California, H.R. 6044 and H.R. 11553. Quoted by Norris Hundley, Jr., Water and the West, (University of California Press, 1975), p. 45.

is had by first using it upon the upper reaches of the stream, continuing its use progressively downward." Bureau of Reclamation engineers, however, repeatedly insisted that, with proper storage facilities, there was plenty water for everyone. Coloradoans were apparently not completely convinced. At a 1920 League meeting, Governor Shoup of Colorado warned, "It is no time . . . for the Western States holding the headwaters . . . to lose any of their rights for any reason whatever."

Article I of the U.S. Constitution provides, in part, "No State shall, without the Consent of Congress, . . . enter into any Agreement or Compact with another state. . . ." Delph Carpenter, a Colorado lawyer, came to believe that the best protection for the upper basin states lay in the formation of an interstate compact governing rights to waters of the Colorado River. Such a compact, when approved by Congress, would also reduce the possibilities of Federal "interference" in allocating Colorado River water.

At a meeting of the League of the Southwest in Denver in 1920, Carpenter succeeded in getting a resolution passed which provided, in part, that the seven basin states are "requested to authorize the appointment of commissioners . . . for the purpose of entering into such compact . . . for subsequent ratification . . . by the Legislature of each of said states and the Congress."[4] The resolution passed and the governors of the basin states proceeded to appoint individual

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[4]Quoted by Norris Hundley, Jr., Water and the West, (University of California Press, 1975). pp. 107-108.

state commissioners to represent their respective states. Delph Carpenter was appointed to be the commissioner from Colorado. President Harding appointed Herbert Hoover (then Secretary of Commerce) as the representative of the Federal government. Hoover was elected to chair the Commission.

We cannot chronicle here the months of hard bargaining or the many proposals and counter proposals that were put forward. The Commission simply could not agree on the amount of water that was to be allocated to each state. Another vexing problem was the question of transfer of water out of the Colorado basin. Even if there was enough water in the river to provide for needs within the basin, what about transfer of water out of the basin to Denver and Salt Lake City? During this period, pressure from California continued for the construction of a high dam on the lower Colorado. Upper basin commissioners were not opposed to the dam itself but they feared that it would give California prior rights to more water than they were prepared to give up. These fears were magnified by a Supreme Court decision in June 1922 in which the Court upheld the doctrine of prior appropriation of water without regard to state lines.[5] That decision implied that California and Arizona could claim a major portion of the water of the Colorado by appropriating water before it was appropriated by the Upper Basin States. As Delph Carpenter analyzed the situation:

> The upper state has but one alternative, that of using every means to retard development in the lower state

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[5]Wyoming v. Colorado, 259 U.S. 419 (1922).

> until the uses within the upper state have reached their maximum. The states may avoid this unfortunate situation by determining their respective rights by interstate compact before further development in either state, thus permitting freedom of development in in the lower state without injury to future growth in the upper.[6]

Once having made this decision, Carpenter proceeded to sell the idea to the other members of the Commission. Once the concept of division by basins had been accepted, the commissioners next became involved in an argument over the division of water between the two basins. Bureau of Reclamation figures for the flow of the Colorado at Lee Ferry are reproduced below. We should note that the flow of the Gila River (a tributary of the Colorado) was not included in this tabulation because it entered the Colorado below the monitoring point. By excluding the Gila River, the lower basin states would automatically receive an additional estimated one million (or more) acre feet of water a year if the water was divided equally between the two basins.

Colorado River Flow At Lee's Ferry, 1899-1920

Year	Acre-feet	Percentage of mean
1899	21,700,000	132
1900	16,800,000	102
1901	15,200,000	93
1902	9,110,000	56
1903	11,300,000	69
1904	9,890,000	60
1905	16,000,000	98

[6]R. Wilbur and N. Ely, The Hoover Dam Documents, H.R. Doc. No. 717, 80th Cong., 2d Sess. A84 (1948), as quoted by Ival V. Goslin in "Interstate River Compacts: Impact on Colorado," Denver Journal of International Law and Policy, Vol. 6, Special Issue, 1976.

Colorado River Flow At Lee's Ferry, 1899-1920
Cont'd.

Year	Acre-feet	Percentage of mean
1906	17,700,000	108
1907	24,800,000	151
1908	12,600,000	77
1909	25,400,000	155
1910	14,200,000	87
1911	17,600,000	107
1912	18,200,000	111
1913	11,800,000	72
1914	20,200,000	123
1915	12,900,000	79
1916	18,900,000	115
1917	20,000,000	122
1918	13,100,000	80
1919	11,000,000	67
1920	21,100,000	129

Sources: "Problems of Imperial Valley and Vicinity," S. Doc. 142, 67 Cong., 2 sess. (1922), pp. 2,5; Cong. Rec., 67 Cong., 4 sess. (1923), p. 2714. Extracted from Norris Hundley Jr., Water and the West, University of California Press, 1975, p. 193.

To make a long story short, the Commissioners finally agreed on dividing the flow of the Colorado (calculated at Lee Ferry) equally between the upper and lower basins. This "equal flow" was set at 7,500,000 acre feet for each basin with the additional proviso that the upper basin states could not cause the flow of the river to be depleted more than 75,000,000 acre feet over a continuous ten year period. This provision attempted to recognize the great seasonal variation in flow. The compact also stated that, if any rights were subsequently granted to Mexico, the deficiency would be borne equally by the upper and lower basin states. Note again that the inflow from the Gila was not include in the above figures. The Compact was signed on November 24, 1922.

While it might seem to persons in the upper basin states that they had been robbed of their water, greatest opposition to the Compact came from California and Arizona. By 1927, Arizona had still not ratified

the Compact. To make matters worse, in that year, the Utah legislature repealed its earlier ratification of the Compact. During all these years, California had pressed for a high dam at Boulder Canyon. Such a dam would reduce flood damage possibilities, provide electric power and storage for irrigation. Finally such a bill, the Swing-Johnson Act was passed in 1928--with the proviso that the Compact (now six years old) must be ratified by all seven states or six of the seven to include California. After the now familiar hassles over ratification, all the Compact states agreed except Arizona and the new president, Herbert Hoover, issued a proclamation on June 25, 1929 declaring the Act to be in effect. The Colorado River Compact had finally been approved. After many years of litigation, on February 24, 1944, Arizona also ratified the Compact.

In retrospect it appears that, given the circumstances existing at the time, Delph Carpenter and the upper basin commissioners probably got the "best deal" that was possible.

La Plata River Compact, 1922

During 1922, Delph Carpenter negotiated a second interstate compact -- this time with New Mexico. While the La Plata River Compact was of minor importance compared to the Colorado River Compact, it was of major importance to the parties concerned. In brief, the compact provided:

1. That between December 1 and February 15, both Colorado and New Mexico could have unrestricted use of the La Plata river within their respective states;

2. Between February 15 and December 1, each state was granted unrestricted use of the river within its boundaries as long as the flow rate at the interstate station equaled or exceeded a mean daily flow of 100 cubic feet per second.

On other days, Colorado agreed to deliver one-half of the flow of the previous day at the border provided that one half did not exceed 100 cubic feet per second.

3. "Whenever the flow of the river is so low that in the judgement of the State engineers of the States the greatest beneficial use of its waters may be secured by distributing all of its waters successively to the lands in each State in alternating periods . . . the use of the water may be so rotated. . . ."[7]

The La Plata Compact gave rise to a most important Supreme Court decision in which the appropriations doctrine was, in effect, arrayed against the power of an interstate compact. We will consider this case (Hinderlider v. La Plata River and Cherry Creek Ditch Company) later in this chapter.

South Platte River Compact, 1923

The South Platte Compact (also negotiated by Delph Carpenter) had provisions somewhat similar to the La Plata Compact. From October 15 to April 1, Colorado has full use of the river but, from April 1 to October 15, Colorado must deliver to Nebraska 120 cubic feet of water per second at the Interstate Station. If Colorado

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[7]La Plata River Compact, Art. II, November 27, 1922. The compact was ratified by New Mexico on February 7, 1923; by Colorado on April 13, 1923, and by Congress on January 29, 1925 (43 Stat. 796).

cannot meet this requirement, no diversions from the lower section of the river (in Colorado) may be permitted which have appropriation dates later than June 14, 1897.[8]

We might notice that Nebraska ratified the compact within one week after it was signed but that the Colorado legislature delayed ratification for almost two years.

The proposed Narrows Dam on the South Platte would capture flood waters between the "open" dates of October 15 to April 1.

The Rio Grande Compact, 1938

This compact involved the states of Colorado, New Mexico and Texas and was concerned with minimum flows of the Rio Grande. Colorado agreed to deliver water at the New Mexico state line based upon an index of runoff at four gaging stations in the headwaters area of the river. The compact also provided for schedules of deliveries, the accrual of debits and credits in deliveries, and for the control of storage in some situations. New Mexico was also required to make certain deliveries to Texas.[9]

The Republican River Compact, 1942

Colorado, Kansas, and Nebraska negotiated this compact to divide the waters of the Republican River Basin. The compact, as originally written encountered opposition in Congress and from the

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[8]South Platte River Compact, Art. IV, April 27, 1923. Ratified by Nebraska on May 3, 1923; by Colorado on February 26, 1925; and by Congress on March 8, 1926 (44 Stat. 195).

[9]Rio Grande Compact, March 18, 1938. Ratified by Colorado on February 21, 1939; by New Mexico on March 1, 1939; and by Texas on March 1, 1939. The Compact was ratified by Congress on May 31, 1939 (53 Stat. 785).

President (Franklin D. Roosevelt) on the grounds that the rights of the United States were not adequately protected. After some modifications, the compact was finally approved.

The Compact allocated 54,100 acre feet to Colorado, 190,300 acre feet to Kansas and 234,500 acre feet to Nebraska.[10]

Costilla Creek Compact, 1944 and 1963

The first Costilla Creek Compact was negotiated in 1944 and approved by New Mexico, Colorado and the United States by 1946. This earlier compact was in effect from 1946 to 1963 when the revised compact was signed. Costilla Creek is a small tributary of the Rio Grande which rises in the Sangre de Cristo mountains of Colorado, flows in a general westerly direction and crosses the state boundary three times before it joins the Rio Grande in New Mexico. These physical features obviously create a problem of water allocation between the two states. The Compact attempts to distribute the waters equitably between the users in Colorado and New Mexico.[11]

Upper Colorado River Basin Compact, 1948

The Colorado River Compact of 1922, it will be recalled, divided the Colorado basin states into an upper basin and a lower basin with water delivery requirements for each basin. However, the 1922

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[10]Republican River Compact, December 31, 1942. Ratified by Colorado on March 15, 1943; by Kansas on February 22, 1943; by Nebraska on February 24, 1943; and by the United States on May 26, 1943 (57 Stat. 86).

[11]The amended compact was signed on February 7, 1963. It was ratified by New Mexico on March 21, 1963; by Colorado on March 25, 1963; and by Congress on December 12, 1963 (77 Stat. 350).

compact did not make allocations to individual states respecting their rights to the waters of the Colorado and its tributaries. During the next twenty years, the lower basin consumed rapidly expanding amounts of Colorado river water but the upper basin states did not. Consequently, most of the water of the upper basin states flowed on down to the lower basin and into Mexico. In the meantime, it had become evident that the negotiators of the Colorado River Compact had grossly over-estimated the total flow of the river. That meant that if the upper basin states substantially increased consumptive use of their water, they would not be able to meet their annual Compact delivery requirements of 7,500,000 acre feet of water at Lee Ferry. Consequently, the upper basin states had lobbied for years for Federal funding of detention dams and other works which would allow their economies to expand without jeopardizing their ability to meet Compact commitments. Congress was reluctant to extend such aid, however, until the states could agree on the amount of their respective entitlement from the River.

Colorado had historically contributed 72.18 percent of the flow at Lee Ferry, New Mexico 1.29 percent, Wyoming 10.94 percent, Utah 14.63 percent, and Arizona 0.96 percent. In 1946, the Bureau of Reclamation completed a comprehensive report on the water systems of the upper basin states which included 134 potential construction projects.[12] However, the Secretary of the Interior announced that he would not encourage Congressional authorization for the proposed upper basin projects until the states involved agreed on their respective

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[12]H. Doc. No. 419, 80th Cong., 1st Sess. (1947).

rights to the waters of the basin. Partially as a result of this announcement, the upper basin states moved quickly to form a compact commission. The first formal meeting of the compact commissioners was held in Salt Lake City on July 31, 1946. Because of the intricacies of the problem, an engineering committee was formed to gather data and submit a comprehensive report -- hopefully by January 1, 1947. However, the committee was unable to complete its work until December of 1948.

In some ways the problems faced by the Upper Basin Commission were more complex than those confronting the original compact commission of 1922. Despite the 18 month engineering study, there was disagreement on the data available regarding depletions, evaporation losses, salvage of water, points for gaging stream flows, and other matters. Perhaps most important were differences among the states as to the basic formula or principle for allocating water in the basin. Colorado, naturally, wanted to use state contributions to the flow of the River at Lee Ferry as the basis for allocation. Other states that contributed less water, wanted to consider past and anticipated diversions in determining the formula. The upshot of the many proposals and counter proposals was the following basic formula: Arizona was allocated 50,000 acre feet per year; of the amount remaining, Colorado was to receive 51.75 percent, New Mexico 11.25 percent, Utah 23.00 percent and Wyoming 14 percent. These amounts and percentages refer to the water of the upper basin states that drains naturally into the Colorado river above Lee Ferry.

In addition to apportioning the waters of the Upper Basin among the states, the Compact also established a permanent interstate agency -- the Upper Colorado Basin Commission. In addition to administering the terms of the Compact, the Commission has also assumed a lobbying role to encourage water development in the upper basin states.

The compact was signed at Santa Fe on October 11, 1948 and was subsequently ratified by all the states involved and by the United States.

The Arkansas River Compact, 1948

This compact deals primarily with the apportionment of waters of the Arkansas River incident to the construction and operation of the John Martin Reservoir. The compact also grew out of a desire to settle a long dispute over the waters of the Arkansas that had involved three Supreme Court cases between Kansas and Colorado (Kansas v. Colorado, 1902, Kansas v. Colorado, 1907, and Colorado v. Kansas, 1943).

The main provisions of the Compact follow.

> During the winter storage season (November 1 through March 31) water is to be stored to the capacity of the Reservoir except that Colorado may demand releases not to exceed 100 cubic feet per second. During the summer storage season (April 1 to October 31) Colorado may demand up to 500 cubic feet per second and Kansas may demand up to 750 cubic feet per second.[13]

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[13]The Compact was signed on December 14, 1948. Colorado ratified the Compact on February 19, 1949, Kansas on March 7, 1949, and Congress gave its consent to the Compact on May 31, 1949 (63 Stat. 143).

In all of the interstate compacts summarized above it is apparent that Colorado has given away portions of the water that originates in Colorado. If one assumes that all water that originates in Colorado is the property of Coloradoans, then each compact appears to have been a "giveaway." However, the downstream states have maintained that they are entitled to the uninterrupted flow of the rivers in their natural condition. A further contention among the downstream appropriation states has been that prior appropriations in their states gave them prior rights to water over more junior appropriators in Colorado. Both of these allegations have been supported, at least in part, by Supreme Court decisions. It should also be noted that in earlier times there appeared to be plenty of water on the West Slope to meet immediate needs so there was no pressing reason to try to reserve Colorado water for Coloradoans. Finally, about the only way to "reserve water" in the appropriation states is by a prior appropriation applied to beneficial use. Since Colorado developed later than some of its neighboring downstream states, it could not (in some instances) make that claim.

The Rio Grande, Colorado, and Tijuana Treaty, 1944

The delta of the Colorado, in Mexico, has rich soils but is a desert in its natural state. At the time the Colorado River Compact was being negotiated, much of this land was owned by American entrepreneurs and was irrigated from the Colorado River. During the administration of President Cardenas (1934-1940) these lands were expropriated by Mexico.

The Compact negotiators were aware that an international agreement with Mexico might be possible at some future date as regards any obligations the United States might have to deliver water to Mexico. Generally speaking, the upper basin states would have perferred to ignore this question entirely so that no inference could be made from the Compact that any such obligation existed. In Delph Carpenter's words: "We don't want to put anything in here that can be construed in any way as the slightest admission when it comes to matters of the State Department." Herbert Hoover agreed: "We do not believe they (the Mexicans) ever had any rights."[14]

The lower basin states, however, were fearful that, if a treaty with Mexico ever was negotiated, they might have to bear the full burden of the loss of any water to Mexico. As a consequence of these fears, and after it was decided to allocate the waters of the Colorado according to basins, the Compact contained the following provision: "If . . . the United States . . . shall hereafter recognize in the United States of Mexico any right to the use of any waters of the Colorado River System, such waters shall be supplied first from the waters that are surplus . . . and if such surplus shall prove insufficient . . . then, the burden of such deficiency shall be equally borne by the Upper Basin and the Lower Basin."[15] This provision was to become of major importance to the State of Colorado when a treaty with Mexico

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[14]Minutes of the Colorado River Commission, November 19, 1922. Quoted by Norris Hundley Jr., Water and the West, University of California Press, 1975, p. 204.

[15]Art. III, Colorado River Compact, 1922.

was, in fact, concluded in 1944.

A treaty with Mexico over water rights to both the Rio Grande and the Colorado rivers had been discussed many times since the beginning of the century. Since the treaty of 1944 included both rivers we need to understand something of the situation along the Rio Grande and its impact on the final decisions as regards the Colorado.

The Rio Grande forms the boundary between the United States and Mexico for a distance of about 1200 miles. Eleven hundred miles of this border is below Fort Quitman and is considered to be in the lower basin of the river. Drainage from Mexico amounts to about 70 percent of the water in the lower basin. Texas irrigators had developed some 580,000 acres in the lower basin of the river. The Cardenas administration then began to develop construction works on the Mexican tributaries that would jeopardize Texas irrigators on the other side of the river. Under these circumstances, Texans lobbied for a treaty with Mexico which would protect their rights. They received considerable support from Texas Senator Tom Connally who was then chairman of the Senate Foreign Relations Committee. Negotiations between Mexico and the United States were attempted to allocate the waters of the Rio Grande in 1926, 1929, 1930, and again in 1938. All of them failed because: 1) Mexican demands appeared to be exorbitant; 2) Mexico insisted that both the conflicts over the Rio Grande and the Colorado be negotiated in the same "package"; 3) and there was considerable resentment in the United States of Mexican expropriation of American properties in Mexico. Californians generally opposed a treaty which would include provisions regarding the Rio Grande where Mexico appeared to have a better case

than it had as regards the waters of the Colorado. The water supply situations on the two rivers were reversed: the United States supplied all the water that went into the Colorado River while Mexico supplied roughly 70 percent of the water that drained into the lower Rio Grande. California reasoned that a compromise deal involving both rivers would work to their disadvantage and to the disadvantage of all the Colorado basin states. They were right!

An oversimplified version of the 1944 treaty is that the United States received roughly half of the Rio Grande water below Fort Quinlan and, in exchange, granted Mexico 1,500,000 acre feet of Colorado River water per year. Stated differently, Mexico received considerably more water from the Colorado than it gave up to Texas from the Rio Grande. In the words of Clay Elder, hydrographic engineer for the Metropolitan Water District of Southern California, "California was sacrificed on the Alter of Texas and the Good Neighbor Policy."[16] If California was indeed "sacrificed," it could be said that Colorado was also sacrificed because the upper basin states must supply half the water delivered to Mexico (under the Colorado River Compact) and, of that half, Colorado supplies about 70 percent. Oddly enough, Colorado did not oppose ratification of the treaty nor did any of the other Colorado basin states except California.

According to Felix L. Sparks, Director of the Colorado Conservation Board,

> "The actual trigger for the execution of the Mexican Treaty of 1944 was the attack by the Japanese on Pearl Harbor on

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[16]Quoted by Norris Hundley Jr. in "The Politics of Water and Geography: California and the Mexican American Treaty of 1944," Pacific Historical Review, May 1962.

December 7, 1941. This attack produced such hysteria in the United States that it was believed that the Japanese might attempt a land invasion of the United States through either the west coast of the United States or the west coast of Mexico, or both.

. . .

It was therefore the questionable opinion of people in high places that an accomodation with Mexico was necessary in order to permit the employment of U.S. military forces on Mexican soil. . . ."[17]

Secretary of the Interior, Harold Ickes, commented at the time: ". . . we guarantee to Mexico about twice as much water as she was ever able to use before the Department of the Interior built and operated Boulder Dam and thereby evened out the flow of that river between flood and dry seasons. Yet the treaty does not make any charge to Mexico for the Boulder storage. . . ."[18]

In similar vein, Ival V. Goslin, Director of the Upper Colorado River Commission, remarked that:

"One cannot help but speculate upon why politicians representing the United States gave to Mexico a guaranteed annual delivery of twice as much water as had ever been used (750,000 acre-feet) in that country prior to the construction of Hoover Dam by

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[17]Felix L. Sparks, "Synopsis of Major Documents and Events Relating to the Colorado River," Paper presented at Western State College, Gunnison, Colorado, July 1976.

[18]Quoted by William E. Thoms, "The Colorado River: Apportioning the Waters," Chicago - Kent Law Review, Vol 47-48, 1970-71, p. 206.

the United States, from a river well known to be water deficient, at the expense of the citizens of the seven Colorado River Basin States. . . ."[19]

The treaty, which was ratified in 1945, did not solve the problems with Mexico as regards the Colorado River. The treaty spoke only of quantity of water. No mention was made of quality. Over the years the salinity of the river increased. By the 1960's it had reached crisis proportions in Mexico. The salinity problem as it affects Mexico, has only indirect consequences for Colorado water management and is therefore considered to be outside the purview of this study.

Interstate Adjudications and Federal Statutes Affecting Colorado

Kansas v. Colorado, 1907[20]

Kansas charged that diversions from the Arkansas River, in the State of Colorado, deprived Kansas residents of the flow of the river to which they were entitled under the riparian doctrine. Kansas further contended that even if the doctrine of prior appropriation was used, Kansas would be the senior appropriator.

Colorado contended that, since the river originated in Colorado, it was entitled to use the water as it saw fit. In effect, that meant that Colorado could appropriate the entire flow of the river if it chose to do so. After all, it was Colorado water.

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[19]Ival V. Goslin, "Outline of Early History of Colorado River Development," Remarks delivered at Western State College, Gunnison, Colorado, July 20, 1976.

[20]Kansas v. Colorado, Supreme Court of the United States, 206 U.S. 46 (1907).

The Court rejected the claims of Kansas on the basis of its assessment of the injury sustained by Kansas as against the benefits which accrued to Colorado. According to Justice Brewer, "We must consider the effect of what has been done upon the conditions in the respective states, and so adjust the dispute upon the basis of equality of rights as to secure as far as possible to Colorado the benefits of irrigation without depriving Kansas of the like beneficial effects of a flowing stream."

This was a most important case for Colorado because it established the concept of "equitable apportionment" and rejected the Colorado contention that the water originating in the State was the property of the State and could therefore be used entirely within Colorado. We cannot overemphasize the importance of this case since it apparently put to rest any claims that the waters originating in a particular state were the exclusive property of that state. Simply stated, Colorado water is not the exclusive property of Coloradoans.

As we have previously noted, there have been three cases to reach the Supreme Court regarding the apportionment of the Arkansas River. This particular controversy may have been settled by the Arkansas River Compact.

Wyoming v. Colorado, 1922[21]

This case involved a dispute over the apportionment of the Laramie River which rises in Colorado, flows into Wyoming, and joins the North Platte (which also originates in Colorado). Among other

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[21]Wyoming v. Colorado, Supreme Court of the United States, 259 U.S. 419 (1922).

things, Wyoming objected to a transfer of water from the Laramie River into another watershed in Colorado. Colorado replied, as in Kansas v. Colorado, that it was Colorado water so it could be used as Colorado saw fit. The Court quickly disposed of the diversion question: "In neither state does the right of appropriation depend on the place of use being in the same watershed. Diversions from one watershed to another are commonly made in both States and the practice is recognized by the decisions of their courts."

In one sense, this was a simpler case than Kansas v. Colorado, discussed above, because both of the states involved were prior appropriation states. Aside from the details of the particular case, the Court established two major principles in this case:

1. The decision in Kansas v. Colorado was reaffirmed in that "The contention of Colorado that she as a State rightfully may divert and use, as she may choose, the waters flowing within her boundaries in this interstate stream, regardless of any prejudice that this may work to others having rights in the stream below her boundary, can not be maintained;"

2. The doctrine of prior appropriation was adjudged to be the rule in interstate as well as intrastate disputes. According to the Court, ". . . the doctrine of appropriation . . . furnished the only principles of right and equity applicable to such a controversy as this is. The cardinal rule of the doctrine is that priority of appropriation gives superiority of right. Each of these States applies and enforces this rule in her own territory. . . . The principle on which it proceeds is not less applicable to interstate streams and controversies than to others."

Wyoming v. Colorado was decided on June 5, 1922 during the period when the Colorado River Compact was being negotiated. The decision obviously pleased the lower basin states and Mexico because, as compared to the upper basin states, they were in most cases the senior appropriators. It was looked upon by the upper basin states with dismay. According to New Mexico's governor Mecham, "If they (the lower basin states) can develop their country under the decision in the Wyoming Colorado case, they do not need any compact."[22] Delph Carpenter admitted that the decision left the upper basin states "badly exposed" and he wrote Frank Emerson of Wyoming, "We simply must use every endeavor to bring about a compact at the next meeting otherwise . . . we may never again have a like opportunity."[23]

Certainly the decision weakened the position of the compact commissioners of the upper basin states and made them amenable to a more generous sharing of the Colorado River than would otherwise have been the case.

The Boulder Canyon Project Act, 1928[24]

After the provisions of the Colorado River Compact were agreed upon, the way was cleared, at least partially, for construction of a high dam on the lower Colorado. It will be recalled that California had lobbied for such a dam since the early years of the century but it had generally been opposed by the other Colorado Basin states.

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[22]Quoted by Norris Hundley, Jr., Water and the West, University of California Press, 1975, p. 179.

[23]Delph Carpenter to Frank C. Emerson, September 7, 1922. Quoted by Norris Hundley, Jr., Ibid. pp. 180-181.

[24]45 Stat. 1057.

As anticipated, Arizona refused to ratify the Compact. The Boulder Canyon Act resolved this problem by specifying that the Compact would become operative when six of the seven basin states ratified it. All the states concerned, except Arizona, ratified the Compact.

Once the Compact had become a reality, all the Colorado Basin states (except Arizona) fell in line and supported the construction of the Boulder Canyon Dam on the Lower Colorado. The Act also specifically stated that it was subject to the terms of the Colorado River Compact. Another provision of the Act, of importance to Colorado, authorized the upper basin states to negotiate a separate compact among themselves to apportion the waters of the upper basin. As we have previously noted, such an agreement was concluded in the Upper Colorado River Basin Compact of 1948.

Hinderlider v. La Plata and Cherry Creek Ditch Co., 1938[25]

The ditch company in this case had a Colorado water right dated January 12, 1898. The La Plata River Compact of 1922 apportioned the waters of the La Plata river between Colorado and New Mexico. In carrying out the terms of the Compact, the plaintiffs charged that the Colorado State Engineer had deprived them of rights which they had obtained before the Compact was ratified.

The important principle enunciated in this case is that interstate compacts are superior to state statutes. In the words of the Court

> Whether the apportionment of the water of an interstate stream be made by compact between the upper and lower States with the consent of Congress or by a decree of this Court, the apportionment

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[25]Hinderlider v. La Plata and Cherry Creek Ditch Co., U.S. Supreme Court, 304 U.S. 92 (1938).

is binding upon the citizens of each State and all water claimants, even where the State had granted the water rights before it entered into the compact.

The Colorado River Storage Project Act, 1956

The rationale for the Colorado River Basin Storage Project Act is best described by Felix Sparks.

> In recent history, the annual flow of the river at Lee Ferry has fluctuated from a high of about 23 million acre-feet to a low of about 5.6 million acre-feet. Without holdover storage above Lee Ferry, there have been years in which no water would be available to the Upper Basin if a delivery of 75,000,000 acre-feet in every consecutive ten-year period were made at Lee Ferry. This fact was fully recognized when the Colorado River Compact was negotiated in 1922. The solution discussed during the compact deliberations was the construction of a major reservoir or reservoirs above Lee Ferry which would then permit a relatively equalized annual flow at Lee Ferry.
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> In addition to the problem of making the specified Lee Ferry water deliveries, the Upper Basin was faced with a major financial task of financing Upper Basin projects which would permit that basin to utilize its apportioned share of water. After the signing of the Upper Colorado River Basin Compact in 1948, the unified Upper Basin states began a concerted effort to obtain congressional authorization of legislation which would make it possible for the Upper Basin states to utilize the total water

supply allocated to that basin by the Colorado River Compact. The result was the enactment of the Colorado River Storage Project Act in 1956.

. . .

The three major provisions of the act are as follows:

(1) It provided for the construction of the Glen Canyon Dam on the Colorado River in Arizona a few miles above Lee Ferry, the Flaming Gorge Dam in Utah on the Green River, the Navajo Dam in New Mexico on the San Juan River, and the Curecanti Dams in Colorado on the Gunnison River. The total combined storage capacity of these four major projects is in excess of 30 million acre-feet.

(2) Authorized the construction of participating projects in the Upper Basin, subject to a finding of feasibility.

(3) Established the Upper Colorado River Basin Fund from apportioned power revenues to assist in the repayment of participating projects.

To date, about two billion dollars have been authorized for expenditure to further the purpose of the Colorado River Project Act.[26]

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[26]Felix L. Sparks, Director, Colorado Water Conservation Board. Remarks delivered at Western State College, Gunnison, Colorado, July 1976.

The Colorado River Basin Project Act, 1968[27]

For many years, Arizona had pressed for the construction of a Central Arizona Project that would divert water from the lower Colorado. We cannot chronicle here the background of this important act nor analyze its complex provisions. However, three sections have direct relevance for Colorado:

1. The Act authorizes construction of the Central Arizona Project which will divert water from Lake Havasu on the Lower Colorado in an amount up to 1.2 million acre feet.

2. Five participating projects in Colorado are authorized for construction. The legislation prescribes that these projects "as nearly as practicable" shall be completed not later than the date of the first delivery of water from the Central Arizona Project.

3. The requirement of the Mexican Treaty for delivery of water from the Colorado River constitutes a national obligation so the states of the Colorado basin are relieved of their obligations under the Compact of 1922 if and when the water supply of the River is augmented in such quantity as to satisfy the requirements of the treaty. In the meantime, existing laws and compacts remain in effect.

Federal Water Quality Legislation

The general thrust of Federal water quality legislation has been to subsidize water treatment facilities and to levy penalties of

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[27]P.L. 90-537, 82 Stat. 885

some sort for non-compliance with water quality standards. While such measures will not, in themselves, increase the total quantity of water available, their net effect should be to increase the amount available for certain purposes. By "cleaning up" return flows from cities and other water polluters the quantity available for fishing and water-based recreation should be materially increased. The possibilities for re-use of water will be enhanced and, in that sense, the useable quantity should be substantially augmented. Opportunities for exchanges of water should be increased thus making for a more flexible water supply system. All of these advantages, of course, involve dollar costs and other kinds of costs. In some cases traditional benefit-cost analysis can be useful in conducting such analyses. In other situations, it would appear to be inappropriate. We should also note that benefit-cost analysis tends to ignore the questions of who benefits and who pays what proportion of the costs.

Indian Rights and the Federal Reserved Rights Doctrine

Federal Reserved Rights Doctrine

This legal doctrine holds that the Federal government acquired water rights when it created reservations out of the public domain. The term "reservation" refers to Indian reservations, military reservations, wildlife refuges, national parks, national recreation areas, and national forests. Presumably any other reserved lands could also fall into this category.

Basic elements of the reserved rights doctrine follow.

The priority date of the reservation of water is the date the land reservation was created. The reserved right does not depend upon any diversion or other definite action to use water. Apparently the right exists in perpetuity and can be exercised at any time even if that should be decades after the establishment of the reservation. Federal reserved rights are not subject to state laws so the concepts of forfeiture and abandonment do not apply. The quantity of water reserved is that quantity which is necessary to fulfill the purposes of the reservation.[28]

The basis of the Federal reserved rights doctrine is the myth that, when the reservations were established, it was the intent of the government to reserve water rights along with the land reservation. That rationale is most questionable. If water reservations had been intended, they could have been specified at the time of the land reservation. Be that as it may, the Federal reserved rights doctrine appears to be firmly established especially as regards Indian rights. A more restricted view of the doctrine appears in the Rio Mimbres case which was decided on July 3, 1978. In that case, the Court held, in effect, that the reserved right only applied to the purposes of the reservation as they existed at the time the reservation was created.

In any event, the reserved rights doctrine jeopardizes water rights acquired under the appropriation system especially when total reliable surface flows have already been appropriated. That is the situation in Colorado and, generally, in the other states of the Colorado Basin.

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[28]See Winters v. United States, U.S. Supreme Court, 207 U.S. 564 (1908); Federal Power Commission v. Oregon, U.S. Supreme Court, 349 U.S. 435 (1955); Arizona v. California, U.S. Supreme Court, 373 U.S. 546,(1963).

Summary

All of the interstate compacts to which Colorado is a party have had the effect of reducing or in some way restricting the use or amount of water available to Colorado. The Mexican Treaty of 1944 has at least the potential of forcing Colorado to provide additional water to satisfy treaty obligations. The Supreme Court cases briefly analyzed in this chapter have had the general effect of restricting Coloradoans in the use of water originating in Colorado. The Federal reserved rights doctrine has had the same effect or has the potential for creating such restrictions. Perhaps the Colorado River Storage Project Act (1956), the Colorado River Basin Project Act (1968), and Federal water quality control laws have resulted in a net gain for Colorado.

The institutional restrictions referred to above are, in considerable port, responsible for the current and projected water shortages in Colorado.

CHAPTER VII

THE COLORADO WATER SYSTEM

Physical Features

Topography

Colorado, "the highest state" has a mean altitude of 6,800 feet. The lowest point, where the Arkansas River crosses into Kansas, is 3,400 feet above sea level. More than fifty mountain peaks exceed 14,000 feet in altitude with Mr. Elbert, near Leadville, being the highest point in the state at 14,431 feet. The continental divide runs in a general north-south direction through the middle of the state. The divide not only separates the waters of Colorado but also separates it economically and in terms of population.

Colorado may be divided into three major geographic areas: the Great Plains, the Rocky Mountains, and the Colorado Plateau. The Great Plains occupy the eastern two-fifths of the state and slope off gradually into Nebraska and Kansas from the base of the Front Range. The Mountain area occupies another two fifths of the central part of Colorado. This area is made up of several individual mountain ranges or groups of mountains. The western one-fifth of Colorado is part of the Colorado Plateau which extends west into Utah and south into New Mexico and Arizona.

Climate

Colorado has a continental climate with wide ranges in temperature and irregular annual and seasonal precipitation. The top news story of 1977, according to an Associated Press survey, was the drouth. At the same time, flash floods occurred in some localities.

Westerly winds prevail during most of the fall and winter months. During spring and early summer moisture laden air masses move in from the Gulf of Mexico and provide most of the precipitation in the eastern part of the state. Generally speaking, the amount of precipitation increases as the altitute increases. The mountain areas thus build up substantial snow pack that melts in the spring and summer months.

Because of the high altitude and generally high wind velocity, evaporation rates are high. While evaporation may be most obvious on the plains and on the Colorado Plateau, considerable evaporation occurs from snow in the mountain area. Man made avalanches are an effort to reduce the amount of snow surface exposed to wind and sun.

Demographic Characteristics

The image most people have of Colorado (including Coloradoans) is a composite of forests, mountains, "snow country," ranches, and trout streams. In one sense, this image is correct but demographically Colorado is an urban state. In 1970, seventy-six percent of the population lived in metropolitan areas and major urban regions.[1]

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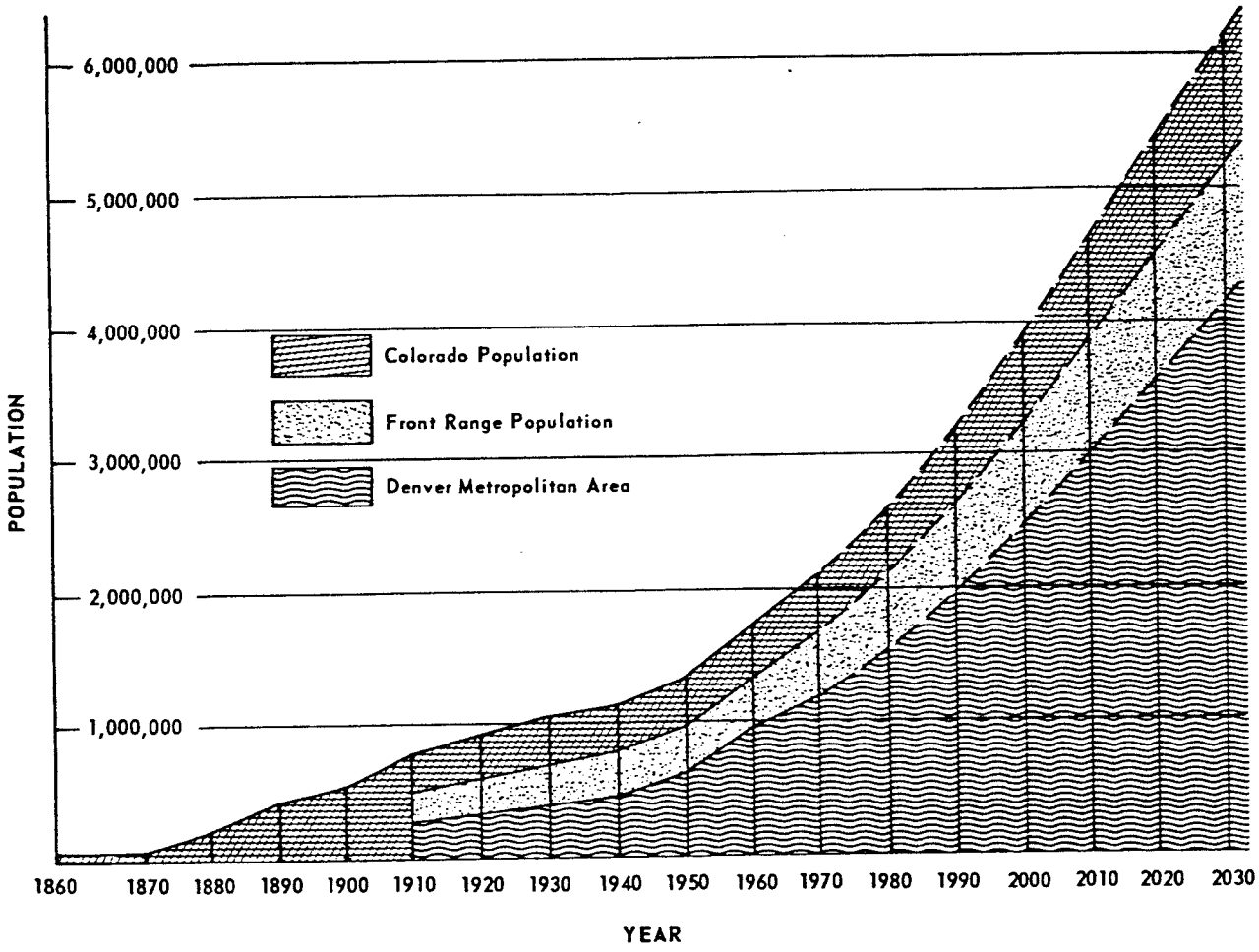
[1]U.S. Department of the Interior, Critical Problems Facing the Eleven Western States, USGPO, 1975 (p. 8).

COLORADO POPULATION PROJECTIONS*



Based on figures supplied by the Colorado State Planning Office.

*U.S. Department of the Interior, Bureau of Reclamation, Critical Water Problems Facing the Eleven Western States, (1975), p. 265.

As we have previously noted, eighty percent of the total population of the state lives in a narrow strip along the east edge of the Front Range and it is in this area that growth has been most rapid. During the decade of the 60's the urban population of Colorado grew by 38 percent. At the same time that urban areas were experiencing rapid growth rates, the population of 32 of the state's 63 counties declined. Areas of declining population export mainly younger people to the urban areas and, since they are likely to have more children than older people, we can expect continued rapid growth in urban areas both from in-migration and natural increase. Furthermore, unless some extraneous factors intervene, urban areas will continue to grow rapidly and rural areas will continue to decline or remain static unless they are located near urban centers. According to the Westwide Study:

> This trend represents a process which tends to feed on itself and becomes self-generating; newcomers are attracted to the opportunities in the complex; industry is attracted to the labor pool and services; finance and services are attracted to the source of industry and people; rural Coloradoans are attracted to the job opportunities; developers are attracted to the opportunities for land value appreciation; and governmental jurisdictions come into being alongside existing ones; new schools, roads, services, and natural resources--land and water-- are required to provide for the needs of increased population and industry base. Once started, the process tends to become irreversible.[2]

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[2]U.S. Department of the Interior, Critical Problems Facing the Eleven Western States, USGPO, (1975), p. 259.

Conversely, once a community begins to decline, the downward spiral tends to continue.

The "extraneous factors" noted above which are most likely to result in population increases in rural areas are those which come about from energy developments or from the establishment of resort areas.

A comparative listing of the populations of Colorado counties for 1960 and 1970 follows.

Regional and county population (1960 and 1970) *

Region and county	Total population			Urban population			Rural population		
	1960	1970	% change	1960	1970	% change	1960	1970	% change
High Plains:									
Baca	6,310	5,674	-10.1	0	0	0	6,310	5,674	-10.1
Bent	7,419	6,493	-12.5	3,402	3,148	-7.5	4,017	3,345	-16.7
Cheyenne	2,789	2,396	-14.1	0	0	0	2,789	2,396	-14.1
Crowley	3,978	3,086	-22.4	0	0	0	3,978	3,086	-22.4
Elbert	3,708	3,903	5.3	0	0	0	3,708	3,903	5.3
Kiowa	2,425	2,029	-16.3	0	0	0	2,425	2,029	-16.3
Kit Carson	6,957	7,530	8.2	0	2,828	0	6,957	4,702	-32.4
Lincoln	5,310	4,836	-8.9	0	0	0	5,310	4,836	-8.9
Logan	20,302	18,852	-7.1	10,751	10,636	-1.1	9,551	8,216	-14.0
Morgan	21,192	20,105	-5.1	11,000	10,971	-.3	10,192	9,134	-10.4
Otero	24,128	23,523	-2.5	12,955	12,797	-1.2	11,173	10,726	-4.0
Phillips	4,440	4,131	-7.0	0	0	0	4,440	4,131	-7.0
Powers	13,296	13,258	-.3	7,369	7,797	5.8	5,927	5,461	-7.9
Sedgewick	4,242	3,405	-19.7	0	0	0	4,242	3,405	-19.7
Washington	6,625	5,550	-16.2	0	0	0	6,625	5,550	-16.1
Yuma	8,912	8,544	-4.1	0	0	0	8,912	8,544	-4.1
Subtotal	142,033	133,315	-6.14	45,477	48,177	5.94	96,556	85,138	-11.83
Front Range:									
Adams	120,296	185,789	54.4	105,922	173,893	64.2	14,374	11,896	-17.2
Arapahoe	113,426	162,142	42.9	103,941	158,058	52.1	9,485	4,084	-56.9
Boulder	74,254	131,889	77.6	56,354	102,602	82.1	17,900	29,287	63.6
Clear Creek	2,793	4,819	72.5	0	0	0	2,793	4,819	72.5
Denver	493,887	514,678	4.2	493,887	514,678	4.2	0	0	0
Douglas	4,816	8,407	74.6	0	0	0	4,816	8,407	74.6
El Paso	143,742	235,972	64.2	109,237	208,281	90.7	34,505	27,691	-19.7
Gilpin	685	1,272	85.7	0	0	0	685	1,272	85.7
Jefferson	127,520	233,031	82.7	106,929	208,991	95.4	20,591	24,040	16.8
Larimer	53,343	89,900	68.5	34,761	59,557	71.3	18,582	30,343	63.3
Pueblo	118,707	118,238	-.4	103,336	103,300	-.03	15,371	14,938	-2.8
Teller	2,495	3,316	32.9	0	0	0	2,495	3,316	32.9
Weld	72,344	89,297	23.4	26,314	41,472	57.6	46,030	47,825	3.9
Subtotal	1,328,308	1,778,750	33.91	1,140,681	1,570,832	37.71	187,627	207,918	10.81
Mountains:									
Chaffee	8,298	10,162	22.5	4,560	4,355	-4.5	3,738	5,807	55.4
Custer	1,305	1,120	-14.2	0	0	0	1,305	1,120	-14.2
Delta	15,602	15,286	-2.0	3,832	3,694	-3.6	11,770	11,592	-1.5
Eagle	4,677	7,498	60.3	0	0	0	4,677	7,498	60.3
Fremont	20,196	21,942	8.6	11,794	15,036	27.5	8,402	6,906	-17.8
Grand	3,557	4,107	15.5	0	0	0	3,557	4,107	15.5
Gunnison	5,477	7,578	38.4	3,477	4,613	32.7	2,000	2,965	48.3
Jackson	1,758	1,811	3.0	0	0	0	1,758	1,811	3.0
Hinsdale	208	202	-2.9	0	0	0	208	202	-2.9
Lake	7,101	8,282	16.6	4,008	4,314	7.6	3,093	3,968	28.3
LaPlata	19,225	19,199	-.1	10,530	10,333	-1.9	8,695	8,866	2.0
Montezuma	14,024	12,952	-7.6	6,764	6,032	-10.8	7,260	6,920	-4.7
Montrose	18,286	18,366	.4	5,044	6,496	28.8	13,242	11,870	-10.4
Ouray	1,601	1,546	-3.4	0	0	0	1,601	1,546	-3.4
Park	1,822	2,185	19.9	0	0	0	1,822	2,185	19.9
Pitkin	2,381	6,185	159.9	0	0	0	2,381	6,185	159.9
Routt	5,900	6,592	11.7	0	0	0	5,900	6,592	11.7
San Juan	849	831	-2.1	0	0	0	849	831	-2.1
San Miguel	2,944	1,949	-33.8	0	0	0	2,944	1,949	-33.8
Summit	2,073	2,665	28.6	0	0	0	2,073	2,665	28.6
Dolores	2,196	1,641	-25.3	0	0	0	2,196	1,641	-25.3
Subtotal	139,480	152,099	9.05	50,009	54,873	9.73	89,471	97,226	8.67
Northwest:									
Garfield	12,017	14,821	23.3	3,637	4,106	12.9	8,380	10,715	27.9
Mesa	50,715	54,374	7.2	23,650	25,994	9.9	27,065	28,380	4.9
Moffat	7,061	6,525	-7.6	3,984	4,205	5.5	3,077	2,320	-24.6
Rio Blanco	5,150	4,842	-6.0	0	0	0	5,150	4,842	-6.0
Subtotal	74,943	80,562	7.5	31,271	34,305	9.7	43,672	46,257	5.92
South Central:									
Alamosa	10,000	11,422	14.2	6,205	6,985	12.6	3,795	4,437	16.9
Archuleta	2,629	2,733	4.0	0	0	0	2,629	2,733	4.0
Conejos	8,428	7,846	-6.9	0	0	0	8,428	7,846	-6.9
Costilla	4,219	3,091	-26.7	0	0	0	4,219	3,091	-26.7
Huerfano	7,867	6,590	-16.2	5,071	4,329	-14.6	2,796	2,261	-19.1
Las Animas	19,983	15,744	-21.2	10,691	9,901	-7.4	9,292	5,843	-37.1
Mineral	424	786	85.4	0	0	0	424	786	85.4
Rio Grande	11,160	10,494	-6.0	3,385	3,909	15.5	7,775	6,585	-15.3
Saguache	4,473	3,827	-14.4	0	0	0	4,473	3,827	-14.4
Subtotal	69,183	62,533	-9.61	25,352	25,124	-.9	43,831	37,409	-14.65
TOTAL	1,753,947	2,207,259	25.8	1,292,790	1,733,311	34.1	461,157	473,948	2.8

*U.S. Department of the Interior, Water for Tomorrow; Colorado State Water Plan, Phase I, 1974.

Water Uses in Colorado

Since available data sources use different base periods, different terminology and different methods of analysis, estimates of water use vary considerably. The estimates which follow should, therefore, be considered as rough approximations only.

It appears that the average annual undepleted water yield in Colorado is about 15,450,000 acre feet. Of this total, about 10,315,000 acre feet are exported out of the state leaving a balance of 5,135,000 acre feet available for use within Colorado. According to Water for Tomorrow, depletions from this residue are: irrigation, 4,177,000 acre feet; municipal, industrial and rural domestic uses account for 251,000 acre feet; and "other uses" total 840,000 acre feet.[3] These figures, incidentally, total 5,268,000 acre feet as compared to the 5,135,000 acre feet cited earlier. If we convert the depletion figures listed above to percentages, they are: irrigation, 79.29 percent; municipal, industrial and rural domestic, 4.76 percent; and "other" 15.95 percent.

Clearly, irrigation is the predominant use of water in Colorado. Colorado is, in fact, the fourth largest state in the union in amount of irrigated acreage. Only California, Texas and Nebraska (in that order) irrigate greater amounts of land than does Colorado. Idaho, in fifth place, is close behind Colorado.[4] The importance of irrigation in

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[3]U.S. Department of the Interior, Water for Tomorrow: Colorado State Water Plan, Phase I, p. 3.3 (1974).

[4]Irrigated acreages in 1974: California, 7,749,000 acres; Texas, 6,594,000 acres; Nebraska, 3,967,000 acres; Colorado, 2,874,000 acres; and Idaho, 2,859,000 acres. Source: U.S. Census of Agriculture.

Colorado agriculture is further indicated by the fact that 42 percent of the harvested cropland in the state is irrigated. This 42 percent produces over 50 percent of the value of crops harvested.

Irrigation is not only the largest user of water in terms of withdrawals, but it is also highest in percentage of consumptive use. Probably 40 to 50 percent of the water withdrawn for irrigation is consumed as compared with 20 to 25 percent in municipal and industrial use. These percentages are tentative because consumptive irrigation use varies with the locality and with seasonal changes in climate. The same can be said for municipal use. Fish and wildlife use, and outdoor recreation generally, actually consume very little water. Neither does the maintenance of in-stream flows except that such flows tend to increase the amount of water that runs out of the state.

The amount of water needed for energy production appears to be highly unpredictable. As is well known, Colorado has large deposits of oil shale and coal. The amounts of water needed for oil shale processing depend upon the rate of development and the kind of technology employed. Coal is presently used to produce electrical energy in coal-fired plants. Coal slurry pipelines (which would export considerable water) are being resisted by state government officials. Probably the only safe prediction as to the demand for water for energy production is that it will increase substantially.

Organization for Water Management

Recapitulation of Basic Legal Doctrines

Colorado is probably the "purest" of the appropriation states. An appropriator need not obtain a permit or other permission to divert water. He needs only to take affirmative efforts to withdraw water and file a record of his "claim". Water rights exist in perpetuity as long as they are put to beneficial use. Water rights may be lost (abandoned) but usually intent to abandon must be established.

Water rights are property rights and are not tied to lands either adjacent to the point of diversion or contiguous to the stream.

> Article XVI of the State Constitution provides, in Section 5,
>
> The water of every natural stream, not heretofore appropriated, within the state of Colorado, is hereby declared to be the property of the public, and the same is dedicated to the use of the people of the state, subject to appropriation as hereinafter provided.

This language is clear enough and was probably adequate in the past. However, most, if not all, of the reliable flows of the state have been appropriated or overappropriated. That means that the waters of Colorado are no longer "the property of the public" nor can they be "dedicated to the use of the people of the state" because they have already been appropriated and are now private property. It also means that the State cannot reserve water or take water without just compensation for any purpose without due process of law.

In Section 6 of Article XVI, the Constitution further provides: "The right to divert the unappropriated waters of any natural stream to beneficial uses shall never be denied." This provision is construed to mean that water rights exist in perpetuity as long as they are applied to a "beneficial use" and that there exists no intent to abandon the right.

The same section of the Constitution establishes two sets of priorities: 1) first in time is first in legal right for appropriators who would use water for the same purpose; 2) if the waters of a stream are not sufficient to satisfy all demands, domestic use has first priority, agriculture second, and manufacturing third. The Constitution does not recognize any other beneficial uses of water. Thus public uses of water for recreation or other purposes have no constitutional standing. The same provision also implies that municipalities may condemn agricultural or industrial water for domestic purposes. Presumably, agricultural users could also condemn industrial water but "just compensation" in such cases would probably be higher than would be feasible for agricultural purposes.

Since water rights are property rights, they can be bought and sold, traded, leased, and, in some cases, borrowed. Thus the water system has much more flexibility than would otherwise be the case.

An Overview of State Organization for Water Management

For purposes of clarity we will first briefly summarize the responsibilities of the major organizations involved in water management and then proceed to a more detailed description of each one.

The state legislature establishes water management policy within the constraints set out in the State Constitution. At present the basic water management law is the Water Right and Administration Act of 1969.

In Colorado, the courts really come closest to being the managers of the water system. They not only adjudicate disputes but their decisions become, in fact, the rules for managing the system. They are also involved in the appointment of the directors of conservancy districts and are otherwise involved in matters that would ordinarily be considered to be executive functions.

The State Engineer's Office acts mainly as a bookkeeper and policeman in administering statutes in conformance with judicial decisions. The foregoing statement is obviously an oversimplification but is essentially correct.

The Colorado Conservation Board was established in 1937 as a planning and coordinating body and, to some extent, as an engineering consulting service for the State of Colorado. It has probably been most active in the past in promoting Federal water projects in Colorado. It also carries out important liaison activities among all levels of state government (including the state legislature) and with the Federal government and with interstate commissions. Its planning activities have been limited mainly because the state actually has little control over the operation of the water system.

Water quality matters are the responsibility of the Department of Public Health and the Water Quality Control Commission.

Ground water matters are administered by the State Engineer under policies established by the State Ground Water Commission.

The actual operation of the Colorado water system is carried out by conservancy districts, irrigation districts, mutual irrigation (ditch) companies and municipalities.

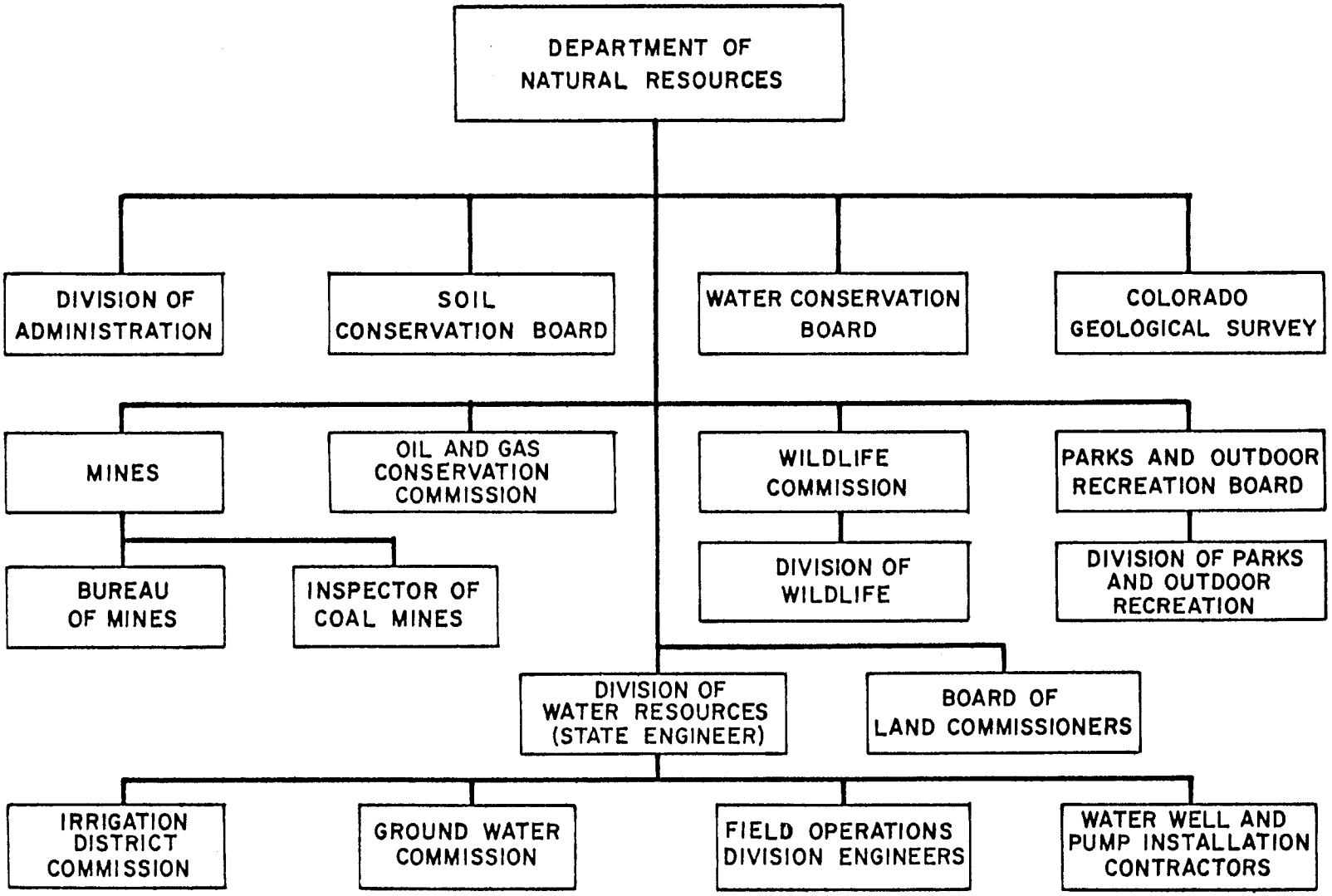
The Colorado Water Conservation Board, Office of the State Engineer (Division of Water Resources), Irrigation District Commission, Ground Water Commission, and various other natural resource agencies are grouped together within a Department of Natural Resources. An organizational chart of the Department follows.

Let us now turn to a more detailed description of each of the organizations noted above.

The Department of Natural Resources was established in 1968 as the result of a constitutional amendment which, among other things, grouped previously independent agencies into seventeen major executive departments. The Department includes five major resource categories--water, land, minerals, parks, and fish and wildlife. Several appointed commissions exist within the Department with varying degrees of authority. Some agencies subsist in considerable part on licenses, fees, or rentals and are thus more independent than would otherwise be the case. The presence of the several commissions and the more or less self-sufficient financial status of some agencies weakens the authority of the director and tends to make him more of a coordinator than a director.

The Colorado Water Conservation Board was established by the legislature in 1937. The responsibilities of the Board are best summarized by Judge Stone, who was the first director:

COLORADO DEPARTMENT OF NATURAL RESOURCES*



* U.S. Department of the Interior, Water for Tomorrow; Colorado State Water Plan, Phase II, Report on Legal and Institutional Considerations, August 1974.

(1) To appraise and inventory the State's water resources and develop programs for their conservation, utilization and control.

(2) To formulate and further a continuing State Policy with respect to water development programs and problems, both intrastate and interstate.

(3) To promote water projects and in connection therewith conduct investigation, make surveys and studies and review and make official State comments upon project reports of Federal agencies.

(4) To aid and collaborate with local affected interests and consult with other interested State agencies in all matters relating to the Federal water development program.

(5) To handle interstate water relations and problems, including the furnishing of engineering service to the Attorney General in interstate litigation over water; and to render aid and assistance, engineering and otherwise, to negotiating and administrative compact commissions.

(6) And generally to aid in the conservation, beneficial utilization, development, and protection of the water resources of Colorado in the interest of the present and future welfare of the State and its citizens.[5]

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[5]Quoted by Ivan C. Crawford, Water Resource Planning in Colorado, Mimeo., 1957 (pp. 48-49). See also Colo. Revised Statute § 37-60-102 to 120.

As early as 1957, Ivan C. Crawford (then director) complained that the Water Conservation Board could actually do very little planning. In his words,

> Under Colorado law it was not possible for the State to reserve the flows or portions of the flows of streams for development in the future.
>
> . . .
>
> . . . as the situation now stands, planning for the industrial future is handicapped because water supplies cannot be appropriated and set aside awaiting such development. Planning for other future uses suffers in the same manner when it is not possible to immediately file on the necessary water and proceed with "due diligence" to a decreed water right.[6]

Jean S. Breitenstein, a former attorney for the Board, wrote in similar vein:

> There is no method or procedure in Colorado whereby a block of water may be effectively and legally reserved for future use. The trouble with the appropriation system is that the race is always won by the swiftest. There are probably few who question the wisdom of the principle when it is applied to individual effort. The difficulty arises when consideration must be given to the over-all planning of vast projects requiring federal financing. It is a fair comment that Colorado's existing constitutional and statutory provisions were designed to meet the

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[6] Ibid., pp. 11 and 76.

> requirements of the era of private development. That has long since passed. To apply our existing laws to the vast public developments which occur if Colorado is to utilize to the fullest extent its water resources is completely unrealistic.[7]

Although the Colorado Water Conservation Board has had a most distinguished series of directors and board members, its planning and control activities have been minimal mainly for the reasons set out by Crawford and Breitenstein above. It has concentrated its efforts on development of water projects, liaison activities and advisory functions.

The Division of Water Resources (State Engineer) supervises the day-to-day distribution of the waters of the state in accordance with statutory directives, court decisions and interstate compacts. Its responsibilities include both surface and ground water. It is also involved with design, construction, and safety of dams over ten feet in height. The state engineer's office also collects considerable data on water flows and is responsible for the very sensitive and time-consuming job of tabulating water rights. The general purpose of the tabulation is to reduce uncertainty, confusion, and litigation over the status of particular water rights. Each division engineer prepares a tabulation (list) of all decreed and conditional water rights in his division according to dates of priority and amounts of water involved. Tabulations are to be updated periodically. As outlined

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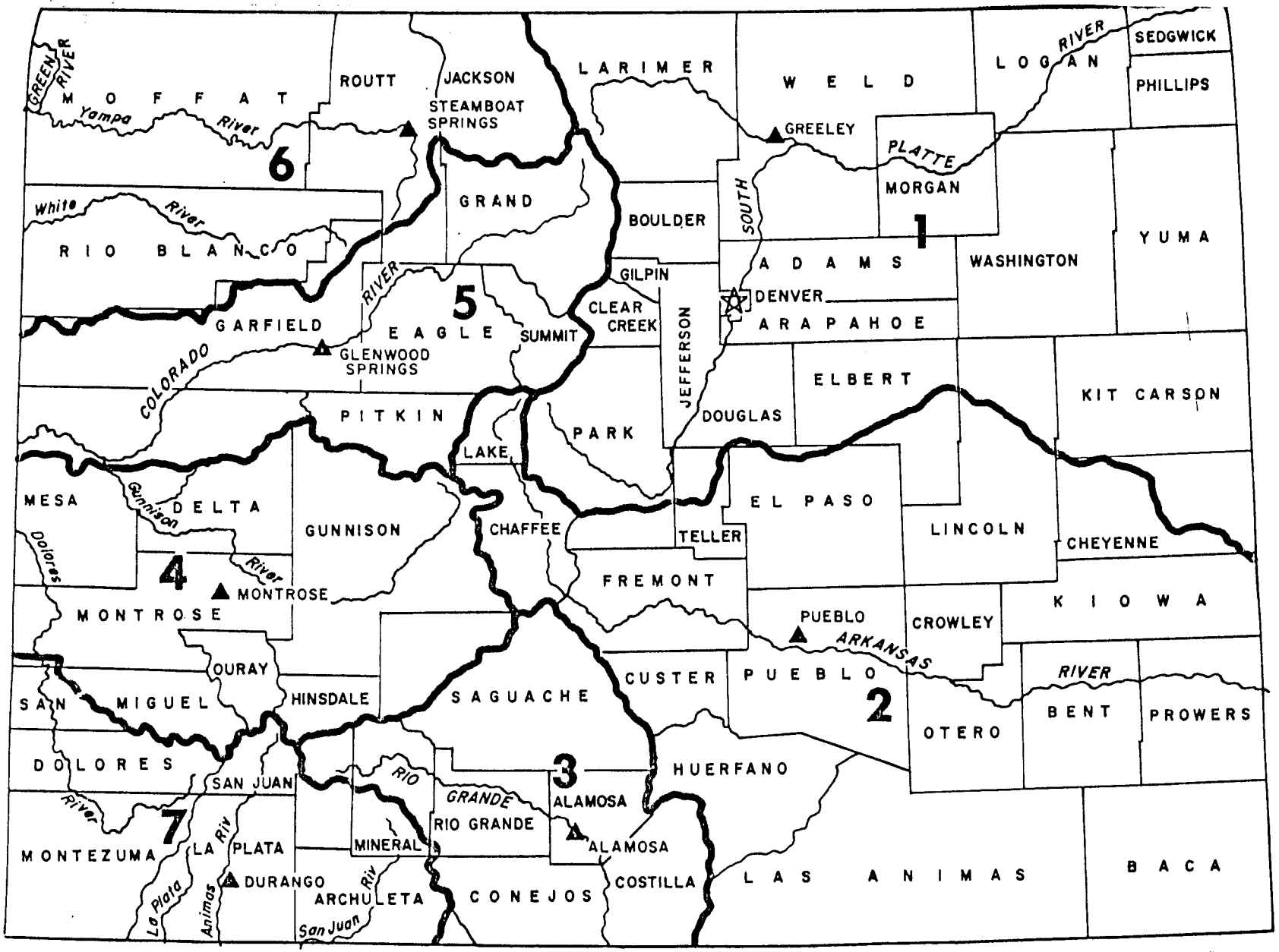
[7]Jean S. Breitenstein, Rancher and Farmer, April 1954, (p. 44) as quoted by Ivan S. Crawford in Water Resource Planning in Colorado, Mimeo., 1957 (pp. 11-12).

above, the tabulation exercise may appear to be a routine clerical operation. In numerous situations, however, it can become an extremely complex undertaking.

The Water Right Determination and Administration Act of 1969 provided for the creation of seven water divisions in the state with boundaries conforming to the major watersheds. Each division is headed up by a division engineer who is responsible to the State Engineer. An organization chart of the Division of Water Resources and a map of the seven water divisions follow.

Within the Division of Water Resources, or attached to it, are the Board of Examiners, Water Well and Pump Installation Contractors, the Ground Water Commission and the Irrigation District Commission.

The Water Court system was provided for in the Water Right Determination and Administration Act of 1969. One water judge is designated by the State Supreme Court for each of the seven water divisions. The water judge is actually a district judge from that water division who may hear other cases but water matters have precedence in his court. The water judge appoints referees who make decisions in water controversies. Decisions of the referee(s) may be appealed to the water judge. Each water division also has a water clerk(s) who is technically a district court clerk but is primarily responsible for the maintenance of records of water rights, water court proceedings and related matters, under the supervision of the water judge. In brief, the water judge determines the validity of water rights in Colorado.



COLORADO WATER DIVISIONS*

WATER DIVISION BOUNDARY ---------- 0

WATER DIVISION OFFICE
WATER CLERK OFFICE ---------- ▲

*U.S. Department of the Interior, Water for Tomorrow, Colorado State Water Plan, Phase II, August 1974.

Water Distribution Systems

Some of the storage of water and much of its actual distribution is carried out by a variety of local water organizations. These include conservancy districts, irrigation districts, mutual ditch companies, and municipalities. Some of these organizations act primarily as "wholesalers" and some as "retailers" of water while others combine both functions.

Water conservancy districts function mainly as wholesalers. They ordinarily operate storage facilities and supply water to irrigation enterprises, large industrial firms and municipalities.

Probably the original reason for the establishment of conservancy districts was the need to form a contracting entity which could enter into agreements with the Federal government for the construction and repayment of large water projects. The immediate impetus for passage of the Water Conservancy District Act of 1937[8] was a proposed project (Colorado-Big Thompson) which would authorize construction of dams and storage reservoirs in the Colorado River watershed and transport water to tributaries of the South Platte via a thirteen mile tunnel through the Continental Divide. Following passage of the Colorado statute and congressional authorization, the Northern Colorado Conservancy District was formed. This was to be the prototype conservancy district for the others that were established later.

Water conservancy districts are authorized to contract with the Federal government for construction, operation, and maintenance of

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[8]C.R.S. §§ 37-45-101 to 152.

diversion and storage facilities, to acquire water rights, to construct and operate facilities, to condemn private property, and to make special assessments and levy ad valorem taxes on all property within the district. Conservancy districts are organized according to statutory procedures through the district courts. The courts also appoint the boards of directors and generally exercise overall supervision of the districts. There are presently 36 water conservancy districts in Colorado as listed on the table which follows.

Irrigation districts are a form of special district originally authorized in the Irrigation District Law of 1905.[9] In common with other special districts, irrigation districts may enter into contracts, exercise the power of eminent domain, issue bonds, and levy assessments against landowners with irrigable land. Districts can obtain water rights and other adjunctive properties and may allocate water to users or contractors. Irrigation districts may function as both wholesalers and retailers of water. Their principal advantage over ditch companies, to be considered next, is their greater financial base which enables them to construct and operate larger water development and distribution facilities.

Mutual Irrigation (Ditch) Companies are the oldest form of water organization in Colorado. Some of them consist of very few stockholders with limited water rights while others are quite large. They perform mainly a retailing function in that they ordinarily distribute water directly to irrigation users. Ditch companies first began as mutual

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[9] C.R.S. §§ 37-41-101 to 160. See also 37-42-101 to 140 and 37-43-122, 123, and 143.

Colorado Water Resource Agencies*

--Water Conservancy Districts

District	Date of organization	River Basin	County
Basalt	4/14/64	Colorado	Garfield, Eagle, Pitkin
Battlement Mesa	5/ 7/62	Colorado	Mesa
Bluestone	1/14/63	Colorado	Garfield, Mesa
Bostwick Park	9/ 6/61	Colorado	Montrose, Gunnison
Central Colorado	9/15/65	Missouri	Adams, Weld
Collbran	10/26/55	Colorado	Mesa
Conejos	9/30/40	Rio Grande	Conejos
Crawford	5/31/57	Colorado	Delta, Montrose, Gunnison
Dolores	11/20/61	Colorado	Montezuma, Dolores
Florida	8/--/48	Colorado	La Plata
Fruitland Mesa	8/18/60	Colorado	Delta, Montrose, Gunnison
Grand Mesa	4/10/61	Colorado	Delta
Great Northern	12/20/63	Colorado	Moffat, Routt
Jackson County	11/ 7/61	Missouri	Jackson
Juniper	6/27/66	Colorado	Moffat
La Plata	4/17/44	Colorado	La Plata
Lower South Platte	5/ 6/64	Missouri	Logan, Morgan, Sedgwick, Washington
Mancos	7/20/42	Colorado	Montezuma
Middle Park	8/21/50	Colorado	Grand, Summit
Northern Colorado	9/28/37	Missouri	Boulder, Larimer, Weld, Morgan, Logan, Sedgwick, Washington
North Fork	3/17/41	Colorado	Delta, Gunnison
Ouray	7/25/57	Colorado	Montrose, Ouray
Pot Hook	6/23/60	Colorado	Moffat
Purgatoire River	12/ 2/60	Arkansas	Las Animas
San Luis Valley	11/14/49	Rio Grande	Alamosa, Rio Grande, Saguache
San Miguel	9/--/57	Colorado	San Miguel, Montrose
Silt	10/ 7/57	Colorado	Garfield
Southeastern Colorado	4/29/58	Arkansas	Chaffee, Fremont, El Paso, Pueblo, Otero, Bent, Kiowa, Prowers, Crowley
St. Vrain and Left Hand	4/19/71	Missouri	Boulder, Larimer, Weld
Tri-County	9/20/57	Colorado	Delta, Montrose, Ouray
Upper Gunnison River	7/ 9/59	Colorado	Gunnison, Saguache, Hinsdale
Upper South Platte	10/17/55	Missouri	Park, Teller, Douglas, Jefferson, Clear Creek
Upper Yampa	3/--/66	Colorado	Routt, Moffat
Ute	4/ 4/56	Colorado	Mesa
West Divide	4/22/64	Colorado	Garfield, Pitkin, Mesa
Yellow Jacket	9/29/59	Colorado	Rio Blanco, Moffat, Garfield

*U.S. Department of the Interior, Water for Tomorrow; Colorado State Water Plan, Phase II, 1974.

water associations whose members cooperated in financing and in the work involved in diverting, and sometimes impounding, water. Title to water rights in these "mutuals" remained with the individual shareholders.

Some ditch companies came to be incorporated and thus assumed the same privileges and responsibilities of other private corporations except that their assets were limited primarily to water rights, diversion and distribution systems, and they were supposedly not organized for profit.[10] There are dozens of ditch companies in Colorado. In the South Platte Basin alone there are 106 irrigation enterprises.[11]

Municipalities supply water directly to domestic consumers, industrial and commercial firms, and sometimes to domestic water supply companies which most commonly exist in rural areas adjacent to municipalities. Municipalities must maintain some dependable storage capacity to meet year-round demands of consumers and for emergencies. Larger cities may also own extensive reservoir systems, carrier ditches, tunnels or pipelines, plus local storage facilities. Smaller towns may depend upon wells.

An incorporated city is a municipal corporation and, as such, has all the powers of a private corporation plus the authority to levy taxes and to enact ordinances (municipal laws). In Colorado, cities may also condemn agricultural or industrial water rights. However,

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[10]For a more detailed analysis see Radosevich, Nobe, Allardice, and Kirkwood, Evolution and Administration of Colorado Water Law, Water Resources Publications, Fort Collins, Colo., (1976) pp. 163-182.

[11]Raymond L. Anderson, Irrigation Enterprises in Northeastern Colorado, Economic Research Service, U.S. Department of Agriculture, Publication No. ERS-117, (1963) p. iii.

cities most commonly buy water rights rather than resort to condemnation proceedings. Cities may also buy, rent or exchange water rights with conservancy districts, irrigation districts, and ditch companies. Obviously, municipalities are in a preferred position in Colorado as regards water resources, not only because of the constitutional priority given to domestic use of water, but also because of their greater flexibility and, in most cases, their superior financial capabilities. Finally, in an urbanized state like Colorado, they have the votes.

Ground Water

Ground water management is primarily the responsibility of the State Ground Water Commission which functions in accordance with the Water Right and Determination Act of 1969. As we have previously noted, most of the ground water in Colorado lies in underground aquifers on the east slope. Early court cases established that ground water which was tributary to a stream (flowed into a stream) could be considered to be similar to surface water and could thus be appropriated in the same manner and with the same privileges as surface water decrees.[12]

Ground waters not tributary to a surface water course were not considered to be subject to the doctrine of prior appropriation until the 1965 Ground Water Management Act declared that designated (non-tributary) ground water was subject to appropriation.[13]

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[12]Medano Ditch Co. v. Adams, 29 Colo. 317 (1902); Platte Valley Irrigation Co. v. Buckers Irr. Mill. and Improvement Co., 25 Colo 77 (1898); Safrenek v. Limon, 123 Colo. 330 (1951).

[13]For a more detailed analysis of the development of Colorado ground water law see Darryl G. Kaneko, Ed., "A Survey of Colorado Water Law," Denver Law Journal, Vol. 47, No. 2, (1970), pp. 307-339, and Wells A. Hutchins, Water Rights Laws in the Nineteen Western States, Vol. III, U.S. Department of Agriculture, Misc. Publication No. 1206, (1977), pp. 230-243.

The Water Right and Administration Act of 1969 declared it to be "the policy of this state to integrate the appropriation, use, and administration of underground water . . . in such a way as to maximize the beneficial uses of all of the waters of this state." To accomplish this, and other purposes, the Act created a Ground Water Commission of twelve members. Three members are ex-officio with the other nine being appointed by the governor on a geographic basis. The State Engineer is the executive director of the Commission and his office carries out the decisions and orders of the Commission.

The Commission defines "designated ground water basins," specifies the level to which the water table may be lowered, and generally supervises the work of ground water management districts. These last are local management districts administered by local people. The districts may levy taxes, borrow money and generally manage ground water matters within the district. Among the most important duties of the Commission is the specification of the levels to which the ground water table may be lowered.

Water Quality Management

Water quality in Colorado varies considerably depending upon location. Generally, the upstream reaches of streams have water of high quality which degenerates as the flow is impacted by human activity. "Point sources" of pollutants include mines, industrial plants, municipal wastes, and concentrated feed lot areas. Energy production, which has doubled approximately every ten years nationally, can be expected to increase the amount of pollutants in the water courses of the state. Even if the best available methods of pollution

abatement are used in energy production, water quality probably will not improve if the amount required continues to accelerate. It appears to be a case of running faster to stay in the same place.

Non-point sources of water pollution include sediment from run-off (which has always existed) and run-off from agricultural lands. Run-off seepage from farm lands (especially irrigated acreages) may contain fertilizers, insecticides and herbicides.

Finally, most uses of water result in increased salinity. From Denver to the Nebraska state line, the salinity of the South Platte increases from 516 p/m to 1,330 p/m. The Arkansas River increases in salinity from 365 p/m near Pueblo to about 3,600 p/m at the Kansas state line.[14]

Overall responsibility for water quality in Colorado rests with the state Water Quality Control Commission and the Water Quality Control Division of the Department of Health. The present system was authorized by the Water Quality Control Act of 1973 (C.R.S. 25-8-101 to 25-8-704). This act was passed in response to the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500) which required that states be in substantial compliance with the Federal act.

The membership of the Water Quality Control Commission is designed to represent different interests and different sections of the state. The Commission consists of eleven members: the Director of the Department of Natural Resources, one member of the State Board of Health, one member of the Wildlife Commisison, one member of the

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[14]U.S. Department of the Interior, Critical Water Problems Facing the Eleven Western States, USGPO, 1975 (p. 277).

Colorado Water Conservation Board, one member from each of the five congressional districts to be appointed by the governor, and two members at large -- also appointed by the governor.

The Commission generally is the policy making body while the Public Health Department carries out the day-to-day administration of the statutes and the policies of the Commission.

* * *

Summary

The Colorado Water System appears to be exceedingly complex. An organization chart which included all the water organizations in Colorado would be gargantuan in size and the interrelationships among organizational units would be almost impossible to depict. The implications of this complex system of multiple units, multiple levels and jurisdictional redundancies will be considered in the next chapter -- both from the perspectives of democratic ideals and institutional efficiency.

CHAPTER VIII

PROBLEMS AND OPTIONS IN COLORADO WATER MANAGEMENT

The Current Colorado Situation

To repeat a statement from Chapter II, "What we do today is determined mainly by what we did yesterday and all the yesterdays before that. We never start from scratch. We start from where we are." This section deals with the general question, "Where are we now with reference to Colorado water management?" In responding to that question, we will also make some short-term predictions as to where we are likely to be "tomorrow."

We can expect a continued emphasis on the maintenance and enhancement of the natural environment to include water quality and aesthetic values associated with water.

We can expect increasing demands for water-based outdoor recreation because of increasing population, increasing urbanization, more leisure time, greater mobility, and possibly increasing affluence. Water based recreation not only requires a high level of water quality but also the maintenance of instream flows and adequate water levels in lakes and reservoirs. Fish and wildlife will continue to require water of high quality and adequate quantity.

We can expect that Federal support for further water development will continue to diminish. President Carter's "hit list" of federally

financed water projects was a portent of things to come. Even if the list of currently proposed projects survives a presidential veto, prospects for further Federal support appear to be waning.

Tourism, one of the state's major industries, can be expected to increase but only if environmental values are preserved and water-based outdoor recreation (including fish and wildlife) is maintained at a high level.

Obligations to deliver approximately ten million acre feet of water to downstream states will continue into the foreseeable future. There may be ways to reduce these amounts but they do not appear to be favorable at this time.

We can expect that population growth will continue and possibly accelerate. Concurrently with population growth will come industrial expansion. Some such industries will make high demands on water quantity and some of them will seriously degrade water quality. Most of this population and industrial growth will occur in the narrow front range corridor -- in the rain shadow of the Rocky Mountains.

Irrigated agriculture will continue to demand a major share of surface flows and will probably deplete underground aquifers faster than they can be recharged.

In an energy-short society, substantial energy production developments on the west slope seem inevitable. Such developments will demand, and probably get, substantial amounts of surface water in the Colorado River basin. If that happens, the possibility of additional transmountain diversions to the east slope will very likely be foreclosed.

In the face of these mounting demands for more water, the supply will remain approximately the same. As the demands accelerate, competition for this scarce common pool resource will intensify and, as noted in Chapter III, greater government involvement will become necessary. Perhaps the spaceship analogy is not too far fetched to illustrate Colorado's probable water future. The spaceship is a closed system in that no inputs are received from outside. If the population of the spaceship grows, more regulation, regimentation, rationing, and recycling becomes necessary. Colorado is not a closed system but the water input is limited and finite.

To complete this summary statement of "where we are now," we need to recognize the existence of the legal system for the allocation of water rights which has been in existence for over a century. Even though the Constitution declares that "The water of every natural stream . . . is hereby declared to be the property of the public, and the same is dedicated to the use of the people of the state. . . ." there is, in fact, no significant amount of water left which is the "property of the public." All reliable flows have been appropriated or obligated to downstream states so there is really none left to be "dedicated to the use of the people of the state." At any rate, "where we are now" is with a century-old appropriations doctrine as administered by a system of water courts. As we will consider in the "Options" section of this chapter, it is unlikely that the present legal system can be significantly changed. To repeat a comment from William Lord, "One of the characteristics of water resource conflict

is that it does not develop until most of the means of successfully resolving it have been foreclosed."

Problems and Options

The problem areas outlined above are those which frustrate or threaten the attainment of goals of some significant group(s) in Colorado. There is no unanimous agreement as to what constitutes a problem. What may be a major problem to one group may be a minor problem to another. Furthermore, a problem for one group may constitute an advantageous situation to another.

Problems are often interrelated and thus cannot realisitically be separated except for purposes of analysis. Similarly, options for problem resolution are also interrelated. The adoption of one option is likely to have spillover effects on other possible options and may also have impacts upon problem areas other than the one it was designed to resolve or alleviate. These considerations should be kept in mind in evaluating the options set out later in this chapter.

We should also be aware of Dean Mann's conclusions (quoted in Chapter I) that westerners prefer individual decision making to governmental decision making and that they prefer local government decision making to state or Federal decision making. These conclusions were corroborated in the survey of Colorado water influentials.[1]

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[1]Larry L. Marcum, Institutional Arrangements for Effective Water Management in Colorado, M.A. Thesis, CSU (1978) p. 102.

Goals for Effective Water Management

Goals for effective water management must be expressed in very general terms if anything approaching a zone of consensus, or even of acquiescence, is to be reached. The more specific the goals, the greater is the likelihood of dissent.

When we raise the subject of goals for water management, we are immediately faced with the question, "Whose goals?" Goals may be different for different people or different groups. Goal attainment for one group may work a hardship on another group. The goals of Trout Unlimited and the groups who depend on tourism are likely to be different, and probably at cross purposes, with the goals of irrigated agriculture. As we noted in Chapter II, in most policy decisions, somebody wins and somebody loses -- and the losers don't like it. Occasionally, it is possible for everyone to win or for everyone to lose as the result of a policy decision. To repeat, a policy decision determines who gets what, when, and how.

In light of these considerations, the goals listed below for effective water management are stated in general terms but are hopefully definite enough to be meaningful.

1. The water management system should be equitable in the sense that no individual or group is discriminated against. It should also be equitable in terms of the burden of costs. Two traditional principles of taxation may be applicable here: taxes should be based upon benefits received and upon ability to pay. "Equitable" does not necessarily mean "equal."

2. The water management system should be responsive to democratic values. The system should be structured so that water policy makers are generally representative of the people of the state and can be held responsible to them. A more detailed analysis of this concept will appear in the "Options" section of this chapter.

3. Contemplated changes in water management should recognize social values of water as distinguished from dollar values determined in the water market. In the words of a National Academy of Sciences study, "In a democratic society, the political process weighs incommensurate values and makes choices. Throughout the nation's history different weights have been given to different values in water resource development."[2] The study goes on to suggest that there has been a shift in values from an emphasis on exploitation of physical resources to a greater appreciation of the intangible values of water. In similar vein, the National Water Commission recommended that, "State property rules relating to water should authorize water rights to be acquired for all social uses, noneconomic as well as economic. In particular, recreation, scenic, esthetic, water quality, fisheries, and similar instream values are kinds of social uses . . . which require protection."[3]

4. The water management system should provide for efficient utilization of water. All of us are generally opposed to waste and

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[2]National Academy of Sciences, Alternatives in Water Management, Publication 1408, (1966) p. 26.

[3]National Water Commission, Water Policies for the Future, Water Information Center, (1973) pp. 278-279.

in favor of conservation -- especially if someone else does the conserving. We should note, however, that measures to reduce waste ordinarily require additional inconvenience costs as well as money costs.

5. A water management system should be stable but amendable to change. Stability is necessary if both private and public entities are to plan and invest resources in water related activities. At the same time, the system must be flexible enough to respond to needed change. Stated differently, flexibility is needed to insure stability. This apparent contradiction in terms is best stated by Vincent Ostrom, "New knowledge gives rise to new possibilities. New possibilities give rise to opportunities both for good and for bad. New knowledge and new possibilities, in turn, lead to the erosion and obsolescence of prior technologies and the appropriateness of prior decision making arrangements . . . . As the magnitude of change in environmental conditions, technological capabilities, preference orderings and relationships among people increases, an increasing capability for altering decision rules . . . will be a necessary condition for sustaining stable social relationships."[4]

6. Finally, the overarching goal of water management should be to provide an adequate water supply to meet all needs. In the words of Governor Lamm, "A state water management system should be developed which provides an adequate supply of quality water to all

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[4]Vincent Ostrom, Institutional Arrangements for Water Resource Development, National Water Commission, (1971) pp. 54-55.

areas that have ecological, agricultural, industrial and human need, and which recognizes the social and economic impact of distribution and use."[5]

Politically Preferred Methods for Goal Attainment in Water Management

"Politically preferred" means those methods which are likely to elicit the most effective support and generate the least effective opposition. The three categories of preferred methods for attaining the goals set out in the preceding section appear to be: 1) Maintain existing rights and the legal status quo; 2) Increase the supply; 3) "Stretch out" the supply. Each of these will be considered in turn.

Maintain Existing Rights and the Legal Status Quo

The appropriations doctrine has been in operation since before Colorado became a state. Originally it was a practical method for allocating water resources and possibly was the only practical method for effectuating such allocations at that time. The appropriations doctrine has been buttressed by constitutional provisions, statutes, and an extensive body of case law. A survey of influentials in Colorado water management conducted by Larry L. Marcum (hereinafter referred to as the "survey of Colorado water influentials") found little support for abandoning the appropriations system. Furthermore, since practically all the surface flows have already been appropriated or obligated to downstream states, it is probably a

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[5]Governor Richard Lamm, statement on "Goals and Objectives for Colorado's Long Range Growth and Development," 25 August 1976.

moot question. It would be theoretically possible for the state to condemn all surface and underground waters and start over with a different system for water allocation. However, such a proposal would very likely evoke the public outrage (mentioned in Chapter II) and would, in fact, "never get to first base."

As we noted in Chapter III, "naturally, those who hold water rights wish to continue to hold them especially when they are likely to appreciate in value. It follows then, that they also wish to maintain those legal values and practices which act to protect existing rights." In fairness, we should add that this is not necessarily a selfish or dog-in-the-manger stance. A lot of "blood, sweat, and tears" have been expended in the acquisition and protection of water rights over the past century.

Finally, we may conclude with Irving K. Fox that, "It is abundantly evident . . . that the configuration of forces tending to maintain the status quo on water resources policy are enormous."

Increase the Supply

The preferred method for attaining the goals of water management is to increase the supply enough to meet most demands without disturbing the legal status quo as regards the allocation of water rights. Even more preferable are devices or methods to increase the supply at minimal costs to local residents. This last method usually means that someone else pays for it. In turn, getting someone else to pay for it, most commonly can be best accomplished by diffusing or dispersing costs as widely as possible so that the additional increment does not constitute a heavy enough burden to be worth fighting

about. The foregoing remarks are not meant to be cynical in nature but are simply a recognition (perhaps too baldly stated) of the fact that we all would prefer that someone else "pick up the tab."

The most obvious methods for increasing the water supply of arid and semi-arid states are: 1) Construction of impoundments to store runoff; 2) Maintenance of watersheds; 3) Importation of water; 4) Withdrawals of ground water; 5) Technological methods to increase water supply.

Construction of dams and reservoirs does not actually increase the total water supply but it can increase the useable supply for a given area by preventing water from "running away." Water storage also makes water available "on demand" (within limits). This last is especially important for municipalities which require a dependable supply the year round. Water impoundments can also be useful in flood control, navigation, and the maintenance of instream flows. Such impoundments are frequently opposed by some environmental groups but are usually favored by "flat-water" recreationists. In the past, most of the large dams have been constructed by the Corps of Engineers or the Bureau of Reclamation. Without going into the details of the various methods for funding such projects, they were subsidies, at least in part, to the region of construction. Such projects generally meet our criteria for preferred methods of increasing water supply.

Watershed management attempts to both slow down the rate of runoff and to increase the total supply. National forest reserves were established, in part, for watershed management purposes. While this method is less spectacular than dam building, it may, in fact, have

generally higher benefit-cost ratios than many dams. Managing a geographical area to protect or enhance water values probably must be subsidized by some public entity to be effective.

Importation of water is a preferred method for increasing supply especially if all or part of the cost of construction is paid by someone other than the recipients of the water. Even if the gaining region pays all the costs of transporting and storing water, it may still be a viable option unless those costs are prohibitively high. Regions which supply water for other areas will ordinarily resist such exportation unless they are adequately compensated in some way or unless some kind of tradeoff can be effectuated.

Groundwater pumping can be an effective method for substantially increasing the supply for short time periods or for providing a steady supplemental supply indefinitely if withdrawals do not exceed recharge rates. Pumping is also a preferred method as long as existing surface rights are protected.

Technological alternatives for increasing water supply are also preferred methods unless the costs are prohibitive and if the general public can be made to share those costs. Desalinization processes and weather modification are examples of such technologies. Most commonly the costs of research and innovation in water supply technologies are borne by the national government so the financial burdens are dispersed nation-wide.

* * *

With the exception of ground water pumping, the preferred methods for increasing water supply outlined above tend to shift the financial

costs to "someone else." This is not altogether a one way arrangement because arid regions do make substantial contributions to national income, provide preferred recreation and living areas, and sometimes provide products to the rest of the nation that would not otherwise be economically available. Examples of the latter may be fruits and vegetables produced in the arid southwest through additions to its water supply.

Stretch Out the Supply

The most common methods of stretching out the supply are sequential use, recycling and reuse, and conservation by various methods. Of the three categories of methods for goal attainment in water management, stretching out the supply is the least preferable. The most common methods of stretching the supply noted above, all involve additional expense, additional controls, additional rules and regulations, and additional supervision and coordination requirements. At the risk of being overly dramatic, these are all steps towards the regimentation of the space ship. Nevertheless, when the preferred methods have been substantially exhausted, Colorado will be forced to move in the direction of the least preferred category of methods -- stretching out the supply. Consequently, many of the specific options offered in the next section of this chapter will be in that category.

Options Under the Existing Water Rights System

In retrospect, it would appear that the prior appropriations doctrine was probably obsolete by 1900 or earlier. First come, first served is an old idea that is used to allocate football tickets,

restaurant tables and the like. It is a convenient way of allocating resources but it is not necessarily the most equitable, practical, or efficient. The appropriation system discourages conservation of water; the appropriator is encouraged to use all his "rights." It makes it difficult to store water for drouth periods. There is no sharing of risk during periods of water shortage. It is difficult to reserve water for public uses under the appropriations doctrine because it is basically a system for the acquisition and protection of private rights and tends to ignore public rights and benefits. It is pro-development and probably encourages premature development. It tends to provide unearned increments (windfall profits) and encourages speculation in water. Finally, it acts to rigidify traditional uses of water and hence all of a water dependent economy.

In recognition of these shortcomings, and possibly some others, Wyoming adopted a permit system for water allocation in 1890, Nebraska followed in 1895; Idaho in 1903; Nevada, New Mexico, North Dakota, Oklahoma and Utah in 1905; Oregon in 1909; California and Texas in 1913; Kansas and Washington in 1917; Arizona in 1919; and Montana in 1973.

If we concede that the prior appropriations system is obsolete, and probably has been for a long time, it is now too late to change the basic system. All the reliable flows have been appropriated and a change to another system would be drastically disruptive. At this point in time, it would also appear to be politically impossible to change the basic system for water allocation. If that is the case, we are then confronted with the necessity of trying to make the present system function more effectively. The options considered below are therefore in the

category of "tinkering" with the basic appropriations system or of making other changes that might increase its efficiency.

Discourage Population Growth in the Front Range Corridor

Since population growth and a finite water supply appear to be on a collision course, it would appear logical to discourage further population growth along the front range. Various methods could be used to discourage additional development. Various kinds of fees and assessments could be levied on new industry and new housing. New developments could be required to furnish water shares, or equivalent dollar amounts, equal to or greater than, their expected consumption of water. This device is presently being used in some communities. Substantially higher fees could be levied for new water taps. Tax incentives or other subsidies to new industry could be prohibited. Many other methods could be developed which would discourage new industry and population growth.

It seems unlikely that most such proposals will be seriously considered until the area reaches a stage of continuing crisis in water supply.

A resolution passed by the Colorado Water Congress (which represents a broad spectrum of Colorado water users) may be representative of current attitudes on limiting population growth through manipulation of water rights: "Be it resolved that the Colorado Water Congress opposes any legislation which would seek to use control of water rights as a planning or zoning tool to control or direct population growth."[6]

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[6]Colorado Water Congress, 1976 Resolutions, No. 1975-2.

Integrate Land and Water Use Planning

The need to coordinate land and water use in planning and zoning seems self evident. In water-short states the two are interrelated and interdependent. The following recommendations of the Bureau of Reclamation are typical statements of this concept.

> Water planning must be tied to land use planning and, conversely, land use planning should consider water availability.
>
> In general, land use planning could affect the location of population growth and, to a lesser extent, the growth rate. The state should take the lead in coordinating water planning and determine those programs to be implemented.[7]

In similar vein, the National Water Commission recommended that "If Congress enacts legislation to establish a program of Federal grants to States for improving State land use planning, it should make adequate provision in that legislation for the coordination of water and land use planning at the State, Federal, and local levels. . . ."[8]

John Undem Carlson, in the Holland and Hart report prepared for Governor Love, observed that

> Returning to the doctrine of prior appropriation, as contained in article XVI, sections 5 and 6, it may be argued that it necessarily carries with it the right to put water to whatever use the owner sees fit whenever he sees fit. This

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[7]U.S. Department of the Interior, Bureau of Reclamation, Critical Water Problems Facing the Eleven Western States, (1975) p. 268.

[8]National Water Commission, Water Policies for the Future, Water Information Center, (1973) p. 369.

> argument depends on an exaltation of the property right in water to a unique, insulated and forever unassailable position. It is believed that there are no property rights so utterly beyond state control.[9]

Carlson then considered the possibility of zoning water use in somewhat the same way, and on a similar legal basis, as is used in land use zoning. He decided that:

> The conclusions are that, except for curtailing waste and nonbeneficial uses, there is little practical prospect for affecting the present place or nature of use of existing water rights without the payment of compensation; that phasing out nonconforming uses in water is not a promising approach; and that the preference system poses a possible obstacle even to condemnation.[10]

He did suggest, however, that future changes of use might be controlled under guidelines established by the legislature.

> It is possible to construct a system of regulation of changes in water rights, reasonable and in accordance with clear legislative guidelines, which does not amount to an unconstitutional taking or damaging of property. Setting aside for the moment the sections of

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[9]John Undem Carlson, "Report to Governor John A. Love on Certain Colorado Water Law Problems," Denver Law Journal, Vol. 50, No.3, (1973-74) p. 345.

[10]Ibid., p. 342.

> the Colorado constitution dealing specifically with water rights, the analogy of regulating water rights to clearly constitutional regulation of property uses arising from zoning and land planning holds promise. Property rights in land are subject to very significant limitations in use under zoning laws, yet such laws, if they are a reasonable exercise of the police power, are upheld against constitutional attack. There is no necessary reason to exalt water rights above other kinds of property rights.[11]

In our survey of Colorado water influentials, we hypothesized that "A state body should be established to coordinate land use planning with water management." While there was universal recognition of the interrelationship between land use planning and water management, there was little agreement with the hypothesis as stated. There was generally a fear that strong state involvement in this matter would: (1) weaken the free market system and the concept of private ownership of property; and (2) a strong bias in favor of local control of land use and water management. The study concluded that: "at the present time, the political climate is such that a strengthened and expanded state land (and water) use planning body would probably not be acceptable."[12]

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[11] Ibid., p. 345.

[12] Larry L. Marcum, op cit., p. 96.

Methods for Facilitating State Action to Preserve and Enhance Societal Values of Water

Are there any options available to the state of Colorado under the appropriations doctrine to preserve and enhance outdoor recreation opportunities, aesthetic values, and fish and wildlife values? These matters are of concern to Coloradoans who wish to maintain a "quality" natural environment. They are also the basis for tourism which is one of Colorado's largest industries. They should also be matters of concern to developers and other groups who are interested in attracting more industry and people to the state. It seems obvious that, if those qualities that make Colorado attractive are destroyed, it will no longer be attractive.

The National Water Commission recommended:

> State property rules relating to water should authorize water rights to be acquired for all social uses, non-economic as well as economic. In particular, recreation, scenic, esthetic, water quality, fisheries, and similar instream values are kinds of social uses, heretofore neglected, which require protection.
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> . . .
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> Public rights should be secured through State legislation authorizing administrative withdrawal or public reservation of sufficient unappropriated water needed for minimum streamflows in order to maintain scenic values, water quality, fishery resources, and the natural stream environment. . . .[13]

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[13]National Water Commisison, op cit., pp. 278-279.

Colorado has gone part of the way in meeting these recommendations. The statutes define "beneficial use" to include ". . . the impoundment of water for recreational purposes, including fishery or wildlife. For the benefit and enjoyment of present and future generations, "beneficial use" shall also include the appropriation by the state of Colorado . . . of such minimum flows . . . on natural streams and lakes as are required to preserve the natural environment to a reasonable degree."[14]

Whether these statutory provisions are constitutional or not is still open to question. The constitution lists only domestic, agricultural and manufacturing as beneficial uses.[15] Even if the constitutional question should be favorably decided, most if not all water has been appropriated so appropriations by the state of Colorado must be among the most junior of appropriators. Consequently, the statutory provisions appear to have very limited impact.

We might note in passing that the maintenance of instream flows near the borders of the state would reduce the amount of water available to Coloradoans.

In our survey of Colorado water influentials, we hypothesized that "Outdoor recreation and fish and wildlife values should be legally recognized as beneficial uses of water in Colorado." There was almost complete support for this concept and a general belief that, if the statute was found to be unconstitutional, the constitution

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[14]Colorado Revised Statutes, Chapt. 148, Art. 21, Section 7.

[15]Colorado Constitution, Art. XVI, Section 6.

could be amended to recognize outdoor recreation and fish and wildlife values as beneficial uses of water.[16]

The survey also hypothesized that "A separate governmental unit should be established to coordinate outdoor recreation and fish and wildlife with water management." There was very little support for this hypothesis. "Objections were not based on the concept itself but on the need for a separate state coordinating body. The most common response was that these functions are already being coordinated (both formally and informally) and that an additional unit of government is unnecessary."[17]

While Federal ownership of about 36 percent of the area of Colorado creates some problems, such ownership does provide a large "reserve" of the societal values discussed above. We should also note that water quality control measures have the effect of expanding opportunities for water based outdoor recreation and also for improving fish and wildlife habitat.

Options for Facilitating the Operation of the Colorado Water Market

Many persons believe that problems of water allocation could best be solved by removing restrictions on water transactions so the market could operate freely. There are some undeniable advantages to such a system in terms of flexibility, simplicity, and "automatic" pricing according to the equilibrium between supply and demand.

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[16] Larry L. Marcum, op cit., p. 64.

[17] Ibid., p. 97.

We have all heard the cliche that, in Colorado, water flows uphill towards money. This statement is only partially correct. Among the restrictions on the free and uninhibited operation of the market are the requirements of beneficial use and priority of uses, the requirements of "due diligence" in conditional decrees, standards for determining abandonment and forfeiture, and restrictions on change of use.

We should notice first, that the appropriations system for acquiring water rights is not a market system. It is simply a method of making gifts of public property to private persons on a first taker basis. If the market system had been originally adhered to, water rights would have been sold to the highest bidder. The point is that the appropriations doctrine is a non-market system for allocating water rights. If, at this late date, proponents of a free market in water are truly serious, they should advocate expropriation of all water rights and resale to the highest bidder.

The concept of beneficial use also acts as a deterrent to free operation of the market. In the words of Timothy Tregarthen: "The doctrine of beneficial use, with its implications of judicial determination of need and non-use, in effect increases the uncertainty of title to rights in water, and therefore their marketability."[18]

Tregarthen has similar comments with reference to priority or preferential use:

> The doctrine of preferential use is similar in spirit to the beneficial use doctrine in that it imposes a non-market

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[18]Timothy D. Tregarthen, "The Market for Property Rights in Water," The Denver Journal of International Law and Policy, Vol 6, Special Issue, (1976) p. 369.

> test of priorities in rights. In its most common form, the doctrine holds that domestic uses of water have priority over agricultural uses, which in turn have priority over manufacturing uses. The notion is quite silly. All economic activity is ultimately for domestic use, that is, consumption. The eating of food off a manufactured plate does not seem greatly less domestic than washing the plate afterwards.[19]

Tregarthen goes on to suggest that a true market system in water would reduce waste because the costs (prices) of water would presumably be higher than they are now.

Generally, the same kinds of arguments could be advanced with reference to change of use, due diligence in perfecting conditional decrees, abandonment and forfeiture, and the threat or possibility of condemnation proceedings.

To these kinds of arguments, Robert Emmet Clark, a distinguished professor of law, has a scathing rejoinder:

> But the market place is a wonderful thing to talk about; it is a wonderful myth. The economists have an objective standard that we in the law do not, since we deal in "weasel words" like "justice", "fairness", "equality", and "equity." The economists use "money" and they use it to measure love, and debt, and water

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[19] Ibid., p. 370.

> rights. The economists cannot adequately measure the law's concerns, and the marketplace cannot be allowed to dictate the laws functions.[20]

Some fifteen years ago, Irving K. Fox and Lyle E. Craine proposed a compromise arrangement that would appear to be promising.

> As one means of motivating public water development agencies to reflect more accurately the values and objectives of society, serious consideration should be given to possibilities for using to a greater extent "market-like" forces to determine the kind and amount of water services provided.
>
> . . . .
>
> The pricing of services in accordance with costs has the advantage of permitting the consumer to indicate directly the value he attaches to the service provided. Individual preferences are expressed and development can proceed in accord with with those preferences.[21]

A variation on the Fox-Craine theme is a proposal by a Utah State University team that would levy water user fees similar to an excise tax. The authors contend that water user fees "would be an economically more efficient and equitable source of financing water

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[20]Robert Emmet Clark, "Water Law and the Public Interest," Denver Journal of International Law and Policy, Vol. 6, Special Issue, (1976) pp. 338-339.

[21]Irving K. Fox and Lyle E. Craine, "Organizational Arrangements for Water Development," Natural Resources Journal, Vol. 2, No. 1, (April 1972) p. 36.

development than general tax revenues."[22]

The possibilities of water user fees should be seriously considered by the state of Colorado. Such fees could provide funds for state water development projects and would also presumably reduce waste of water. Such a user fee structure could be the same for all water users or differential rates could be imposed for different categories of use. Fees for water used in energy production might, for example, be higher than fees levied on other uses.

It would appear that statutes and procedures for effectuating temporary transfers of water should be examined with a view of facilitating such transfers. Trades and deferred trades, leases or rentals, temporary changes of use or temporary permits, and possibly easements, should make the water system more flexible and better utilize scarce supplies. Such temporary transfers should obviously not jeopardize the status of existing water rights if the present system is to be maintained.[23]

Regardless of the method, or combination of methods, that might be used to "free up" the water market one inevitable result appears to be a reduction in water available for irrigated agriculture. Our survey of Colorado water influentials was in almost unanimous agreement on this point. There was, however, considerable disagreement as to the seriousness of the problem and methods which might be used to alleviate it. Some respondents believed that the problem was

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[22]See Hoggan, Asplund, Anderson, and Houston, A Study of Feasibility of State Water User Fees for Financing Water Development, Water Research Laboratory, Utah State University, Logan, Utah, (1977).

[23]See L. M. Hartman and Don Seastone, Water Transfers: Economic Efficiency and Alternative Institutions, The Johns Hopkins Press, (1970).

exaggerated because irrigation now consumes the major portion of the state's waters so the potential amount consumed by expanding municipal and industrial uses would be insignificant. Such respondents also pointed out that processed return flows from municipal and industrial uses return to the river and can be used again downstream. The significance of the loss to irrigated agriculture, in fact, depends upon the rate of growth and amount of municipal and industrial demands. If Colorado should ever become close to being the nation's "energy capitol" the water demands will be enormous.

Other respondents believed that water conservation could solve the problem. Conservation would undoubtedly help but waste prevention is not "free" as we will discuss later in this chapter.

Lastly, if obstructions to the free operation of the water market are to be removed or reduced, the state should be adequately funded and allowed to enter the water market to protect societal values.

Improved Water Quality Management as an Aid to More Effective Water Use

It should be clear that the quality of water determines the quantity available for any given use. Water quality is important everywhere but it is especially important in water short regions and more important still in states, like Colorado, where tourism is "big business" and where protection of the natural environment has high priority.

We should also note that different uses require different levels of water quality -- all uses do not require highest quality water.

Furthermore, "pollutants" of one sort can be tolerated in some uses and not in others. Silt, for example, is ordinarily considered objectionable, if present in significant quantities, but the Bessemer Ditch Company recently won a suit in which they alleged that they were being deprived of their right to "silty" water.[24]

Since water quality determines useable water quantity, authorities on water management seem to be in agreement that the two functions should be administered by the same agency. As early as 1957, the Council of State Governments cautiously observed that: "Properly to relate pollution control to other parts of an overall state water program, some states may find it desirable to place the administration of the pollution program within a coordinated water agency."[25]

The National Water Commission remarked that "Water quality planning should be a composite of water supply planning, other water resource planning. . . ."[26]

In a report to the National Water Commission, the Utah State University Foundation concluded that:

> Since quality and quantity problems are inseparable in actual use situations, but governed or administered separately by independent agencies, the potential for conflict is obvious. Most states have adopted strong statewide goals

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[24]Colorado Supreme Court, August 21, 1978. The Court held that appropriators are entitled to protection against detrimental changes in water quality.

[25]William L. Frederick, Director of Research, State Administration of Water Resources, Council of State Governments, (1957) p. 69.

[26]National Water Commission, op cit., p. 83.

> in water quality management. As these are pursued, attention must be paid to the body of existing law pertaining to water rights or there may result some unreasonable and severe impairments to maximizing water utility. California has wisely recognized that jurisdiction over water quality should be correlated with the function of allocating water quantity by combining the water rights and water quality control functions.[27]

Walker and Cox, in considering water quality problems in Virginia, recommended that: "The wastewater management function of the State Department of Health should be transferred to the State Water Control Board."[28]

A review draft of the Interagency Task Force on Irrigation Efficiencies (presumably not for quotation) observed that separate agencies for water quantity and quality control were potentially conflicting and that integration of water quantity and quality control laws should be a matter of top priority -- especially for western states.[29]

With special reference to Colorado, George Radosevich et al concluded that: "Two issues must be clearly resolved and accomplished

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[27]Utah State University Foundation, Extending Utility of Non-Urban Water Supply, Logan Utah, (1971) p. 102.

[28]William R. Walker and William E. Cox, Water Resources Administation in Virginia, Virginia Water Resources Center, Bulletin 107, (1976) p. 237.

[29]See Technical Work Group for the Interagency Task Force on Irrigation Efficiencies, Irrigation Water Use and Management, Review Draft, June 1978.

. . . if Colorado is to be successful in fully utilizing the tremendous potential of its water resources: (1) There must be an integration of water quantity and quality into one law and agency. . . ."[30]

Overall responsibility for water quality control in Colorado is lodged in the state Water Quality Control Commission and the Water Quality Control Division of the Department of Health. The present system was authorized by the Water Quality Control Act of 1973.[31] Generally speaking, the Commission is the policy making body while the Public Health Department carries out the day-to-day administration of the statutes and the policies of the Commission.

In drafting the 1973 act, the legislature was mindful of the need to coordinate the interests and needs of various sections of the state and the water-related agencies of state government. They hoped to accomplish this needed coordination through the membership of the Commission. Consequently they specified that the membership of the Commission be composed of the following: the Director of the Department of Natural Resources, one member of the State Board of Health, one member of the Wildlife Commission, one member of the Colorado Water Conservation Board, one member from each of the five congressional districts to be appointed by the governor, and two members at large also appointed by the governor.

The wisdom of using ex-officio officers in a policy making body is questionable. Even more questionable is the use of part-time

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[30]G.E. Radosevich, K.C. Nobe, R.L. Meek and J.E. Flack, Economic, Political and Legal Aspects of Colorado Water Law, Environmental Resources Center, Report No. 44, Colorado State University, (1973) pp. 47-48.

[31]Colorado Revised Statutes, 25-8-101 to 25-8-704.

citizen boards. In neither case do the members have the time to become expert in the matters under consideration. They are also likely to take a parochial view of state problems and think of themselves as representatives of either a state agency or a particular section of the state. This last is, of course, what the legislature intended -- that the Commission be representative of different points of view and different interests. In such situations, however, there is a tendency for the members to defer to the member who has the most direct interest in a particular problem -- and to expect that he will defer to them on matters that most directly affect their agency or section of the state.

Probably of greater importance than the composition of the Commission is the location within the Public Health Department. As we have spelled out in some detail, the weight of informed opinion seems to be that both water quantity and water quality management should be located in the same agency.

In our survey of Colorado water influentials, we proposed that: "The water quality function should be transferred from Public Health to the State Engineer's Office or established as a separate unit. Placement in Public Health puts water quality in a medical frame of reference in which human health becomes the main consideration. Other factors such as salinity, turbidity, and outdoor recreation tend to be ignored or downgraded." This proposal received little support. There appeared to be a general belief that the Water Quality Commission was doing a good job so it should not be disturbed. One

informed respondent explained the placement of the agency in Public Health saying that: "The people who are use oriented (irrigators, industry) are not the ones to clean up the river. It needs to be separated from the State Engineer's Office and put in a free standing agency. It was put in Public Health because they seemed to have the technical skills required."

Respondents, generally, did not seem to be especially concerned about this proposition; there were no really strong sentiments pro or con. It seems most unlikely that this lack of concern and general satisfaction with the present system can continue for very long.

Water Courts and Referees

The Water Right Administration and Determination Act of 1969 established a system of water judges for each of the seven water divisions of the state. The water judge is a district judge who is designated "water judge" by the Supreme Court. The water judge acts on water matters in addition to his other duties as district judge except that water cases have priority in his court. The water judge is selected from among the district judges in each water division.[32] The water judge system was an effort by the legislature to add expertise to the judicial system by allowing some district judges to specialize in water matters. This was undoubtedly an improvement over the previous system. However, it may not have gone far enough. In the survey of Colorado water influentials we hypothesized that: "The present water judges should be assigned to

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[32]Colorado Revised Statutes, 148-21-10.

a single state water court. Such a change should produce more consistent and rational decisions." As could be expected, the reaction to this hypothesis was mixed. There was general acceptance of the need for greater expertness and a better distribution of case loads among water judges. Those reacting negatively to the hypothesis did so out of a belief that a state water court would be less sensitive and knowledgeable about local conditions; that travel to Denver would increase costs and general inconvenience; and that a state water court might come to be dominated by front range interests. A modification of the hypothesis -- that judges of the proposed State Water Court "ride circuit" among the various water divisions met with less resistance.[33]

The water judge is authorized to appoint referees "For the purpose of making investigations required by section 148-21-18 and rulings required by section 142-21-19. . . ."[34] Referees may be full-time, part-time or contractual court employees. Referees make decisions on water matters and they constitute a de facto court of original jurisdiction in water matters. Referees may re-refer matters to the water judge and appeals to the water judge may be taken from decisions of the referee.

The water referee systems appears to be in direct contradiction to the implied intent of the legislature in establishing a system of expert, specialized water courts. Referees may be part time amateurs

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[33]Larry L. Marcum, op cit., pp. 57-58.

[34]Colorado Revised Statutes, 148-21-10.

as regards complex water matters. Furthermore, there is a greater likelihood that they will have local biases and perhaps, in some cases, conflicts of interest as compared with full time, career officials.

The arguments in favor of the present referee system are that it provides a flexible arrangement for handling a changeable work load and that local referees are more likely to understand local situations. Related to this last is a belief that state referees would be more arbitrary and likely to "go by the book." We might note that the terms "arbitrary" and "go by the book" have connotations of impartiality and consistency.

Our survey of Colorado water influentials hypothesized that: "The present water referee system and its functions should be transferred to the Office of the State Engineer with appeals to the courts possible. Such a change should produce more consistent and rational decisions." We found most opposition to this hypothesis from water lawyers, representatives of local water agencies, and some agricultural groups.[35] The original Water Right Determination and Administrative Act of 1969 placed the water referee function in the state engineer's office but the bill was amended in the House of Representatives to establish the present referee syteem. It would appear that the political climate of the state has not changed enough in the past nine years to make the proposed change feasible.

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[35] Larry L. Marcum, op cit., pp. 55-56.

Alleviating Colorado Water Problems by Increasing the Supply

If population growth cannot, or will not, be limited or directed, the next obvious possibility is to try to expand the existing supply of water. As previously discussed, this is a preferred option which (if it can be accomplished) will solve most of the problems. There are several possibilities for augmenting the present supply. Each of these will be considered in some detail.

Construction of Additional Water Impoundments

While the most promising sites have already been developed, there still remain several points where dams could be constructed which would increase the useable water supply. Some of these are marginal in terms of benefit-cost analysis as presently calculated and some of them would have the effect of reducing volume of flow to downstream states. Nevertheless, additional water development projects appears to be a viable method for increasing supply if methods for adequate financing can be developed.

Federal funding of water projects is presently being curtailed. If that is "the shape of things to come", other methods of financing should be considered which would enable the state to construct additional projects. However, Article XI of the State Constitution prohibits the state from incurring "any debt by loan in any form." If the constitutional prohibition could be amended or circumvented in some way, there would still remain the problem of how to market bonds. Revenue bonds might be difficult to market without a definite revenue producing project and a history of similar successful state

projects. If bonds were marketed under the full faith and credit of the state, then it would appear that such projects should be of recognizable benefit to the entire state. California developed such a funding program some time ago and, according to William Warne: "More than a billion and a half of water project bonds are outstanding, underwritten by the full faith and credit of the state, but relying on water service contractors to pay their annual charges in order to meet the interest and bond redemption schedules. So far the water user payments have met all bond charges and built up a reserve."[36]

In 1971, the legislature established a "Colorado Water Conservation Board Construction Fund" in an amount not to exceed $10 million to finance water projects selected by the legislature. This was to be a revolving fund; year end balances were not to revert to the general fund except for amounts over $10 million. The Colorado Water Conservation Board may levy such charges on the using entity as are necessary to recover its capital investment and associated costs. If the state is to become seriously involved in the construction of water developments, it seems obvious that this fund, or some other funding arrangement, will need to be very substantially expanded.

If it is not feasible for the state to expand its water development projects, such developments could be undertaken by one of the three water conservation districts or by one, or a combination, of water conservancy districts. Larger municipalities could, of course,

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[36]William Warne, "Drought," Public Administration News and Views, July 1977, p. 19.

continue to finance and construct water impoundments. W. D. Farr, chairman of the Greeley Water and Sewage Board, has suggested that a consortium of ditch companies and cities along the South Platte could build a "Narrows type" dam and reservoir.[37]

If the days of Federal funding state projects are over, as appears to be the case, states or their subunits will be forced to find methods for financing local projects.[38] Some tentative suggestions for funding such projects have been noted above.

The preceding discussion was based on the assumption that additional water projects in Colorado are necessary and desirable. This viewopint is disputed by environmental groups who maintain that some existing projects were unnecessary, and that their damage to the environemnt has exceeded any possible benefits. As previously mentioned, "flat-water" recreationists generally support additional water impoundments.

Improvements in Watershed Management

Watershed management is especially important in Colorado because much of the streamflow originates from rain and snowfall at higher elevations. At these high elevations, natural ecosystems are fragile and more susceptible to damage than at lower elevations. There are two general methods for enhancing watershed effectiveness:

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[37]W. D. Farr, "Challenge to Innovation," Colorado Drought Workshop, Denver, Colorado, November 29, 1977.

[38]For a perceptive discussion of these developments, see Henry P. Caulfield, Jr., "Let's Dismantle the Federal Water Resource Development Establishment, or the Apostasy of a Longstanding Water Development Federalist," Panel on the Role of Federal, State and Local Governments, National Conference on Water, U.S. Water Resources Council, April 22-24, 1975, and by the same author, "Planning Programs and Water Problems: Do they Match?" National Conference on Water, St. Louis, Missouri, May 24, 1977.

maintaining or improving present vegetation and modifying vegetation within watersheds. The most common methods for maintaining or improving vegetation are restrictions on grazing and timber harvesting. Other improvements can be made by reseeding and reforestation methods.

Various methods can also be used to "save snow" by reducing the rate of evaporation. Such techniques include snow fences of various kinds and the use of man made avalanches to concentrate snowpack.

Since much of the high country in Colorado is "owned" by the Forest Service, Bureau of Land Management, or the National Park Service, these agencies have assumed most of the responsibility for maintaining watersheds. It would appear logical that Colorado should investigate possibilities for greater state involvement in this important area of water production. To repeat a previous statement, watershed management may be less spectacular than dam building and the results may be less obvious but, in some cases, benefit-cost ratios may be higher.

Importation of Water

These remarks on importation of water are mainly a summary of a more extended discussion in Chapter V.

Western Colorado with 37 percent of the area of the state has about 69 percent of the state's total surface water yield. More importantly, most of the population, industry, and irrigated agriculture is east of the Continental Divide. The people are where the water is not. One might ask, "Why don't the people move to the areas of water abundance?" To some extent, this has

happened but there are many exceptions. The cities of Denver, Salt Lake City, Los Angeles, Phoenix, and Tucson are among the most obvious examples of moving water to people rather than moving people to water.

Coloradoans on the east slope have tried to move water eastward across, or through, the mountains since the first small ditch was built across Hoosier Pass in 1860. Since that time the major diversions across the Divide have been Chambers Lake, Twin Lakes Tunnel, Moffat Tunnel, Jones Pass Tunnel, Colorado-Big Thompson, Roberts Tunnel, and the Fryingpan-Arkansas project. Federal funding played a major role inthe construction of most of these projects.

Transmountain diversions fall into the preferred category of options for increasing water supply if part of the costs are borne by the Federal government and if there is not too much opposition from the area which loses water.

It seems unlikely that any further major transmountain diversions will be attempted in Colorado in the foreseeable future. Federal funding for intrastate interbasin diversions would seem to be foreclosed at least for the immediate future. Furthermore, if such funds should become available, the Colorado Water Conservation Board resolved, in 1969, that it would not approve any additional transmountain diversions, financed with Federal funds, until the total water requirements of the West Slope had been determined. It also seems unlikely that the West Slope will voluntarily give up any more water unless compensating amounts are supplied in some way.

Environmental groups are also likely to oppose further diversions. Forest Service ownership of lands along the Continental Divide could impede acquisition of rights of way. The Colorado Water Conservation Board has filed applications for instream decrees under provisions of a 1973 act. Finally, energy developments on the west slope are certain to demand additional water. In the words of Raphael J. Moses, ". . . the day of the major transmountain diversion of water in Colorado has passed . . . . Any one (of the problems listed above) is probably enough. The combination is overwhelming."

We will not speculate here about the possibilities for importing water from Canada or from the Columbia. We can only reiterate that intrastate transmountain diversions are not likely in the foreseeable future so that potential source of supply for the east slope appears to be foreclosed.

Increasing Supply Through Ground Water Withdrawals

Use of ground water is a preferred option for augmenting or replacing surface water if the supply is available and pumping costs are not prohibitive. When such conditions exist, ground water has one or more of the following advantages over suface water:

1. "Conflicts among joint and alternative water users are somewhat minimized as contrasted with users of surface supplies. Fish and wildlife, recreation, and navigation are unlikely to be impaired by ground water developments.[39]

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[39]See Vincent Ostrom, Institutional Arrangements for Water Resource Development, National Water Commission, (1971) pp. 548-549.

2. Ground water may be reached within a few hundred feet of the place where it is to be used, and on the same property, whereas surface water may require pipelines and rights-of-way over stretches of several miles.
3. Ground water may be available for use in areas where the water in streams and lakes has already been appropriated by other users.
4. Yield from wells and springs generally fluctuates less than streamflow in alternating wet and dry periods.
5. Ground water is more uniform in temperature and soluble mineral load than surface water, and is generally free of turbidity and bacterial pollution.[40]
6. There are no storage costs and no evaporation losses in storage and transmission.

Most of the ground water development in Colorado has occured since World War II. Since that time the technology for drilling and pumping plus the development of various devices for applying water to land, e.g., sprinkler systems, have advanced far enough to make irrigation from wells practical. When extensive pumping began, it soon became evident that some wells were draining water from a steam and thus injuring the rights of surface water appropriators. Water from such aquifers came to be called "tributary" water because if was found to be connected with a stream. Obviously, it is sometimes difficult to define the exact boundaries of a tributary aquifer. We should

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[40]U.S. Department of Agriculture, The Yearbook of Agriculture , (1955) pp. 63-74.

also noted that withdrawals from a stream may lower the ground water table in tributary aquifers.

At the same time that wells were being drilled in tributary aquifers, other wells were being drilled in areas that were not connected to any stream. These were called "closed" basins or aquifers. Wells drilled in closed aquifers do not injure or reduce the rights of prior appropriators of surface water but they may reduce the amount of water available to other wells in the same closed aquifers.

Tributary aquifers are supposedly recharged both by precipitation and by stream flows while closed aquifers are recharged by precipitation only. Consequently, recharge of closed aquifers is ordinarily slower than the recharge rate of tributary aquifers.

The general disadvantages of ground water for augmenting supplies are the slow recharge rate and the relative uncontrollability of the groundwater source. These factors tend to encourage withdrawals faster than the recharge rate -- "mining" the resource. As the water table falls, pumping becomes more expensive and eventually becomes impractical. When that happens, communities based on a ground water economy become ghost towns and individual pumpers either go bankrupt or quit before that point is reached.

The thought of mining water that has taken hundreds or thousands of years to accumulate is repugnant to many people but it is no worse than mining coal or oil that is even older. This last is correct, however, only if the pumpers, and those dependent upon them, are aware that the water source will eventually be depleted. If energy costs continue to rise with consequent higher costs of pumping, that day may

come sooner than expected.[41] The policy of the Colorado Groundwater Commission on applications for new wells in designated basins in eastern Colorado is to analyze the application "on the basis of permitting 40 percent depletion of the saturated thickness of the aquifer within a circle three miles in radius and a time period of 25 years."[42] This may sound like an exact basis for evaluation but with several dozen new applications being filed every day and with several thousand wells already in operation with different drilling dates plus seasonal variations in recharge rate, it becomes considerably less precise.

Ground water in Colorado is administered under two basic statutes: the Ground Water Management Act of 1965[43] and the Water Right Determination and Administration Act of 1969.[44] A particularly important part of the 1969 Act was the declaration of legislative intent that: "It is the policy of this state to integrate the appropriation, use and administration of underground water tributary to a stream with the use of surface water in such a way as to maximize the beneficial use of all the waters of this state."[45] This declaration was supported by

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[41] See Doug Sorenson, "Water will Outlast Energy to Pump it," Irrigation Age, October 1976, p. 31.

[42] C. J. Kuiper, State Engineer, "Colorado: The Problem of Underground Water," Denver Journal of International Law and Policy, Vol. 6, Special Issue, (1976) p. 456.

[43] Colorado Revised Statutes, 37-90-101 to 141.

[44] Ibid, 37-92-101 to 602.

[45] Ibid., 37-92-102(1).

other provisions of the Act which allowed plans for augmentation of the total supply of a given stream and its tributary aquifers.[46]

Administration of water in designated ground water basins is carried out by a Ground Water Commission, the State Engineer and by local Ground Water Management Districts. In general terms, the Commission is the policy forming unit while the State Engineer carries out the day-to-day administration of the Acts and the policies of the Commission. The Water Management Districts are a form of special district with the usual powers and responsibilities of such districts. In addition, they have the authority to enact rules for conserving, preserving, protecting, and recharging the groundwater of their respective districts.

The Ground Water Commission consists of twelve members: seven "resident agriculturists," two members representing municipal and industrial water users of the state and three voting ex-officio members; the director of the Department of Natural Resources, the director of the Colorado Water Conservation Board and the State Engineer. It would appear that the Commission is heavily weighted in favor of agricultural interests but it may be argued that such representation is justified since most ground water is used for irrigation. However, considerable amounts of underground water are used for municipal uses and, when surface supplies cannot meet demands, there will be increasing pressure to use ground water to augment municipal supplies.

Management districts are governed by resident elected boards of directors.

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[46] Ibid., 37-92-103(a).

Coordination of ground water management with surface water and other related water matters is supposed to be accomplished by inclusion of the three ex-officio state officials as voting members.

If the legislature really intended to "integrate the appropriations, use and administration of underground water . . . with the use of surface water in such a way as to maximize the beneficial use of all the waters of this state" as stated in the preamble to the 1969 Act, it does not appear logical to have created separate policy making and administrative units to manage ground water. One does not ordinarily attempt to integrate functions by separating them. Presumably, at the time the two basic acts were under consideration, there existed too much conflict between pumpers and surface water users to permit the integration objective envisioned in the 1969 Act. That may still be the situation in 1978. However, the creation of additional governmental units to manage groundwater must inevitably lead to still greater fragmentation in statewide water management and less efficient use of water.

As competition for water increases, it seems safe to predict that the administration of both surface and ground waters must be integrated in a single unit. The sooner this integration occurs the better it will be for the state of Colorado. These conclusions are in agreement with the National Water Commission's Recommendation No. 7-4: "The States should adopt legislation authorizing the establishment of water management agencies with powers to manage surface water and ground water supplies conjunctively . . . ."[47]

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[47] National Water Commission, Water Policies for the Future, Water Information Center, (1973) p. 235.

Precipitation Augmentation to Increase Water Supply

Precipitation augmentation (weather modification) is a preferred option for increasing water supply if the costs are not prohibitive and if the increased precipitation does not unduly disrupt other activities that require clear, dry weather. Cloud seeding experiments have been conducted for some twenty years so the technique is now advanced far enough to have practical application. The Bureau of Reclamation estimates that "Augmentation of Colorado River flows by as much as 1.3 million acre-feet annually through weather modification appears physically and economically practicable."[48]

Lewis O. Grant, one of the pioneers in precipitation augmentation research, asserts that ". . . the potential for water augmentation from Colorado watersheds should be of the order of 1.5 to 2.0 million acre-feet per year."[49] Grant also maintains that "The direct cost of the augmentation would be low in relation to present water values and particularly those to be expected in the future."[50] Clearly, precipitation augmentation has moved out of the science-fiction era and may now be a practical method for increasing water supply.

Solving the physical problem of precipitation augmentation gives rise to other problems. Some of these problems are listed below.

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[48]U.S. Bureau of Reclamation, Critical Water Problems Facing the Eleven Western States, (1975) pp. 174-175.

[49]Lewis O. Grant and Kelvin S. Danielson, "Augmentation and Conservation of Water Resources, Denver Journal of International Law and Policy, Special Issue, (1976) p. 503.

[50]Ibid.

1. Who should pay the costs of precipitation augmentation? Should the state government (general taxpayers) pay for water which directly benefits only a small proportion of the public?
2. Who owns the rights to the "new" water? Should those rights be distributed according to the present system of prior appropriation? If not, what other system might be used? If another system is used, how does one separate the "new" water from the "old" water or measure the amount of the "new" water?
3. If precipitation augmentation is paid for by private individuals or firms, how will that affect previous water rights they may already own? If they cause damage to downstream populations, what are their liabilities?
4. If cloud seeding operations are carried on by private entrepreneurs, how are their activities to be controlled?
5. At the present stage of the technology, most precipitation augmentation occurs in higher elevations during winter months. How are residents of these areas to be compensated for the additional costs and inconveniences caused by additional snowfall? They get the "dis-benefits" but usually none of the benefits.
6. If the benefits of precipitation augmentation are to be maximized, substantially greater attention must be given to watershed management. If watersheds are managed solely for the purpose of increasing and regulating water supplies, dis-benefits may accrue to persons engaged in timber harvest, grazing, and outdoor recreation. How are they to be compensated for probable losses? Much of the watershed area is

> administereed by the Federal government. Who should pay the costs of more intensive watershed management? Does the Federal government have first call on the "new" water under the reserved rights doctrine?[51]

One may draw two general conclusions from the foregoing discussion: (1) the state of Colorado should encourage and support continued research in precipitation augmentation; (2) the problems outlined above (and related problem areas) should be thoroughly investigated and solutions developed which are both practical and equitable. This will be no easy task.

Increasing Supply Through Modifications of Interstate Compacts and Supreme Court Decisions

The possibility of obtaining favorable modifications of interstate compacts and Supreme Court decisions affecting interstate water commitments (analyzed in Chapter VI) is probably extremely low but it may be worth further study. The fact that conditions have changed or that some compacts may have been based on erroneous estimates would not appear to be a legitimate basis for abrogating any such compacts. The concept of "equitable apportionment" first enunciated by the Court in Kansas v. Colorado[52] might, or might not, provide the basis for re-negotiations or possible litigation.

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[51] For a discussion of these, and similar problems, see Danielson, Sherk, and Grant, "Legal System Requirements to Control and Facilitate Water Augmentation in the Western United States," Denver Journal of International Law and Policy, Vol. 6, Special Issue, (1976) pp. 511-525.

[52] Kansas v. Colorado, Supreme Court of the United States, 206 U.S. 46 (1907).

Federal Reserve Rights and Indian Claims

As noted in Chapter VI, the reserved rights doctrine holds that the Federal government acquired water rights when it created reservations out of the public domain. Apparently the right exists in perpetuity and the concepts of due diligence, forfeiture and abandonment do not apply. Perhaps of greatest significance was the presumption that the water reservation was for an indeterminate amount that could, presumably, be increased as the need arose. A more restricted view of the doctrine was expressed in the Rio Mimbres case decided on July 3, 1978. The Court held in that instance that the reserved right applied only to the purposes of the reservation as they existed at the time the reservation was created.

It seems most unreasonable for the Federal government to assert that the water reservation is for an indefinite amount forever. Such a stance casts a cloud of uncertainty over water rights acquired under the appropriations system. It would seem advantageous for all parties if the amount reserved could be established with a reasonable degree of exactitude. Neither rational planning nor investment can go forward unless the uncertainties created by the reserved rights doctrine can be minimized.

Stretch Out the Supply

Stretching out the supply is the least preferable of the three categories of options for meeting present and projected demands for water. Stretching out the supply is likely to involve additional time, money and convenience costs. It is also likely to require additional controls and more centralized decision-making. Centralized decision making involves higher coordination costs and runs contrary to

traditional preferences for local or individual decision making. However, as Walter Hickel has pointed out,

> An individual or local government can take care of a problem in an individual or local way, but there are very few local splashes that do not make waves across the country; local problems tend to become problems of the community called the United States. Decisions on where to put a freeway or how to dispose of municipal sewage have repercussions that are important throughout the land.
>
> There are very few purely private decisions any more. Increasingly, every private decision related to our society must also be considered a public decision, one that cannot be undertaken without regard for its effect upon other individuals. Continued indifference to the public today can only burden more severely the public of tomorrow.[53]

Whether or not we agree with Hickel, we are faced with the reality that the gap between the demand for water and the supply is rapidly closing and that, in some localities, demand already exceeds supply. In that context, Colorado will be driven to use some of the methods included in the least preferable category of options -- stretching out the supply. Some of these options are described below. The listing is not necessarily in order of preference or importance.

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[53]Walter J. Hickel, former governor of Alaska and Secretary of the Interior, "The Making of a Conservationist," Saturday Review, October 2, 1977, p. 67.

Conservation of Water Through Improved Irrigation Practices

Since irrigation is the largest user of water and by far the largest consumptive user, conservation measures, if successful, should have the greatest payoff in irrigated agriculture. A 10 percent reduction in municipal use would be minuscule as compared with a 10 percent reduction in total irrigation use. This is, of course, a macro viewpoint. A reduction in irrigation water consumption along the eastern borders of the state will not automatically provide additional water to Denver and other front range cities. A 10 percent reduction in per capita water use in a city may be a very small percentage of the total water used in the state but it may be enough to pull the city through a shortage period. We need to keep these macro and micro considerations in mind if we are to realistically appraise the feasibility of various conservation methods.

The concept of "waste" also needs to be considered in both a macro and micro context. Waste is not always waste. According to one observer, "Water comes down the river and somebody uses it. If they over irrigate (waste) the water comes back to the river in return flow or recharges an aquifer so where is the waste?" Conserving water by lining irrigation ditches may reduce the amount which might otherwise recharge an aquifer. Reduction of use of water by a city may reduce the return flow to the river. So "waste" is sometimes difficult to define. Perhaps "water loss" is a more accurate term. Water can be "lost" only by evaporation, transpiration, pollution (for some purposes), and, from a parochial point of view, by export out of the state. If water is wasted, but not lost, it supposedly becomes available again to some other user. This macro viewpoint, however, has little relevance

to the individual irrigator or the manager of a municipality or industrial plant which has only a limited supply.

If a city or an individual irrigator can conserve water, the saving may benefit some other user but probably not the person who did the saving. The "saver" will incur additional time, money, or convenience costs but ordinarily none of the benefits. From his point of view, this is a losing proposition. He will not conserve water unless he can use the water saved; unless the saving results from some other practice (such as land leveling) that is beneficial to him; unless he is forced to conserve by higher water prices or by a restriction in amount allocated; or unless the conservation measures are paid for by someone else. We should be clear that conservation of irrigation water is not free or the result of a mental attitude. It requires additional work, or equipment, or dollar expenditures, or at least inconveniences to the irrigator. It is easier to let the water run all night than to get out at 2:00 A.M. to shut it off.

Some of the more common methods for conserving irrigation water are listed below.

1. Conversion to crops that require less water. Conversion costs are incurred in this alternative and reduced profits may result from the new crop.
2. Installation of sprinkler systems is apparently more efficient than traditional flood irrigation. However, sprinkler systems are expensive to install and expensive to operate as compared with an "in place" flooding system.
3. Conversion to trickle irrigation. Again we have the costs of conversion if a ditch system is already in place.

4. "Every-other-row" irrigation supposedly produces higher yields per acre foot of water used for certain crops.
5. Land leveling to eliminate "dry knobs," unproductive potholes, and excessive labor. Land leveling, however, may be an expensive undertaking.
6. Improved scheduling so the farmer gets the water when it is needed. Obviously, improved scheduling will not occur simply by admonishing water managers to do a better job. Scheduling is dependent upon supply and storage factors.
7. Greater use of fertilizer may increase yields with the application of the same amounts of water. However, fertilizer is expensive and may create undesirable "side effects" in return flows.
8. Phreatophytes can be eradicated and thus increase the total supply available for crops. However, their removal is costly. Furthermore, in some cases they grow in areas that are not now being cropped so their eradication will increase the flow of the river but will not necessarily increase yields enough to compensate the farmer for removing them. Phreatophytes also have aesthetic values and provide cover for birds and wildlife.
9. It is commonly held that irrigation water is underpriced in terms of the increased yields it can produce. If that is correct, water prices could be raised through imposition of an excise tax, a use tax, or some similar device. If the price of water was substantially increased, water conservation would, presumably, take place automatically. If prices were high enough, marginal irrigators would be driven out of business.

10. The doctrine of "use it or lose it" should be jettisoned. This would allow the irrigator who conserved water to sell his surplus without fear of adverse use or abandonment proceedings. It would also allow him to convert to crops which require less water without jeopardizing his water right holding. Generally, it would provide greater flexibility both for individual irrigators and the system as a whole. This flexibility should result in savings in total water consumed or in increased production with the same amount of water

There are numerous technical methods or devices for conserving irrigation water which are not listed above and which are beyond the scope of this paper. It is safe to say, however, that all of them involve additional costs of some sort. As these costs go up, the point is eventually reached where it is no longer practical or rational to incur additional costs to produce greater efficiencies in the use of irrigation water.

Conservation of Urban Water Supplies

Waste of water in urban areas has received the most publicity even though municipal and industrial uses account for only a small percentage of water used and an even smaller proportion of water consumed. That is probably because more people see evidence of waste in running water in gutters and because southwestern cities (including Colorado) periodically experience water shortages during drouth periods. During these periods of scarcity the water shortage is given great publicity by the supplying unit and by the media. A crisis atmosphere prevails and various methods are used to reduce water use. Such

reductions are likely to be of little significance in terms of total state water use but they may be of real significance for the particular city involved. Urban water conservation is therefore important for particular sites. Stated differently, it is "site specific."

Unless Colorado cities can obtain more water or reduce growth rates, these periods of water shortage will become more common and so will efforts to conserve water. As we have mentioned several times, a preferred method for solving water problems is to obtain more water. If the present system for acquiring water rights remains unchanged, some cities will be able to obtain sufficient water through purchase of agricultural water or through condemnation proceedings. After all, the cities have the money and they have the votes. However, agricultural interests still have considerable political muscle and probably many urban dwellers are sympathetic to agricultural needs and genuinely desire to maintain a viable agricultural industry in the state.

Some cities because of their size or location may find it impractical or prohibitively expensive to acquire sufficient agricultural water to meet their needs. In either case it may be necessary or desirable to reduce per capita water use or, in some other way, reduce total water requirements. As in the case of irrigation water, such conservation methods entail additional money or convenience costs.

Some methods for accomplishing urban water conservation are outlined below.

1. Installation of a dual water system - one for domestic use and one for industrial and other uses which do not require potable water. A few cities have installed such systems. A dual system would take some of the load off purification plants by allowing untreated water to by-pass them and go

directly into the industrial system. It would also be possible to give domestic sewage minimum treatment and pump it back through the industrial system. Since anti-pollution laws require comparatively high quality discharges into streams, a part of this process will already have been performed so the "industrial water" might be pumped back through the system several times before treatment costs became prohibitive. A dual system would obviously be most economical in cities which use a high proportion of total water supplies for industry and if that industry is concentrated in one or a few sections of the city.

Installation of a dual system would require high initial costs but, over an extended time period, it could save some cities both water and dollars.

2. In some instances, high quality irrigation water could be "borrowed" before it is used for irrigation, put through the city water system, and then returned to the irrigation company. This procedure would require supplementing the original supply and would also entail additional costs in returning the "used water" to the irrigation system. The fact that irrigation companies may have senior rights does not appear to be a rational obstacle if they are compensated for the inconvenience or reduced quality.
3. Optimal sequential use is a system which uses water in a sequence from highest quality requirements to lowest quality requirements. Ideally, uses which require highest quality

should have first call on the water with other users obtaining water in succession as the quality deteriorates in accordance with their need for various levels of water quality.

A second feature of the sequential use system is that the sequence of water use should be from the least consumptive to the highest consumptive use. If the highest consumptive use (irrigation) has first call on the water, obviously the total supply will be sharply reduced.

The two major components of the system may not always be compatible but it is clear that domestic use requires the highest quality and is probably the least consumptive. According to the sequential use concept, it should therefore have first call on any water available.

The advantage of the sequential use system is that the same water can be used several times without intensive treatment after each use and that water is further conserved by putting the most consumptive use at the end of the sequence.

One disadvantage of the system is the need to construct additional pipelines, or other conveyances, plus the costs of pumping — moving the water around. An even more difficult problem is the coordination and timing requirements that would be necessary to insure that all users get their water when they need it and in the quantity to which they are entitled. Notwithstanding these problems, optimal sequential use offers one of the most attractive alternatives for stretching out the supply — hopefully, without injuring any user group.

4. Potable reuse is probably the most expensive method of conserving water at the present stage of the technology.[54] Furthermore, its acceptance by the public is questionable. Surveys of public opinion vary in their findings on the acceptability of recycled water — probably depending upon the composition of the survey population and the manner in which questions are phrased.

5. "Demand Control" through metering and pricing. A recent study by Flack, Wheatley, and Hill found that metering was cost effective, even at low water prices if the costs of installation were reasonable, i.e., less than $500 per meter.[55] Increased costs for water are an effective demand control if the increase is high enough to be meaningful and, of course, if water use is metered. The increase in water prices must be substantial to have lasting effect. A moderate increase appears to be effective for a short time only. After the initial "shock" wears off, usage tends to go back to something like its original rate. This phenomenon appears to be similar to the response to the sharp rise in gasoline prices. A variation on the pricing mechanism as a demand control is to increase rates as the volume used increases. When pricing is used as a demand control, we should take note of the fact

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[54] See Kenneth J. Miller, "Denver's Successive Use Program", Denver Journal of International Law and Policy, Vol. 6, Special Issue, (1976) p. 544.

[55] Flack, Wheatley and Hill, Achieving Urban Water Conservation, Colorado Water Resources Institute, Colorado State University, (1977) p. 156.

that lower income families are "hardest hit." Furthermore for many urban dwellers, puttering around with lawns, flower gardens and shrubbery may be a principal recreation activity.

6. Mechanical water saving devices were found to be cost effective conservation methods according to Flack, et al. They also found that "pressure reduction is a technique that saves water with little or no customer inconvenience as long as minimum pressures of about 40 psi are maintained."[56]
7. Water use restrictions have been found to be effective when the public perceives a real scarcity of water and a real need to conserve. However, if the restrictions are imposed for prolonged time periods, they tend to become decreasingly effective.[57]
8. Conservation of water through changes in horticultural species and practices has been advanced as a partial solution to urban water problems. This does not appear to be a practical alternative. Homo Sapiens may be the most adaptable of all living organisms but, at his present stage of development, he does not adapt by changing his anatomy or physiology. Neither does he adapt by making radical changes in his life style. Instead, he creates what might be called artificial environments. Among the most obvious features of these artificial environments are fire, buildings, transportation

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[56] Ibid.

[57] Ibid.

systems, electricity, and the storage and transport of water for irrigation, industrial, recreational and domestic use. It is most unlikely that he will trade green lawns, trees and shrubbery for rock gardens and cactus plants.

Stretch Out Supply by Facilitating Temporary Transfer Mechanisms

Temporary transfers of water are a method for stretching out the supply or more fully utilizing the supply available. To be most effective, such temporary transfers can be facilitated if the possibilities of forfeiture and abandonment are jettisoned. Applicable statutes should be amended to eliminate the possibility of loss of a water right through non-use.

It is recognized that this proposal runs contrary to long established practice throughout the West and that it is contrary to the statments of water experts generally -- except for those who advocate the removal of all controls so the water market can operate without any constraints. Advocates of the present system maintain that the doctrines of forfeiture and abandonment save water by allowing other potential users to "pick up" the water that is not being fully utilized. I am convinced that it has the opposite effect -- for two principal reasons: (1) The holder of a water right is obligated to use all of his entitlement whether he needs it or not. Consequently, there is actual pressure on him to waste water. If he was not so obligated, the water would remain in the stream and become available to junior appropriators; (2) The "use it or lose it" requirement reduces the possibilities for temporary transfers of water because the

holder of a water right is afraid to jeopardize his holding by loaning, renting or otherwise temporarily disposing of all or part of his entitlement. There can be many different reasons why an irrigator, for example, may not want, or need the entire flow to which he is entitled in any given year or part of a year.

Municipal systems should be able to borrow water from irrigation companies and, conversely, irrigation companies should be able to borrow from cities. Similarly, individual irrigators should be able to borrow from each other. Irrigation companies and conservancy districts should also be able to loan and borrow water from each other.

The city of Northglenn, Colorado, has pioneered in the development of a borrowing arrangement with the Farmers Reservoir and Irrigation Company wherein the city borrows water from the irrigation company, puts it through the city system, gives it partial treatment, and then returns it to the irrigation company. The water returned is supplemented by well water and water from other sources within the city. The city pays the costs of "moving the water around."[58] On July 12, 1977, the citizens of Northglenn voted a $31,000,000 bond issue to finance this project. It is expected to be operational by November, 1980.

When borrowing arrangements are not feasible, for whatever reason, renting or leasing water on a temporary basis should be encouraged and facilitated among individual irrigators, ditch companies, municipalities, irrigation districts and conservancy districts. Increased costs of moving water around may, in some cases, be partially offset by reduced

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[58]Agreement between the Farmers Reservoir and Irrigation Company and the City of Northglenn, September 2, 1976.

treatment costs. Such arrangements, it should be clearly understood, are not to damage the entitlements of the entity which rents or leases water.

We have to this point only considered temporary transfers among irrigation users and municipalities. Permanent transfers (sales) of irrigation water for municipal use tend to be irreversible. However, transfers for energy development are more likely to be temporary -- even though "temporary" could mean several years. The possibilities for leasing or renting water for energy development (rather than sale) would appear to be of long term benefit to the state.[59]

When a growing municipality or domestic water district acquires water rights from irrigators, it reduces irrigated agriculture in the losing area by the amount of water rights purchased. The city then puts the water through its system and returns from 50 to 90 percent of the water (depending upon the season of year) to the river. It then becomes available for downstream users but not to the area from which the water was obtained. Downstream users do not buy this return flow; they simply appropriate it. Equity considerations and the overall, long term effects of these arrangements should be thoroughly investigated. Analysis of this problem area would constitute another study and cannot be pursued further here.

The right of municipalities to condemn irrigation water (and presumably industrial water) for domestic use is presently in a state

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[59]For a detailed analysis of the transfer problem see Hartman and Seastone, Water Transfers: Economic Efficiency and Alternative Institutions, Johns Hopkins Press, 1970.

of uncertainty in Colorado. Article II of the Colorado Constitution contains the usual provision that private property shall not be taken or damaged for public use without just compensation. A 1975 statute provided that in condemnation matters involving water rights, a three member commission was to be established, in each case, to determine the necessity of the proposed condemnation and other related matters.[60] In October of 1973, the City of Thornton began condemnation procedings against the Farmers Reservoir and Ditch Company for water rights in Standley Lake. Because of various technicalities, the case was not decided until September 4, 1976. On that date the district court dismissed the case on the general grounds that the city had failed to comply with state law. On appeal, the State Supreme Court, on February 6, 1978, reversed the decision of the district court by ruling that home rule cities (including Thornton) were exempt from the requirements of the 1975 act. Representative Youngland, and others, then circulated a petition to amend the constitution to reduce the powers of home rule cities as regards condemnation powers relating to water rights. The succes of the petition is conjectural at this writing. Whatever the outcome of this controversy, condemnation of agricultural water should be viewed as a last resort possibility. Cooperation rather than conflict is the best way to solve Colorado's water problems.

One such cooperative institutional device might be the establishment of a state water pool or water bank. The water bank would function something like a commodities broker in that it would

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[60]Colorado Revised Statutes, 38-6-202 to 210.

inform potential buyers and sellers of the going rate for water in different parts of the state. Sellers would deposit water in the bank and buyers would make purchases at the going rate plus transportation costs. Conservancy districts might act as "branch banks" of the state water banking system. Once again, depositors in the water bank would not endanger the validity of their holdings by making such deposits. Deposits and withdrawals from the bank would, of course, be altogether voluntary. A limited variation of this scheme was used in California during the drouth of 1977.[61]

The various institutional devices outlined above should "stretch out the supply" by facilitating temporary water transfers without damaging existing water rights. As such they should be both economically practical and politically feasible.

Improved Organizational Structure for More Efficient Water Management

If one were to prepare a set of organizational charts for each of the various levels of water agencies in Colorado on a series of transparent overlays, by the time the last overlay was added there would be a solid, unintelligible mass. This does not mean that the system is incomprehensible or unworkable. It obviously does work but it is also obviously fragmented, disjointed, and uncoordinated. There are a myriad of organizational units each administered by a different management group with little coordination or communication among them. The state government does not exercise any real

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[61]See Angelides and Bardach, Water Banking: How to Stop Wasting Agricultural Water, Institution for Contemporary Studies, 1978.

management control. Water policy decisions are likely to be fragmented, localistic, and parochial.

The multiplicity of organizational units, the multiple levels, and the jurisidictional redundancy which exists makes central control and integrated water management difficult or impossible. This may be an advantage or a disadvantage depending upon one's perspective. Multiplicity of units may provide greater possibilities for adaption to local situations but it may also contribute to inefficient use of water from a statewide perspective. The greater the number of organizational units, supposedly the greater is the opportunity for citizen participation and, according to the folklore, "home folks know best." However, what appears to be democratic citizen participation in water decisions may, in fact, turn out to be "boss rule" by local elites.

In this section we will first summarize the pros and cons of centralized versus decentralized water management and then go on to list a series of possibilities for improvements in the organizational structure of Colorado water management.

According to Blair Bower,

> . . . if there is a multiplicity of local water agencies distributing water in an area, without interconnections among them, more water will usually be required to meet the total water needs of the area than if the operations in the various local areas were integrated. Each local system, when operated independently, must have its own reserve capacity. Each system may have separate transmission lines to a

> common source of supply. Without integration no advantage can be taken of diversities in demand and/or supply patterns of the individual systems. The effect is to increase the total amount of water development required in the basin to meet the same outputs.
>
> The implication for water resources administration is that local water resources planning, development, and operation should be integrated with basin-wide or region-wide water resources planning, development and operation.[62]

In like manner, but with particular reference to Colorado, Wayne Peak has commented that

> The institutional arrangements through which water distribution in Colorado has been effected have grown incrementally for more than a century. Little comprehensive planning has marked their development. The result is a fragmented set of rules, rights, special interests, and quasi-public administrative bodies, many of which have their origins in a historical Colorado which no longer exists. One consequence of this situation is that many of the institutions which today exercise control over water resources are anachronisms. Meanwhile, qualitatively different problems and conditions with which present institutions are incapable of dealing effectively have emerged.

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[62]Blair T. Bower, "Some Physical, Technological, and Economic Characteristics of Water and Water Resource Systems: Implications for Administration," Natural Resources Journal, October, 1963, pp. 221-222.

Fragmentation of influence and authority is another component of the organizational problems of water governance. The proliferation of agencies which supply water directly to users is staggering. Within a seven-county area along the Front Range alone, there are over 250 such agencies serving domestic and agricultural users. In addition to these service-oriented agencies there is a host of local, state, and federal authorities which exercise some degree of authority over water-related matters ranging from environmental protection to flood control to wastewater treatment to the adjudication of water rights. Overlapping jurisdictions and limited but unclear authority characterize this complex of administrative and judicial offices. It is not surprising that no effective, comprehensive, and coordinated plan exists for the utilization of Colorado's water resources. Rather, it is remarkable that the degree of coherence that does exist, suboptimal though it may be, was produced at all.

While it is true that coordination and planning cannot create additional water for areas of increasing demand, it is equally true that it can produce equivalent results as far as users are concerned by maximizing the efficiency of water use, by establishing more equitable cost-sharing policies among users, and by permitting the concentration of resources which facilitates the development of more efficient technological means of water distribution and use.[63]

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[63]Wayne Peak, "Institutionalized Inefficiency: the Unfortunate Structure of Colorado's Water Resource Management System," Water Resources Bulletin, American Water Resources Association, June 1977, pp. 553-554.

Similarly, Harvey Doerksen has pointed out that

> These doctrines (discussed in Chapter IV) collectively have a number of important management implications. First, they result in piecemeal decision making. Second, they shift much of the major decision-making responsibility onto the courts. Third, with each decision, they progressively reduce the decision options available. Fourth, they provide traditional water users with a disproportionate amount of influence over the decision process. Fifth, they deepen the existing cleavages between the various components of the decision-making system and make cooperation difficult.[64]

W. D. Farr, Chairman of the Greeley Water and Sewage Board and a long time director of the Northern Colorado Water Conservancy District has observed that

> What is needed is a total management plan for the total use of our water on a year to year basis. Our present water owners, ditch companies, cities, underground water users and individuals all do a fine job of managing their own water rights. The problem is the fragmentation of hundreds of owners trying to be sure that no one gets a drop of <u>their</u> water. The use of Colorado-Big Thompson water in the South Platte Valley has softened this competition the past few years. The flexibility of moving water from one tributary to another has become a great asset.

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[64]Harvey Doerksen, "Water, Politics and Ideology: An Overview of Water Resources Management," <u>Public Administration Review</u>, September-October 1977, p. 446.

> Flexibility is the key to the future of managing Colorado's water. The ability to move water upstream or downstream, from one tributary to another, or from a high loss reservoir to a more efficient reservoir. These are the tools that are needed. There is not very much more water that can be developed. The problem is to best manage and utilize our total water supplies, not only on a day to day basis, but on a prudent plan for years ahead.[65]

Finally, the city council of Thornton, Colorado passed a resolution calling for state control of water resources. The resolution stated in part

> The plan should include the concept that the state will manage all of the water in the state as a wholesaler and allocate and distribute to municipal utility systems, agricultural irrigation systems, and directly to commercial and industrial uses in those cases where water service is not available through municipal systems to commercial and industrial users. This plan would leave the responsibility to each local system for the retail functions including distribution, operation, and maintenance.
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> In carrying out the state's responsibility, the state must develop and maintain adequate storage facilities, delivery systems, and appurtenances.[66]

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[65] W. D. Farr, "Challenge to Innovation," Proceedings, Colorado Drouth Workshops, Environmental Resources Center, Colorado State University, November 1977, p. 21.

[66] City Council of the City of Thornton, Colorado, Resolution passed and adopted on April 14, 1976.

Vincent Ostrom makes a convincing argument for the opposite point of view,

> Perhaps the peculiar structure of American institutions for water resource development represent efforts on the part of Americans to build substantial elements of democratic administration into their system of public administration. Those elements of democratic administration would display characteristics substantially at variance with a hierarchically-ordered system of bureaucratic administration. We would expect to find elements of bureaucratic administration but we would not expect those elements to be the dominant characteristics in a system of democratic administration. Instead of a fully integrated structure of command, we would expect to find substantial dispersion of authority in many different structures of command. The exercise of control over the legitimate means of coercion would not be monopolized by a single structure of authority. We would expect to find persons from diverse backgrounds in communities exercising leadership and entrepreneurial initiative in the development and conduct of public enterprises to provide different types of water services. We would expect such enterprises to be constituted in ways that placed extensive reliance upon decision making mechanisms reserving important decisions for consideration by all of the members of a community and their elected representatives. We would also expect the constitution of such enterprises to allocate

> decision making capabilities sufficient to get a job done but to otherwise restrict the power of command to a minimum. Finally, we would expect the community of people being served by public functionaries to have reserved sufficient decision making capabilities for themselves that they could effectively challenge the operation of those functionaries whenever their performance failed to be satisfactory when measured by a standard of reasonableness shared by practical men.
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> . . . I would conclude that the system of private and public enterprises which comprise . . . the American water industry . . . has developed a high level of productivity. This high level of productivity is a consequence of the extensive opportunities for public entrepreneurship afforded by the system of overlapping jurisdictions and fragmentation of authority inherent in the American political system. When much of the world cries out in want, institutional arrangements which are capable of a high level of productivity can be viewed as important assets in American life. The basic structure of the American water industry should not be radically altered.[67]

The proposals for organizational change in Colorado water institutions which follow are thought to be administratively sound,

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[67]Vincent Ostrom, Institutional Arrangements for Water Resource Development, National Water Commission, (1971) pp. v, 41-42.

economically practical and politically feasible. Their basic objective is to improve effectiveness with minimum disruption of the present system. In so doing, dislocations can be minimized and potential opposition reduced. Stated differently, the objective is to retain the present basic structures but to provide mechanisms for improved coordination of all water agencies on Colorado. Ditch companies, irrigation districts, municipalities, ground water districts, and conservancy districts are not isolated islands. The decisions of each affect the others and the public in general.

1. Extend the authority of the conservancy districts to include general supervision and coordination of the activities of ditch companies, irrigation districts, and municipalities within their respective districts.

There are hundreds of ditch companies and municipalities in Colorado and dozens of irrigation districts all going their separate ways. Improved coordination of their activities would seem to be an obvious necessity.

2. The Colorado Water Conservation Board should be given responsibility for general supervision and policy guidance as regards the conservancy districts.

If conservancy districts are given the responsibilities set out in No. 1 above, a mechanism should be provided to insure a reasonable degree of state control. The Colorado Water Conservation Board appears to be the logical entity to assume that responsibility.

3. Transfer the functions of the Water Quality Control Commission to the Colorado Water Conservation Board. The Water Quality Control Commission should be retained in an advisory capacity.

To reiterate previous statements in this report, water quality considerations cannot be realistically separated from water quantity matters. The quality of water determines the quantity available for given uses. Informed water authorities appear to be unanimously in agreement with this principle.

4. Transfer the functions of the Ground Water Commission to the Colorado Water Conservation Board. The Ground Water Commisison should be retained in an advisory capacity. Ground Water Management Districts should continue as presently constituted, subject to general supervision by the conservancy district in which they are located.

There is no argument about the need to integrate surface and ground water supplies. That was a stated purpose of the Water Right and Administration Act of 1969. This proposal moves toward the accomplishment of that objective.

5. If the additional responsibilities suggested above are given to the Colorado Water Conservation Board, its members should be appointed on a full time basis. Hurried judgements by part time members will no longer suffice.

* * *

These organizational changes should help to stretch out the supply by improving the management of the state's scarce water resources.

CHAPTER IX

SUMMARY: OPTIONS FOR IMPROVING WATER MANAGEMENT IN COLORADO THROUGH INSTITUTIONAL CHANGE

Note 1. The statements which follow are brief summaries of the options set out in Chapter VIII.

Some of the options listed in this summary statement are contradictory in nature and are included because they have strong support from some segments of the Colorado water community. However, most of them are compatible and could be implemented without counteracting each other.

Most of the options listed would not jeopardize existing water rights and would not cause major disruptions in either established practices or organizational structures.

The rationale for the options set forth below (including pros and cons) is spelled out in greater detail in Chapter VIII.

Note 2. These summary statements should be considered as options only. They are not necessarily the writer's recommendations.

Options Under the Existing Water Rights System

1. Discourage population growth in the Front Range Corridor and encourage population dispersion into other areas of the state -- especially those which have declining population rates.

2. Integrate land and water use planning. In water-short states the two functions are interrelated and interdependent.

3. Employ the zoning concept to regulate water use.

4. Outdoor recreation and fish and wildlife values should be legally recognized as beneficial uses of water in Colorado. Uncertainty as to the constitutionality of existing statutes should be resolved as expeditiously as possible.

5. Constraints on the operation of the water market could be removed.

   a. If constraints are removed, the State of Colorado should be allowed to enter the water market to obtain water rights to protect societal values.

   b. Excise taxes might be levied on water use to raise prices to a level corresponding to their market value.

6. Water quality management and water quantity management should be administered by the same agency.

7. The present district court water judges should be transferred to a State Water Court.

8. The present water referee system should be jettisoned in favor of full time, professional hearing officers.

Options for Alleviating Colorado Water Problems by Increasing the Supply

1. Construct additional needed water development projects with state funds. If state funding is not feasible, necessary developments could

be financed and constructed by conservancy districts or consortiums of sub-state units.

2. Allocate additional resources to watershed management.

3. Import additional water from the West Slope -- if that is feasible.

4. Increase supply by ground water withdrawals.

   a. Integrate ground and surface water management.

5. Substantially increase state support for precipitation augmentation.

6. Investigate the possibilities for renegotiation of interstate compacts with the objective of reducing Colorado's obligation to downstream states.

7. Conduct a legal study to determine if further litigation might improve Colorado's position with reference to its water obligations to other states.

8. Attempt to resolve as expeditiously as possible the question of the amounts of water involved in Federal Reserved Rights and Indian claims.

Options for Stretching Out the Supply

1. Conservation of water through improved irrigation practices.

   a. Conversion to crops that require less water. Conversion costs are incurred and profits may be reduced.

   b. Installation of sprinkler systems. Cost of installation and operation may be prohibitive.

c. Conversion to trickle irrigation. Installation costs may make this alternative impractical.

d. Every-other-row irrigation supposedly produces higher yields per acre foot of water used -- for some crops.

e. Land leveling to improve efficiency of water withdrawn and reduce labor costs. However, initial costs of land leveling may be prohibitive.

f. Improved scheduling so farmer receives water when he needs it.

g. Greater use of fertilizer. However, fertilizer is expensive and may create undesirable "side effects" in return flows.

h. Eradicate phreatophytes. Cost is again a factor. Phreatophytes also have aesthetic values and provide cover for birds and wildlife.

i. Impose a user fee or excise tax on water used. Supposedly, water conservation would then take place automatically.

j. The doctrine of "use it or lose it" should be jettisoned to permit greater flexibility and consequent improved efficiency in water use.

2. Conservation of Urban Water Supplies.

a. Installation of dual water systems: one for domestic use and one for industrial or other uses. The major disadvantage of this option is the high initial cost.

b. Utilize a system of "borrowing" irrigation water, putting it through the municipal system and returning it to the irrigation company. Increased costs and scheduling are problem areas.

c. Optimal sequential use is a promising option. Once more, increased costs and scheduling are serious problems.

d. Potable reuse, at the present stage of the technology, may be the most expensive method of conserving water.

e. "Demand control" through metering and pricing. Lower income families may be "hardest hit."

f. Reduction of pressure can save water without consumer inconvenience.

g. Water use restrictions are likely to be effective but only during crisis periods.

h. Changes in horticultural species can conserve water but public acceptance is unlikely.

3. Conserve water supply by facilitating temporary transfer mechanisms. Such temporary transfers include loaning and borrowing, rentals or leases, and perhaps other temporary arrangements. Such temporary transfers should be encouraged, not only among individuals, but also among ditch companies, irrigation districts, municipalities and conservancy districts. A state "water bank" might act as the broker to facilitate such transfers. Conservancy districts might function as "branch banks." Any such arrangements should not damage the entitlements of the owners of water rights.

4. Improved organizational structure for more efficient water management. The basic objective of the options which follow is to maintain the present basic structures but to provide mechanisms for improved coordination of all water agencies in Colorado.

a. Extend the authority of the conservancy districts to include general supervision and coordination of the activities of ditch companies, irrigation districts, ground water management districts, and municipalities within their respective districts.

b. The Colorado Water Conservation Board should be given responsibility for general supervision and policy guidelines as regards conservancy districts.

c. Transfer the functions of the Water Quality Control Commission to the Colorado Water Conservation Board. The Water Quality Control Commission should be retained in an advisory capacity.

d. Transfer the functions of the Ground Water Commission to the Colorado Water Conservation Board. The Ground Water Commission should be retained in an advisory capacity. Ground Water Management Districts should remain as presently constituted subject to general supervision by the conservancy district in which they are located.

e. Members of the Colorado Water Conservation Board should be appointed on a full-time basis. Hurried judgements by part-time members will not be adequate if the foregoing organizational recommendations are implemented.

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