

**Water in the
West:
Challenge for
the Next Century**

June 1998

**Report of the
Western Water
Policy Review
Advisory Commission**

FOREWORD

I am pleased to transmit the final report of the Western Water Policy Review Advisory Commission. We were fortunate in having a dedicated staff, whose names are listed here, who carried this process through on a tight schedule. The work of this Commission also demanded much from the citizen commission members and the Congressional and agency staff members. Thanks are due to the commission members who devoted themselves to serving our government by attending meetings and reviewing reams of reports and drafts. Additionally, we deeply appreciate the contributions made to the Commission report by writers and researchers. The members of the public who took time to attend meetings, prepare testimony, and review drafts have enriched this report and have also shown that the West is capable of robust, yet respectful dialogue. This dialogue, which we hope our report will further, is where the future will be shaped.

This report provides a good overview of the status of the West's water and of the pressures that require change in our water management practices. Foremost is that the West is a magnet for population growth; a transformative fact that has affected every aspect of western life. Water policies have already begun to change in response to growth and the changing economy, but more needs to be done. We need to consider how to keep agriculture productive, while acknowledging that healthy riparian and aquatic ecosystems are also critical to the long term sustainability of the West. Growing cities need water, but water marketing makes many westerners uneasy. Tribal water needs often have been neglected, despite the legal and moral obligations that underpin them. Critics deride the federal government as having too many agencies dealing with water issues and charge that disorganization and poor coordination has resulted.

No single solution was identified in this report for these complex challenges, but our central recommendation is that the federal government must support watershed and basin innovation. Watershed and basin management are part of a shift towards stakeholder involvement and coordination of agencies, along hydrologic rather than political lines. This shift will take different forms across the West but will ease the difficulties caused by a proliferation of federal agencies and help the West address the many legitimate interests in water management. This is not a recipe for the creation of federal commissions in each basin; rather, it endorses the integration of federal programs at the watershed and basin level. Federal policies also must change in how we address tribal rights, aquatic ecosystem degradation, land use, protection of farming and ranching communities, and other critical areas. These recommendations are explicitly made within a framework of respecting existing property rights in water.

The Commission was charged with a comprehensive review of Federal activities in the western states which affect the use and allocation of water, and the review of numerous aspects of water resources, management, institutional and legal matters, and the performance of federal agencies. We did so through meetings with the public, research, and symposia, and the assistance of experts. I am especially proud of the research reports prepared for the Commission in which experts provided their appraisals of difficult water-related problems. Their research is now published and available. The basin studies that were prepared for the Commission present an incisive overview of how all of the elements listed in the statute play out in a basin and attempt to capture the interrelationship of these factors. They are not dry policy studies but are firmly anchored in the realities of particular places.

Everyone associated with western water knows how controversial it can be, with John Wesley Powell warning, "I tell you, gentlemen, you are piling up a heritage of conflict." We structured the activities of the Commission to give every opportunity for members to shape the workplan we followed, to suggest areas of study, to participate in the drafting of principles and recommendations, and to review, comment on, propose changes to, and ultimately adopt or reject the final report. With this, we transmit a report that we hope will both educate and stimulate policy ideas.

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Reports to the Commission

Research Reports to the Commission:

Aquatic Ecosystems Symposium

Edited by Dr. W.L. Minckley, Arizona State University

A Survey of Columbia River Basin Water Law Institutions and Policies

Northwest Water Law and Policy Project of the Natural Resources Law Institute, Northwestern School of Law of Lewis & Clark College

Budgeting for Federal Water Projects

EOP Foundation, Inc.

Climate Variability, Climate Change, and Western Water

Dr. Kathleen A. Miller, National Center for Atmospheric Research

Estimates of Water Use in the Western United States in 1990, and Water-Use Trends, 1960-90

Dr. Wayne B. Solley, U.S. Geological Survey

House and Senate Committee Jurisdiction and Executive Branch Responsibility Over Water Resources

Congressional Research Service

Improving Drought Management in the West

Dr. Donald Wilhite, National Drought Mitigation Center, University of Nebraska

Indian Water—1997, Trends and Directions in Federal Water Policy: A Summary of the Conference Proceedings

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Patterns of Demographic, Economic, and Value Change in the Western United States: Implications for Water Use and Management

Dr. Pamela Case and Gregory Alward, U.S. Forest Service

Resource Management at the Watershed Level: An Assessment of the Changing Federal Role in the Emerging Era of Community-Based Watershed Management

Betsy Rieke and Dr. Douglas S. Kenney, Natural Resources Law Center, University of Colorado

Seeking Solutions: Alternative Dispute Resolution and Western Water Issues

Dr. Gail Bingham, RESOLVE, Inc.

Water in the West Today: A States' Perspective

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Water Quality in the West

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Western Hydropower: Changing Values/New Visions

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Western Land Use Trends and Policy Implications for Water Resources

Dr. William E. Riebsame, University of Colorado

The Upper Basins' Political Conundrum: A Deal is Not a Deal

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River Basin Reports to the Commission:

A River in Common: The Columbia River, the Salmon Ecosystem, and Water Policy

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The Commission held the following events and public meetings:

Basin Workshops

Basin/Area	Location	Date
Colorado River	Phoenix, Arizona	February 26, 1996
Missouri River	Omaha, Nebraska	March 11, 1996
Kansas-Oklahoma- Texas Region	Oklahoma City, Oklahoma	April 9, 1996
Columbia River	Lewiston, Idaho	April 10, 1996
Platte River	Casper, Wyoming	April 12, 1996
Great Basin	Salt Lake City, Utah	April 15, 1996
Sacramento-San Joaquin Rivers	Sacramento, California	April 16, 1996
Platte River	Denver, Colorado	April 23, 1996
Rio Grande	Albuquerque, New Mexico	April 25, 1996

Basin Study Kickoff Meetings

Basin	Location
Colorado	Salt Lake City, Utah
Columbia	Portland, Oregon
Platte	Denver, Colorado
Sacramento-San Joaquin	Sacramento, California
Truckee-Carson	Reno, Nevada
Upper Rio Grande	Albuquerque

Commission Meetings

Location	Dates
Portland, Oregon	February 16-17, 1996
Denver, Colorado	May 16-17, 1996
Denver, Colorado, by conference call	September 12, 1996
San Diego, California	November 21-22, 1996
Tempe, Arizona	February 17-18, 1997
Phoenix, Arizona	March 17-18, 1997
Boulder, Colorado	April 17-19, 1997
Washington, DC	May 15-17, 1997
San Francisco, California	June 10-12, 1997
Boise, Idaho	July 10-12, 1997
Denver, Colorado	September 4-6, 1997
Boulder, Colorado	February 19, 1998

Executive Summary

"Water is the true wealth in a dry land."
— Wallace Stegner

In directing the Western Water Policy Review Advisory Commission (Commission) to make recommendations about the proper role of the federal government in western water management for the next 20 years, the Congress gave our Commission a daunting task. For the past year and a half, we have labored to understand the details of numerous and often conflicting federal programs while striving not to lose sight of the "big picture."

Though many previous studies have documented the chronic problems of water in the West, the convergence of a number of trends makes this study unique and timely. Early in our tenure, we learned that western water planners for the 21st century must address staggering growth projections. For the past 15 years, the West has been experiencing the most dramatic demographic changes for any region or period in the country's history. Should present trends continue, by 2020 population in the West may increase by more than 30 percent. The West is rapidly becoming a series of urban archipelagos (e.g., Denver, Salt Lake City, Boise, Missoula, Portland, Phoenix, Albuquerque, Dallas, Houston, and Seattle) arrayed across a mostly arid landscape.

At the same time, reports to the Commission identified unhealthy trends in aquatic ecosystems and water quality, pressing water supply problems, unfilled American Indian water claims, an

agricultural economy suffering the stress of transition, rapid conversion of open space to urban development, and rising drought and flood damage exacerbated by the potential for global warming. Additional population growth will only cause these crises to worsen unless bold action is taken. Population predictions underscore the urgency for wise long-range water policy planning, effective and efficient water management institutions, and consistent enforcement of existing laws.

Part of the impetus for our Commission's formation was the Congress's finding that current federal water policy suffers from unclear and conflicting goals implemented by a maze of agencies and programs. This finding was reinforced and documented by the Commission's investigation. Lack of policy clarity and coordination resulting in gridlock was a consistent theme of public testimony and scholarly research. We have concluded that these problems cannot be resolved piecemeal but, rather, must be addressed by fundamental changes in institutional structure and government process. Moreover, our work led us to an even more basic conclusion: that the geographic, hydrologic, ecologic, social, and economic diversity of the West will require regionally and locally tailored solutions to effectively meet the challenges of the 21st century of water management.

The lives of westerners and the places we live are changing so rapidly that irreversible developments are often not preceded by thoughtful policy

discussion and choices. In this report, we offer suggestions for addressing water problems in a proactive manner that will foster the necessary policy discussion and integrate the increasingly complex interests in western water.

This summary describes the many recommendations offered by the Commission. Two areas are highlighted first because they received the widest support among the diverse group of Commission members—Principles of Water Management for the 21st Century and New Governance of Watersheds and River Basins.

Principles of Water Management for the 21st Century

The Commission proposes principles by which any federal water program should be guided or judged against. The first principle, sustainable use of water, is adopted from the President's Council on Sustainable Development and forms the backbone of the Commission's recommendations. Both internationally and domestically, sustainable development links together the diverse elements of the water use community and provides the basis for common dialogue and problemsolving. Sustainable water use seeks to achieve a balance between the capability of a system to meet social needs and its biological capacity.

Ensure Sustainable Use of Resources

Use and manage water and related resources so that at the national, regional, and local levels, environmental, social, economic, and cultural values can be supported indefinitely. All water resources policies and programs in the West must recognize and address the dramatic current trends in

population growth and movement. Consideration must be given at all levels of government to growth impacts on water and associated land and open space resources. Policies which encourage growth must be assessed carefully in relation to the available resource base.

Maintain National Goals and Standards

National standards and goals for the quality of water and related resources play a valuable role in the maintenance and restoration of resource health. There is a continuing need for national standards and goals.

Emphasize Local Implementation, Innovation, and Responsibility

Federal, tribal, state, and local cooperation toward achieving national standards should be the basis of water policy. Where possible, responsibility and authority for achieving these national standards should rest with nonfederal governing entities. Reasonable flexibility should be allowed and innovation encouraged in the approaches taken to achieve national standards within a framework of monitoring and accountability.

Provide Incentives

Wherever possible, use economic and other incentives to achieve national, regional, or local water resource goals. Existing incentives and policies for water use and associated land management should be examined to determine whether they promote or impede sustainable use of resources and serve contemporary social goals. Funding should be used to provide incentives for state and local entities to achieve resource goals.

Respect Existing Rights

Acknowledge and respect existing treaties, compacts, and equitable apportionments with states and tribes. Respect and give appropriate legal deference to existing water rights and state water appropriation systems.

Promote Social Equity

Determine and fulfill tribal rights to water. Universal access to safe domestic water supplies should be a priority. We must also recognize that local economies have developed throughout the West as a result of government policies designed to encourage certain land and water uses. As those policies evolve, regardless of the reason, people and communities affected by such changes may need time and assistance to make a transition. Water transfers should be carried out with full consideration of the communities of origin, third party transfers, and unintentional consequences, and should be open to participation by affected parties.

Organize Around Hydrologic Systems

Strive to make state and federal water programs and decisionmaking more efficient and effective. To help address the problems created by multiple and often conflicting jurisdictions, authorities, and program objectives, we should organize or integrate water planning, programs, agencies, funding, and decisionmaking around natural systems—the watersheds and river basins. This will require integrating institutional missions, budgets, and programs, as well as their congressional oversight. Duplicative or overlapping programs and activities should be integrated or modified. Planning and management of land and water, surface and groundwater, water quantity and quality, and point and nonpoint pollution must be coordinated at the appropriate level of government.

Ensure Measurable Objectives, Sound Science, Adaptive Management

National, regional, and local water resource goals should be translated into measurable objectives. Performance should be assessed through open, objective, scientific studies, subject to peer review. Where knowledge is incomplete, actions should be based upon the best available data within a framework of monitoring and adaptive management. Determination of the best use of resources should take into account social, economic, environmental, and cultural values.

Employ Participatory Decisionmaking

National, regional, and local resource decision-making must be open to involvement and meaningful participation by affected governments as well as interested and affected stakeholders. Sufficient information about the consequences of resource decisions should be made available to the public.

Provide Innovative Funding

Given declining federal budgets, innovative sources of funding and investment, including public and private partnerships, must be found for the management and restoration of western rivers.

New Governance of Watersheds and River Basins

The Commission investigated numerous examples of local watershed initiatives, watershed councils, basin trusts, citizen advisory groups, and collaborative governmental partnerships that are springing up around the West to address critical problems of water supply, water quality,

environmental degradation, quality of life concerns, and compliance with interrelated federal, state and local laws. We believe that these initiatives hold much promise for meeting the growing challenges of western water management. To accept local participation is not simply to engage in a democratic exercise, but to recognize the growing need for (1) sustainable, local economies and energetic stakeholder consensus to replace frustration and dissension; (2) alternative sources of revenue to supplement federal appropriations; (3) coordinated and clarified regulatory requirements to reduce governmental gridlock; and (4) policy-relevant science to better inform program and budget decisions.

From the bottom up, the new federal challenge is to encourage local innovation, to effectively participate with local stakeholders in watershed groups and watershed councils, and to integrate them with federal, tribal, local, and state governmental requirements.

From the top down, the federal challenge is to establish policies which direct the federal resource agencies to coordinate their activities throughout hydrologic regions. This approach will require establishment of a national policy of interagency coordination which cascades down to regional offices and field personnel. It will also require better budgetary coordination to stimulate true integration of all federal water activities in each locale.

Accomplishment of these objectives will drive fundamental change in the structure of the federal government. We anticipate that during the next century, the federal resources management agencies will undergo widespread realignment of their organizational and enforcement functions. Recognizing how slowly governmental institutions change, in this report we recommend a partial reorganization of functions which can be immediately implemented within the present

governmental agency framework. While we reaffirm many existing goals and programs, we suggest a recalibration of the way in which these goals are achieved.

We propose a change in the function and approach of the federal resource agencies to a "nested" governance structure. This new governance approach reflects the hydrologic, social, legal, and political reality of the watershed. Fundamental principles of those governance structures are: regional flexibility, participation of all affected stakeholders in formulating joint programs to effectuate shared objectives, and recognition that intensive interaction among federal, state, tribal, and local governmental entities and stakeholders is essential to design durable solutions.

As the Commission learned throughout its process, examples of new basin governance structures are already emerging across the West to realize these very goals. There should be great hope based upon the initial success of these new institutional processes, and their continuation should be embraced by the federal government. They take many forms, depending upon the nature of the issues, the number of states and federal agencies involved, the legal parameters, and the number and nature of stakeholder interests. We highlight many of these new processes throughout the Commission report. They include: the Northwest Power Planning Council on the Columbia River; the Bay Delta Accord and the CALFED process on the Sacramento and San Joaquin Rivers; the three-state cooperative agreement with the Department of the Interior on the Platte River; the Upper Colorado Fish Recovery Program and the Lower Colorado Multispecies Recovery Program on the Colorado River. These efforts are distinct in many ways because they reflect the unique needs of each basin. They also share many characteristics in common, including the support and voluntary involvement of all interested parties.

From these initiatives, we have formulated a vision of how governance of rivers might be retooled for the 21st century. Rather than representing "more government," this proposal acknowledges and incorporates the successes that westerners are already bringing about to make government more responsive to local needs. The federal government, along with other levels of government, has a substantial presence and exercises significant authority in most major western river basins. Nothing in the Commission's new governance vision would expand that role. Insofar as the federal presence is more limited in some basins, this proposal would not give additional authority to the federal government. What we propose would, instead, make existing governmental programs more coordinated and efficient by requiring that federal agencies better coordinate their activities within river basins. The federal agencies would also be required to work effectively with other levels of government as well as all stakeholders. At present, there is no requirement that federal agencies coordinate at a basin level. It is our belief that a successful coordination strategy must proceed on two fronts: federal agencies must be given a mandate and a mechanism to forge horizontal cooperation, and coordinated federal goals and programs must also be integrated vertically with state, tribal, and local activities.

The vertical integration must go in both directions. Appropriate federal objectives and requirements need to be clearly expressed and communicated from the basin level to local watershed groups. In turn, those very requirements should be informed by local needs and objectives. Funding should be directed to the local level, where appropriate, to realize and accomplish joint goals, and regional and local initiatives should be encouraged. Watershed councils, where they exist, are varied and unique entities, and they should not be bureaucratized nor recruited as arms of the federal government. Federal agencies should cooperate with them.

We believe that, in order to accomplish the desired level of coordination and cooperation, river basin forums should be created in which federal agencies; state, tribal, and local governments; and stakeholder groups can come together to set joint goals for improving conditions in the basin. We do not recommend any single template for these forums. In fact, our report discusses a number of different models that could be used, depending on the needs of any given basin. The federal government should continue to support experimentation by sponsoring pilot projects in a variety of basins.

Our recommendation that the federal government coordinate its agencies better is made with full awareness of the bureaucratic infighting and competition that could frustrate achievement of this goal. Budgetary disclosure, such as that which is now occurring in the Everglades restoration effort and in the Northwest Power Planning Council, enables the public to understand the federal resources that are being spent on a problem and to evaluate the effectiveness of that spending. Further, our research revealed how difficult it is for anyone to track federal proposals for a region without this sort of coordinated budgeting. If we are to have more public participation, more democracy in the management of a basin's rivers, we need to require that federal agencies coordinate their budget submittals, that they seek public comment on their proposals before they approach the Congress, and that they fully reveal to the public how money is being spent in a region. The experience in the Everglades and in the Columbia River basin demonstrates that this can be done: our proposal attempts to capture the rough contours of what should be done across the West.

Our vision of a new governance for western river basins includes the following specific suggestions, to be tested through pilot projects:

(1) A new approach to governance based on hydrologic systems, linking basins and watersheds.

The federal resource agencies in the basin will adopt practices which encourage, through financial support, in-kind services, and cooperative interaction, the growth of collaborative watershed groups and initiatives on which all stakeholders are fairly represented.

The federal agencies will develop a cooperative process at the river basin level, utilizing existing entities where they exist and involving the leaders of federal, tribal, state, and local agencies; watershed council leaders; and other stakeholders as appropriate, created for the purpose of determining jointly supported solutions to regional water problems.

This process will provide for increased coordination among the federal regional offices in the basin and will facilitate funding of programs proposed by watershed councils as well as the agencies. The President should issue an Executive order or memorandum/directive to the heads of federal agencies and Cabinet secretaries to require regional and/or watershed level coordination of agency budget requests. Agency budget requests pertaining to water resource management and development shall be subject to mandatory review for interagency programmatic coordination and consistency. The designated water resource management officials performing these reviews shall be located in the particular region they serve.

(2) Basin-level objectives.

The river basin planning process will lead to the joint development of measurable objectives for the basin, which comply with federal, tribal, state, and local substantive law, that will be communicated to interested parties in the basin including watershed councils.

(3) A basin trust fund.

The process will encourage the formation of basin accounts and basin trusts which integrate federal, state, tribal, and local funds with money or in-kind contributions from nongovernmental sources such as foundations, stakeholders, and utilities to fund activities that support basin objectives; once a fund is established, a mechanism should be developed which will permit retention of these funds in an interest-bearing reserve account or trust and facilitate carryover management of the funds on a sustained multiyear basis.

These funds, which may include federal appropriations, state funds, and local contributions, will be distributed in an orderly and equitable manner, primarily at the watershed level, to further established objectives for the basin.

(4) A link with watershed councils.

Watershed councils will develop plans and identify specific projects to accomplish their own unique local needs, consistent with the objectives established in basin plans. No specific process or format should be

required, in order to stimulate local innovation and flexibility; watershed councils will utilize integrated databases of federal agencies, state agencies, tribes, and other parties, as well as gather new information to establish baseline conditions and resources.

Watershed councils will provide a forum to educate stakeholders about applicable laws and requirements.

(5) A greater consistency of proposed projects with federal, state, tribal, and local laws and regulations.

Any project which is submitted by watershed councils to comply with the objective set at the basin level shall be presumed consistent with prevailing laws unless within 60 days it is found inconsistent by relevant authorities; this approach would be tested in pilot projects.

(6) A greater reliance on adaptive management.

There will be an orderly process for establishing baseline conditions and measuring results of specific projects to document the achievement of objectives and to adjust the basin plan and objectives as appropriate.

These new governance processes are already providing federal and state agencies, tribes, local agencies, and local organizations with tools to solve problems which, though complex at any level, are most effectively addressed by those most directly concerned. There may be a need for new federal authority to address the unique needs of these emerging governance structures, and it is the recommendation of the Commission that authority

be given for pilot efforts to test these approaches. It is hoped these ongoing efforts and future pilot projects will provide the executive branch and the Congress with the insight necessary to develop policies which maximize the efficiency of federal expenditures, increase effectiveness of the administrative programs, and unify governmental actions to achieve federal and other goals.

The following are brief summaries of the remaining Commission recommendations. More details are provided in the main report.

Tribal Water Rights

A key objective of federal water policy is to assist tribes in meeting tribally defined goals regarding the use, management, and protection of their water and water rights. The federal government needs to fulfill its trust responsibilities to Indian nations and tribes to secure and protect tribal water rights and to assist the nations and tribes in putting those rights to use. Federal contributions toward meeting these obligations should not be limited to potential federal liability for breach of trust but should recognize moral and legal obligations to protect and assist the tribes as well. The federal government should recognize that it has often failed to protect prior and paramount Indian water rights while encouraging and financing non-Indian water development.

The Congress should appropriate funds and authorize the development of water supply and sanitation systems to ensure that residents of reservations have sufficient potable water and modern sewage treatment facilities to maintain the public health and protect the environment. The Congress should also appropriate funds to support the rehabilitation and betterment of existing Indian irrigation projects to improve their efficiency and reduce their adverse impacts on the environment.

Restoration of Aquatic Ecosystems

Many aquatic systems in the American West are degraded and must be restored if they are to be sustainable. By "restoring" aquatic ecosystems, the Commission does not mean returning these systems to predisturbance or predevelopment conditions; rather, the Commission's overall goal is to restore the systems in order that important functions can be recovered and benefits can be realized and sustained over time.

The Commission notes that, in general, federal environmental laws such as the Endangered Species Act and the Clean Water Act have played important roles in protecting and, in some cases, requiring the restoration of aquatic ecosystems. While some changes are necessary to improve the implementation of these laws, the Commission believes these laws continue to be important in ensuring that aquatic and other ecosystems are protected and in setting the parameters within which locally driven watershed initiatives operate.

No comprehensive river restoration program exists. To date, river restoration efforts have not always been formulated in a coordinated and prioritized manner. Ecological risk assessment should be used across the West to gauge where federal support is most needed for restoration. Federal agencies should work with states, tribes, and others to develop and implement comprehensive project plans which take into account social and economic factors to:

1. Improve water quality in western waterways to meet state water quality standards and to support designated uses established by states and tribes pursuant to the Clean Water Act (such as swimming, fishing, and support of aquatic life).

2. Recover and protect threatened and endangered aquatic species and other species at risk.
3. Specifically recognize the benefits of conserving native species, communities, and ecosystems; take steps to sustain native species through activities and programs which will maintain, restore, and enhance instream, riparian, and upland habitat and wetlands; and remove barriers to fish migration, spawning, and rearing. Such actions can potentially prevent additional listings under the Endangered Species Act.
4. Insure sufficient instream flows to achieve and protect the natural functions of riverine, riparian, and flood plain ecosystems. Provide consideration for upstream reservoir and lake habitat.
5. Eradicate and control the spread of exotic and non-native species and pests (e.g., zebra mussels, purple loosestrife) as appropriate by establishing monitoring, inspection, eradication, and public education programs.
6. Identify and remediate contaminated sites that are degrading aquatic ecosystems.

Water Quality

Despite progress in the quality of western water resources, significant problems remain to be addressed. These include: (a) nonpoint source runoff and discharges; (b) poor integration of land and water management; (c) inadequate management of some specific sources of water quality impairment; (d) inadequate water quality standards

for some uses of water; (e) poor integration of groundwater and surface water pollution control programs; (f) poor coordination of water quality and water use programs; (g) insufficient attention to more holistic and integrated approaches to water quality protection and improvement; and (h) inadequate water quality monitoring.

Water Quality Standards

The water quality of western rivers presents issues that are often different from those in the eastern United States. There is little recognition of this in the Clean Water Act or in the programs of the Environmental Protection Agency (EPA).

1. EPA, the U.S. Geological Survey (USGS), and the states should broaden their water quality monitoring to enable them to knowledgeably assess the condition of western (and the nation's) aquatic ecosystems.
2. Western ephemeral streams in arid areas, dry many months of the year, with aquatic ecosystems that can be vastly different from year-round water bodies, present a unique challenge under the Clean Water Act. The Commission supports EPA's effort to find ways to treat these aquatic ecosystems as a separate type of water use and to develop a more appropriate, though equally protective, set of water quality criteria that states and tribes may use in setting water quality standards that protect these ecosystems and their species and habitats. The Commission also encourages states to develop biological criteria to help define the biological integrity of the state's waters.
3. Hydrologic modification activities are increasingly a source of concern in western

aquatic ecosystems, ranking third nationally as a source of water quality impairment for rivers. Water quality criteria and best management practices should be aggressively developed that encourage states to pursue instream flow and other standards for protection of the physical and biological aspects of instream water quality as appropriate.

Nonpoint Sources of Pollution

Despite extensive program efforts and expenditures under the voluntary programs of the Clean Water Act and the farm bills, and establishment of soil loss limits by the Natural Resources Conservation Service of the Department of Agriculture, the problem of nonpoint source discharge continues and threatens to undermine the considerable national success in addressing point sources of water pollution. Nonpoint source programs must be implemented more aggressively by states, with active support and cooperation of the federal government. These programs should, from wherever feasible, emphasize incentives for adoption of best land management practices and be designed so that they can be implemented flexibly at the watershed level. The Congress should consider modifying or changing the Clean Water Act approach to nonpoint sources (found in sections 208 and 319) to that of the Coastal Zone Management Act.

The EPA and the states should more actively pursue cooperative implementation of the watershed-based total maximum daily load process. Two promising areas are a reformed system of nonpoint source best management practices and pollutant trading systems developed on a watershed basis.

Integrating Land and Water Quality Management

The federal government is a substantial land and water manager in the West and, therefore, has important obligations in this area. The mission and authority of each federal water and land management agency—including the Corps of Engineers, Bureau of Reclamation (Reclamation), Forest Service, Bureau of Indian Affairs, Bureau of Land Management, U.S. Fish and Wildlife Service, and National Park Service—should explicitly include land management goals and strategies to improve water quality, particularly from nonpoint sources. Federal agencies should be held to the same water quality protection practices as others.

Specific Sources of Water Quality Impairment

Discharges from publicly owned wastewater treatment works that are utilized beyond their capacity are a potential cause of water quality impairment in specific western water bodies. The states and EPA should carefully monitor the water quality impacts of growth in the West and assure that growth does not outstrip current and future waste treatment capacity.

Among the most serious unregulated forms of water pollution is that generated by irrigated agriculture through irrigation and drainage districts. Irrigation return flows can, in certain situations, contain toxic constituents as well as salts, pesticides, and fertilizers. Some of these discharges are particularly well-suited to be designated as "point sources," as they often enter waterways through discrete and specific points—pipes and ditches— after being collected in carefully engineered systems. These point source discharges were exempted by the Congress from Clean Water Act requirements; that exemption should be reconsidered.

The large and growing number of sizeable confined animal-feeding operations represents an ever-increasing threat to surface water and groundwater quality. Under the Clean Water Act, most such feedlots are point sources in the technical sense only, but they are generally treated as exempt from regulation in the practical sense. Clean Water Act authorities should be applied to require that all confined animal feeding operations operate under the National Pollutant Discharge Elimination System (NPDES).

Groundwater-Surface Water Linkage

Because of the hydrologic link between surface and groundwater, the discharge of pollutants into groundwater from a wide range of sources should be subject to a rigorous system of management under the Clean Water Act, such as the NPDES or the nonpoint source best management practices programs, or through watershed management approaches.

Water Use and Water Quality Linkage

The Commission joins with many other voices in noting that water quality and water use systems are not integrated or effectively coordinated at the federal, state, or local level. The relationships between water use (water allocation and water rights) decisions and water quality management should be recognized at all levels of government decisionmaking, while acknowledging that the Congress determined that "the authority of each state to allocate quantities of water within its jurisdiction shall not be superseded, abrogated, or otherwise impaired by this [Clean Water] Act." Federal agencies with water management responsibilities should recognize that storage and diversions for water use can have a locally significant adverse effect on instream water quality in western states.

Management of Water and Water Facilities

Water Supply

The Commission recognizes that additional water supplies will be needed to address growing consumptive needs, environmental needs, and tribal water rights. Emphasis in new supply development should be given to smaller, offstream storage; to more efficient storage such as conjunctive use of surface and groundwater; to water recycling; and to risk-sharing approaches.

Groundwater Management

State law should recognize and take account of the substantial interrelation of surface water and groundwater. Rights in both sources of supply should be integrated, and uses should be administered and managed conjunctively. The Congress should require state conjunctive management of groundwater and regulation of withdrawals as a condition of federal financial assistance for construction of new water storage projects or other federally funded activities.

Drought Management

An interagency task force should be established to develop an integrated national drought policy and plan that emphasizes a preventive, anticipatory, risk management approach to drought management and promotes self-reliance. (Work has begun toward this goal. A task force has recently been initiated for the western United States by cooperative agreement among the Department of Agriculture, Department of the Interior, the Federal Emergency Management Agency [FEMA], and the Western Governors' Association; this task force should be expanded to include other federal agencies.)

Water Conservation and Efficiency

Water conservation, or improved efficiency of use, can have many benefits and should be the first approach considered for extending or augmenting available supplies. The Commission, therefore, recommends that the Secretaries of the Interior, Defense, and Agriculture should actively encourage and work with users of federal project water to improve project water use efficiency and onfarm water use efficiencies wherever there is reasonable expectation that significant public purposes might be served. In these cases, the Administration should provide incentives and technical and educational assistance for contracting agencies and water users. Many Reclamation irrigation districts have very limited information on water deliveries and use, making a basic calculation of system efficiency difficult. Such data are prerequisite to assessing feasible options for improving water management.

Pricing

For new or renewed water service contracts, federal agencies should seriously consider pricing their services closer to the full cost to the taxpayers of providing the service and, if appropriate, promote water rate structures that encourage efficient water use. In considering proposals for new projects for water-related services, the Congress should carefully evaluate the merits of proposed financial arrangements that provide water and other services to project beneficiaries at less than their full cost.

Operation of Dams and Water Delivery Systems

The Commission recommends that the Secretaries of the Interior and Defense and the Chairman of the Federal Energy Regulatory Commission be directed to prepare and submit to the Congress for each of the dams they manage a brief assessment of the

value of undertaking a systematic review of the dam's purposes, authorities, and operations. Public scoping should be part of this process. The agencies should then be authorized and directed to undertake such reviews, prioritized based on the results of the scoping. Any need for modifying a facility's structures, project authorities and purposes, operations, project beneficiaries, or cost allocations should be identified through a public planning process and reported to the Congress if statutory changes are required. The Congress should provide funding and authority for those changes which appear to improve the way water projects serve public needs, while addressing equitably the rights as well as the financial obligations of current water users.

Water Marketing and Transfers

The Commission finds that water transfers are an essential part of any discussion of the future of the West and its water, particularly given growth projections. Voluntary water transfers are occurring throughout the West and are helping to meet the demand for new urban supplies and for environmental flows in a manner that is both fair and efficient. They are also a critical aspect of viable Indian water rights settlements. However, water transfers that occur without attention to their potentially damaging effects on local communities, economies, and environments can be harmful to ecosystems and social systems that are dependent on irrigation economies.

In view of the potential usefulness of voluntary water transfers as a means of responding to changing demands for use of water resources, federal agencies should facilitate voluntary water transfers as a component of policies for overall water management, subject to processes designed to protect well-defined third party interests. The Congress should review existing water resources

legislation in order to assure that federal law does not impede voluntary water transfers.

State and local jurisdictions should provide clear rules governing a community's right to participate in proceedings regarding transfers from an area.

Enforcement of Reclamation Law

Reclamation should also take steps to ensure that water use from Reclamation projects is in compliance with project authorities and federal Reclamation law.

Flood Plain Management

The 1997 floods in California, Nevada, and the upper Midwest, along with the 1993 Midwest/ Mississippi floods, demonstrate the need for an overarching flood plain management policy to consistently achieve the nation's policies of flood control, disaster prevention and mitigation, disaster relief, and environmental restoration.

1. The major recommendations of the 1994 report, *Sharing the Challenge: Floodplain Management into the 21st Century* (the Galloway Report) should be adopted and implemented.
 - a. The responsibility for flood plain damage reduction through flood plain management should be shared among all levels of government and by those at risk of flooding.
 - b. Enhanced organization and consistency of government activities would further flood plain management and reduce future flood damage.

- c. The reduction of vulnerability to flood damages should be pursued by giving full consideration to all possible alternatives, including permanent evacuation of the flood-prone areas, flood warning, floodproofing structures remaining in the flood plain, creating additional natural and artificial storage, and adequately sizing and maintaining levees and other structures.
2. Development of flood plains should not be subsidized by the federal government. This recommendation is made, in part, to minimize the increasing losses of life and property as a result of flooding events and, in part, to provide the flood storage, flood conveyance, and environmental benefits associated with healthy riparian and riverine ecosystems.
3. All federal expenditures for flood plain management and disaster relief should consistently encourage responsible behavior and discourage behavior likely to lead to future loss of life and property. The Administration should establish a policy that communities and individuals that are eligible to purchase flood insurance and have failed to do so are not eligible for major federal disaster assistance, except for such assistance as is needed to provide for immediate health, safety, and welfare and to provide a safety net for low-income flood victims. The Administration should increase incentives for communities that participate in flood plain management planning through FEMA's National Flood Insurance Program Community Rating Systems.
4. The Administration should pursue, and the Congress should adopt, a change in law to require 50/50 cost sharing among federal

and local governments for funding future structural flood control projects. For nonstructural approaches to flood mitigation, the federal government should fund up to 75 percent.

5. The federal government should more aggressively pursue nontraditional solutions, including purchasing flood plain lands or flood easements, creating setback levees, restoring wetlands and natural storage areas, requiring floodproof structures on the flood plain, and allowing for natural pooling of rivers in lightly populated areas.

Maintaining the Water Infrastructure

The Commission recommends that the Congress and the federal water agencies:

1. Acknowledge the importance of sufficient funding for operation and maintenance of significant federal facilities upon which the public relies for water supply.
2. Recognize the fiscal benefits of preventive maintenance.
3. Place greater importance on maintenance and rehabilitation of key existing federal water infrastructure than on funding for new projects.
4. Develop a long-range approach to maintenance, considering expanded use of user fees and other cost-sharing approaches.
5. Explore further application of revolving funds and similar mechanisms which allow needed maintenance to be accomplished in a more timely and efficient fashion.

6. Continue to vigorously pursue means to reduce costs of operation.

Transfer of Federal Facilities

The Commission believes that it is desirable to transfer assets out of federal ownership in those situations in which the new owner can manage those assets as well as or better than, and at less cost than, the federal government. We concur with the Administration's requirement that transfers be in compliance with environmental laws, that the public be involved in the transfer process, that Native American trust responsibilities be met, and that taxpayers' interests be protected.

We recommend that agencies contemplating facility transfers establish criteria for the transfer of title such as those prepared by Reclamation and that such criteria be consistent among the agencies.

The Commission recommends that the federal government continue to retain ownership of and control over large multipurpose federal water projects. It is important to recognize that these projects have critical functions important to multiple users, stakeholders, beneficiaries, and the public which should be protected. Few, if any, owners outside the federal government can provide adequate protection to these multiple, conflicting, and, often, interstate interests.

Similarly, the Commission is wary of privatization of federal hydropower assets. These assets are usually one component of multipurpose facilities that serve irrigation, municipal, recreation, and fish and wildlife purposes as well as power. It is not clear how these other needs might be met after privatization.

Protecting Productive Agricultural Communities

Over the last century, the farm population in the United States has declined steadily and dramatically, while the value of food production has increased. For the better part of this century, substantial assistance to agricultural production encouraged the expansion of low-priced food production for the United States and for export to the rest of the world. Some of the expansion occurred in areas which were economically marginal or which damaged important natural resources. As federal supports are reduced, further contraction and restructuring of agriculture are likely, and the family farm and ranch are at risk.

At the same time, farm and ranchlands in many parts of the West are giving way to urban growth, suburban sprawl, and the growth of "ranchette" and luxury second homes in rural areas. While this has been financially beneficial to many individual farmers, in some areas the conversion of agricultural lands to other uses has had a serious impact on traditional economies and cultures.

Particularly in the interior West, existing ranching and farming operations are concentrated along riparian corridors, in flood plains and rich bottomlands. While these operations sometimes have negative environmental impacts on riparian resources, they also maintain the area as relatively undeveloped land, providing important benefits to wildlife and open space.

Maintaining these important benefits from farming and ranching operations in the face of changing national and international economies and the tidal pressure of urban growth is a complicated and difficult task, requiring attention from the federal, state, and local levels. It is the judgment of the

Commission that, in the majority of cases, federal water policy affects but does not drive these trends or changes. We do recommend:

1. That federal water policy not subsidize nonagricultural growth and development into agricultural areas.
2. That state and local officials give more attention to putting growth on a sustainable basis.
3. That federal agencies participate with and encourage local efforts to develop plans for land use that preserve the important economic, environmental, cultural, and amenity value of open agricultural and ranchlands.
4. That federal water agencies develop or continue programs that support sustainable agriculture by:
 - a. Strengthening locally led conservation partnerships by ensuring a strong base program of technical assistance and financial incentives to address the array of water resources issues.
 - b. Assisting in development of water conservation plans for districts contracting for federal water supplies.
 - c. Providing loans, grants, and other financial assistance that promote flexible water conservation on farmlands and other lands.
 - d. Conducting research to improve and promote water conservation.
 - e. Facilitating water transfers and marketing of federally supplied water within states that benefit both water conservation and the financial viability of agricultural operations.
5. That irrigation districts, water management agencies, tribes, local and state officials, stakeholders, and affected publics work together to anticipate demands for water conversion and to develop approaches for such conversion that protect the integrity of communities and the environment.

Improving Decisionmaking, Reducing Conflict

Coordinating Federal Policy

The most recent institution charged with coordinating federal water policy was the Water Resources Council, created by the 1965 Water Resources Planning Act and defunded in 1981. Since then, coordination of federal water programs, when it has occurred, has come variously from the Office of Management and Budget, the Council on Environmental Quality at the White House, and such ad hoc bodies as the Task Force on Floodplain Management. Today, most recognize that the world in which federal water policy functions is vastly changed from that overseen by the Water Resources Council. New, large federal water projects are not being funded or even proposed. Today, the need for policy development and coordination stems from the many environmental and social crises affecting the nation's rivers. In the West, federal agencies are responding to tribal water rights, endangered species listings, and Clean Water Act lawsuits in nearly every river basin.

The Commission believes that functioning river basin forums and processes as described above can play a major role in shaping, coordinating, and implementing federal policy at the regional level. However, we believe that there remains a need for national coordination of water policy and programs, especially as federal resources decline and the need for prioritysetting becomes more acute. At a time when our water resources policies are in such rapid transition, it is remarkable that there is no regular forum for discussion of these issues by involved federal officials.

Coordinating Federal Strategy

The water problems that federal agencies deal with in the West today span the jurisdictions of several agencies and several departments (a detailed description of the jurisdictions and authorities of the various congressional committees and federal agencies related to water resources is in appendix C). However, only issues of major political or national significance can get sufficient attention from a Secretary or the President to resolve interdepartmental or intradepartmental conflict. For most problems, there is no forum to develop a coordinated approach; hence, the common criticism of federal agencies not "speaking with one voice." The Commission recommends, for issues of regional significance, the appointment of a designated official who has the responsibility to shepherd the issue on behalf of the President or Secretary as appropriate. This person would undertake to develop a clearly articulated federal objective to be clearly conveyed to field organizations and managers. The official would name a lead organization at the field level to coordinate federal activities and budgets and would designate a single point of legal counsel to coordinate all involved federal agency counsels.

The Federal Role in Research and Data Collection

Using Good Science

Sound, unbiased data and analysis are a prerequisite to the success, efficiency, and economic prudence of many federal activities. The Commission recommends that when federal agencies undertake projects or programs which depend on new scientific research or knowledge, the agencies should bring expert review and contribution to research and monitoring plans, data analysis, and assessment of conclusions. Options include external review panels, such as National Research Council review committees, and publication in peer-reviewed journals. Also, joint investigations with universities and professional groups, project conferences, and symposia should be utilized.

Adaptive Management

When natural river systems and their associated biota are combined with extensive water control structures, the resulting network of interrelationships is extraordinarily complex. The Commission endorses and encourages the use of adaptive management wherever long-term programs or projects are implemented or facilities are operated that may have significant impact upon valued environmental, social, economic, or other resources, and where significant uncertainty exists about the best management action or about its effects.

Monitoring

In its review of the first 25 years of implementation of the National Environmental Policy Act, the

Council on Environmental Quality concluded that, "In most cases at present, agencies do not collect long-term data on the actual environmental impacts of their projects. Nor do agencies generally gather data on the effectiveness of mitigation measures." Therefore, in addition to supporting the increased use of adaptive management, the Commission recommends that agencies give more attention to monitoring significant environmental resources, programs, and mitigation efforts.

Water Research

The Congress and the Administration should acknowledge the scarce nature of western water resources and should recognize that water resources research is a legitimate federal interest that should be supported. To address these issues, the Administration should propose and the Congress should fund a tightly structured research program. A substantial effort must be made to consult with state and other water managers to ensure that research is directed at high-priority problems and to coordinate research across the federal agencies so that limited research funds may be spent most efficiently.

National Water Data

Two critical needs have emerged related to federal water data collection programs: (1) improving efficiency and coordination in data collection, and (2) ensuring continuity and coverage in data collection.

The longstanding programs of the USGS to collect and publish basic streamflow information provide very important information to a broad community of water users and water management organizations. For many reasons, including increasing data collection costs and tighter state and federal budgets, the number of gauging stations being maintained has

declined substantially. The Commission received considerable comment about the need to maintain and ensure the continuity in this basic data collection program. Steps should be taken to develop among the agencies and cooperators a plan for this program that results in greater financial and programmatic stability, and this plan should be presented to the Congress for additional funding if needed.

Similarly, the collection, analysis, and publication by the USGS of water use data from the states has served as one of the few sources of information about regional or national trends in stream diversions, water supply, and use. As our focus on water management is increasingly on the river basin or watershed, often spanning multiple states, it is important to maintain this source of information for both its broad and historic view.

The USGS and the EPA are engaged in several water quality data collection programs, in concert with the states. The largest of these is the National Water Quality Assessment (NAWQA). To improve the coordination and efficiency of these data programs, we encourage the efforts of the Interagency Taskforce for Monitoring, which includes representatives from all levels of government, to conclude the development and implementation of a national strategy under the National Water Quality Monitoring Council. We strongly recommend that further steps be taken to add a focus within NAQWA on critical biological indicators, in addition to the physical and chemical variables currently assessed.

While groundwater use is an area of water management that is arguably the least sustainable in many areas given current practices, data on this resource is not systematically collected and coordinated, either by the states or the USGS. Groundwater management is an area often involving complex interrelationships, and it creates an increased need for data collection and analysis. A

more coordinated approach by local, state, and federal agencies seems prudent, given the heavy reliance on groundwater by agriculture in some regions and by municipal water users in many areas. The western states need good information about groundwater to make informed water management decisions. The resources to perform these studies vary by state, and the federal government's role in providing information can be critical. The USGS, in conjunction with state officials, should help quantify existing data bases and should make available any computer models, geophysical methodology, seismic information, or other tools that could be used to assist decisionmakers. The USGS should also engage in analysis of groundwater resources and provide policy relevant information such as forecasts of aquifer life to the water resources community.

Reasons for Hope

The challenges ahead are daunting. Progress will require significant changes in our water institutions and the way that we manage our water resources. Steady political leadership will be essential. Yet, there are already many signs of progress.

All around the nation, individuals and communities are taking a greater role in stewardship of their natural resources. Hundreds if not thousands of watershed groups now exist nationwide. They have been organized for many reasons—to monitor water quality, to restore fish habitat, to improve recreation, to promote water-related economies. They are providing a community-based forum for resolving, at the local level, some of the most difficult kinds of water conflicts—instream flows, nonpoint source pollution, fish passage, and subdivision of riparian areas. They are achieving success often without regulatory intervention and with very meager funding because they capitalize on the sense of ownership and obligation to others that exists foremost at the community level.

These efforts illustrate an important point: individuals are most likely to recognize unsustainable resource use first when it affects their local environment. Thus, local watershed groups play a critical educational role and also represent a force for sustainable management at the basin level.

Residents of the West are also supporting improved resources management with their votes and dollars. The most notable example is the recent bond election in California, where voters approved hundreds of millions of dollars to help restore the Bay-Delta estuary and improve the reliability of water supplies.

Public support such as this is being mobilized frequently by strong federal-state partnerships, such as the Bay-Delta Accord, which demonstrate that with forward-looking political leadership, very difficult problems can be addressed in a collaborative way. Solutions are not simple or quick; but where good-faith efforts are undertaken, citizens have shown their willingness to provide the necessary funds.

As in the Bay-Delta effort to solve water problems, states in general are taking on a range of roles that is broader than their historic mission of enforcing water rights. They are becoming much more proactive in addressing issues that in the past might have been left to federal agencies or not addressed at all. For example, the Western Governors' Association is addressing the issue of land use planning and protection of open space from uncontrolled growth, traditionally not a politically profitable topic in the West.

The federal government, in turn, is experimenting with ways to make achievement of national environmental goals easier. The use of Habitat Conservation Plans, for example, is showing some promise of enlisting private landowners in cooperative efforts to more effectively protect ecosystems and habitats, rather than just individual

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species. Concerted efforts are also being made to coordinate federal agency activities to make more efficient use of limited budgets as is being done for the Bay-Delta program, the Northwest Forest Plan, and the Everglades restoration.

In this report, the Commission has highlighted some of these promising new initiatives. Our governance recommendations build on these initiatives and seek to improve integration of federal programs with

state, tribal, and local efforts. Our other recommendations address persistent water problems that must be confronted in order to meet the challenge of 21st century western water management. The West is growing, our water resources are going to be called upon to work harder and harder, and we all must work together to achieve wise management of this most precious resource. Water defines the West, and our use of it will define the West of the 21st century.

Frequently Used Acronyms and Abbreviations

BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BPA	Bonneville Power Administration
CAFOs	concentrated animal feedlot operations
cfs	cubic feet per second
Commission	Western Water Policy Review Advisory Commission
Corps	U.S. Army Corps of Engineers
CWA	Clean Water Act
DWR	Department of Water Resources
EDF	Environmental Defense Fund
EIS	environmental impact statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FACA	Federal Advisory Committee Act
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
Interior	U.S. Department of the Interior
maf	million acre-feet
M&I	municipal and industrial
NAWQA	National Water Quality Assessment
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System Permit
NPR	National Performance Review
NPS	National Park Service
NRC	National Research Council
NRCS	Natural Resources Conservation Service
O&M	operation and maintenance
OMB	Office of Management and Budget
OM&R	operation, maintenance, and replacement
Reclamation	Bureau of Reclamation
SDWA	Safe Drinking Water Act
Service	U.S. Fish and Wildlife Service
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
Western	Western Area Power Administration
WGA	Western Governors' Association
WSWC	Western States Water Council

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"Water is the true wealth in a dry land."
— Wallace Stegner

In directing the Western Water Policy Review Advisory Commission (Commission) to make recommendations about the proper role of the federal government in western water management for the next 20 years, the Congress gave our Commission a daunting task. For the past year and a half, we have labored to understand the details of numerous and often conflicting federal programs while striving not to lose sight of the "big picture."

Though many previous studies have documented the chronic problems of water in the West, the convergence of a number of trends makes this study unique and timely. Early in our tenure, we learned that western water planners for the 21st century must address staggering growth projections. For the past 15 years, the West has been experiencing the most dramatic demographic changes for any region or period in the country's history. Should present trends continue, by 2020 population in the West may increase by more than 30 percent. The West is rapidly becoming a series of urban archipelagos (e.g., Denver, Salt Lake City, Boise, Missoula, Portland, Phoenix, Albuquerque, Dallas, Houston, and Seattle) arrayed across a mostly arid landscape.

At the same time, reports to the Commission identified unhealthy trends in aquatic ecosystems and water quality, pressing water supply problems,

unfilled American Indian water claims, an agricultural economy suffering the stress of transition, rapid conversion of open space to urban development, and rising drought and flood damage exacerbated by the potential for global warming. Additional population growth will only cause these crises to worsen unless bold action is taken. Population predictions underscore the urgency for wise long-range water policy planning, effective and efficient water management institutions, and consistent enforcement of existing laws.

Part of the impetus for our Commission's formation was the Congress's finding that current federal water policy suffers from unclear and conflicting goals implemented by a maze of agencies and programs. This finding was reinforced and documented by the Commission's investigation. Lack of policy clarity and coordination resulting in gridlock was a consistent theme of public testimony and scholarly research. We have concluded that these problems cannot be resolved piecemeal but, rather, must be addressed by fundamental changes in institutional structure and government process. Moreover, our work led us to an even more basic conclusion: that the geographic, hydrologic, ecologic, social, and economic diversity of the West will require regionally and locally tailored solutions to effectively meet the challenges of the 21st century of water management.

The lives of westerners and the places we live are changing so rapidly that irreversible developments

are often not preceded by thoughtful policy discussion and choices. In this report, we offer suggestions for addressing water problems in a proactive manner that will foster the necessary policy discussion and integrate the increasingly complex interests in western water.

This summary describes the many recommendations offered by the Commission. Two areas are highlighted first because they received the widest support among the diverse group of Commission members—Principles of Water Management for the 21st Century and New Governance of Watersheds and River Basins.

Principles of Water Management for the 21st Century

The Commission proposes principles by which any federal water program should be guided or judged against. The first principle, sustainable use of water, is adopted from the President's Council on Sustainable Development and forms the backbone of the Commission's recommendations. Both internationally and domestically, sustainable development links together the diverse elements of the water use community and provides the basis for common dialogue and problemsolving. Sustainable water use seeks to achieve a balance between the capability of a system to meet social needs and its biological capacity.

Ensure Sustainable Use of Resources

Use and manage water and related resources so that at the national, regional, and local levels, environmental, social, economic, and cultural values can be supported indefinitely. All water resources policies and programs in the West must recognize and address the dramatic current trends in

population growth and movement. Consideration must be given at all levels of government to growth impacts on water and associated land and open space resources. Policies which encourage growth must be assessed carefully in relation to the available resource base.

Maintain National Goals and Standards

National standards and goals for the quality of water and related resources play a valuable role in the maintenance and restoration of resource health. There is a continuing need for national standards and goals.

Emphasize Local Implementation, Innovation, and Responsibility

Federal, tribal, state, and local cooperation toward achieving national standards should be the basis of water policy. Where possible, responsibility and authority for achieving these national standards should rest with nonfederal governing entities. Reasonable flexibility should be allowed and innovation encouraged in the approaches taken to achieve national standards within a framework of monitoring and accountability.

Provide Incentives

Wherever possible, use economic and other incentives to achieve national, regional, or local water resource goals. Existing incentives and policies for water use and associated land management should be examined to determine whether they promote or impede sustainable use of resources and serve contemporary social goals. Funding should be used to provide incentives for state and local entities to achieve resource goals.

Respect Existing Rights

Acknowledge and respect existing treaties, compacts, and equitable apportionments with states and tribes. Respect and give appropriate legal deference to existing water rights and state water appropriation systems.

Promote Social Equity

Determine and fulfill tribal rights to water. Universal access to safe domestic water supplies should be a priority. We must also recognize that local economies have developed throughout the West as a result of government policies designed to encourage certain land and water uses. As those policies evolve, regardless of the reason, people and communities affected by such changes may need time and assistance to make a transition. Water transfers should be carried out with full consideration of the communities of origin, third party transfers, and unintentional consequences, and should be open to participation by affected parties.

Organize Around Hydrologic Systems

Strive to make state and federal water programs and decisionmaking more efficient and effective. To help address the problems created by multiple and often conflicting jurisdictions, authorities, and program objectives, we should organize or integrate water planning, programs, agencies, funding, and decisionmaking around natural systems—the watersheds and river basins. This will require integrating institutional missions, budgets, and programs, as well as their congressional oversight. Duplicative or overlapping programs and activities should be integrated or modified. Planning and management of land and water, surface and groundwater, water quantity and quality, and point

and nonpoint pollution must be coordinated at the appropriate level of government.

Ensure Measurable Objectives, Sound Science, Adaptive Management

National, regional, and local water resource goals should be translated into measurable objectives. Performance should be assessed through open, objective, scientific studies, subject to peer review. Where knowledge is incomplete, actions should be based upon the best available data within a framework of monitoring and adaptive management. Determination of the best use of resources should take into account social, economic, environmental, and cultural values.

Employ Participatory Decisionmaking

National, regional, and local resource decision-making must be open to involvement and meaningful participation by affected governments as well as interested and affected stakeholders. Sufficient information about the consequences of resource decisions should be made available to the public.

Provide Innovative Funding

Given declining federal budgets, innovative sources of funding and investment, including public and private partnerships, must be found for the management and restoration of western rivers.

New Governance of Watersheds and River Basins

The Commission investigated numerous examples of local watershed initiatives, watershed councils, basin trusts, citizen advisory groups, and

collaborative governmental partnerships that are springing up around the West to address critical problems of water supply, water quality, environmental degradation, quality of life concerns, and compliance with interrelated federal, state and local laws. We believe that these initiatives hold much promise for meeting the growing challenges of western water management. To accept local participation is not simply to engage in a democratic exercise, but to recognize the growing need for (1) sustainable, local economies and energetic stakeholder consensus to replace frustration and dissension; (2) alternative sources of revenue to supplement federal appropriations; (3) coordinated and clarified regulatory requirements to reduce governmental gridlock; and (4) policy-relevant science to better inform program and budget decisions.

From the bottom up, the new federal challenge is to encourage local innovation, to effectively participate with local stakeholders in watershed groups and watershed councils, and to integrate them with federal, tribal, local, and state governmental requirements.

From the top down, the federal challenge is to establish policies which direct the federal resource agencies to coordinate their activities throughout hydrologic regions. This approach will require establishment of a national policy of interagency coordination which cascades down to regional offices and field personnel. It will also require better budgetary coordination to stimulate true integration of all federal water activities in each locale.

Accomplishment of these objectives will drive fundamental change in the structure of the federal government. We anticipate that during the next century, the federal resources management agencies will undergo widespread realignment of their organizational and enforcement functions. Recognizing how slowly governmental institutions

change, in this report we recommend a partial reorganization of functions which can be immediately implemented within the present governmental agency framework. While we reaffirm many existing goals and programs, we suggest a recalibration of the way in which these goals are achieved.

We propose a change in the function and approach of the federal resource agencies to a "nested" governance structure. This new governance approach reflects the hydrologic, social, legal, and political reality of the watershed. Fundamental principles of those governance structures are: regional flexibility, participation of all affected stakeholders in formulating joint programs to effectuate shared objectives, and recognition that intensive interaction among federal, state, tribal, and local governmental entities and stakeholders is essential to design durable solutions.

As the Commission learned throughout its process, examples of new basin governance structures are already emerging across the West to realize these very goals. There should be great hope based upon the initial success of these new institutional processes, and their continuation should be embraced by the federal government. They take many forms, depending upon the nature of the issues, the number of states and federal agencies involved, the legal parameters, and the number and nature of stakeholder interests. We highlight many of these new processes throughout the Commission report. They include: the Northwest Power Planning Council on the Columbia River; the Bay Delta Accord and the CALFED process on the Sacramento and San Joaquin Rivers; the three-state cooperative agreement with the Department of the Interior on the Platte River; the Upper Colorado Fish Recovery Program and the Lower Colorado Multispecies Recovery Program on the Colorado River. These efforts are distinct in many ways because they reflect the unique needs of each basin. They also share many characteristics in common,

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including the support and voluntary involvement of all interested parties.

From these initiatives, we have formulated a vision of how governance of rivers might be retooled for the 21st century. Rather than representing "more government," this proposal acknowledges and incorporates the successes that westerners are already bringing about to make government more responsive to local needs. The federal government, along with other levels of government, has a substantial presence and exercises significant authority in most major western river basins. Nothing in the Commission's new governance vision would expand that role. Insofar as the federal presence is more limited in some basins, this proposal would not give additional authority to the federal government. What we propose would, instead, make existing governmental programs more coordinated and efficient by requiring that federal agencies better coordinate their activities within river basins. The federal agencies would also be required to work effectively with other levels of government as well as all stakeholders. At present, there is no requirement that federal agencies coordinate at a basin level. It is our belief that a successful coordination strategy must proceed on two fronts: federal agencies must be given a mandate and a mechanism to forge horizontal cooperation, and coordinated federal goals and programs must also be integrated vertically with state, tribal, and local activities.

The vertical integration must go in both directions. Appropriate federal objectives and requirements need to be clearly expressed and communicated from the basin level to local watershed groups. In turn, those very requirements should be informed by local needs and objectives. Funding should be directed to the local level, where appropriate, to realize and accomplish joint goals, and regional and local initiatives should be encouraged. Watershed councils, where they exist, are varied and unique entities, and they should not be bureaucratized nor

recruited as arms of the federal government. Federal agencies should cooperate with them.

We believe that, in order to accomplish the desired level of coordination and cooperation, river basin forums should be created in which federal agencies; state, tribal, and local governments; and stakeholder groups can come together to set joint goals for improving conditions in the basin. We do not recommend any single template for these forums. In fact, our report discusses a number of different models that could be used, depending on the needs of any given basin. The federal government should continue to support experimentation by sponsoring pilot projects in a variety of basins.

Our recommendation that the federal government coordinate its agencies better is made with full awareness of the bureaucratic infighting and competition that could frustrate achievement of this goal. Budgetary disclosure, such as that which is now occurring in the Everglades restoration effort and in the Northwest Power Planning Council, enables the public to understand the federal resources that are being spent on a problem and to evaluate the effectiveness of that spending. Further, our research revealed how difficult it is for anyone to track federal proposals for a region without this sort of coordinated budgeting. If we are to have more public participation, more democracy in the management of a basin's rivers, we need to require that federal agencies coordinate their budget submittals, that they seek public comment on their proposals before they approach the Congress, and that they fully reveal to the public how money is being spent in a region. The experience in the Everglades and in the Columbia River basin demonstrates that this can be done: our proposal attempts to capture the rough contours of what should be done across the West.

Our vision of a new governance for western river basins includes the following specific suggestions, to be tested through pilot projects:

(1) A new approach to governance based on hydrologic systems, linking basins and watersheds.

The federal resource agencies in the basin will adopt practices which encourage, through financial support, in-kind services, and cooperative interaction, the growth of collaborative watershed groups and initiatives on which all stakeholders are fairly represented.

The federal agencies will develop a cooperative process at the river basin level, utilizing existing entities where they exist and involving the leaders of federal, tribal, state, and local agencies; watershed council leaders; and other stakeholders as appropriate, created for the purpose of determining jointly supported solutions to regional water problems.

This process will provide for increased coordination among the federal regional offices in the basin and will facilitate funding of programs proposed by watershed councils as well as the agencies. The President should issue an Executive order or memorandum/directive to the heads of federal agencies and Cabinet secretaries to require regional and/or watershed level coordination of agency budget requests. Agency budget requests pertaining to water resource management and development shall be subject to mandatory review for interagency programmatic coordination and consistency. The designated water resource management officials performing these reviews shall be located in the particular region they serve.

(2) Basin-level objectives.

The river basin planning process will lead to the joint development of measurable objectives for the basin, which comply with federal, tribal, state, and local substantive law, that will be communicated to interested parties in the basin including watershed councils.

(3) A basin trust fund.

The process will encourage the formation of basin accounts and basin trusts which integrate federal, state, tribal, and local funds with money or in-kind contributions from nongovernmental sources such as foundations, stakeholders, and utilities to fund activities that support basin objectives; once a fund is established, a mechanism should be developed which will permit retention of these funds in an interest-bearing reserve account or trust and facilitate carryover management of the funds on a sustained multiyear basis.

These funds, which may include federal appropriations, state funds, and local contributions, will be distributed in an orderly and equitable manner, primarily at the watershed level, to further established objectives for the basin.

(4) A link with watershed councils.

Watershed councils will develop plans and identify specific projects to accomplish their own unique local needs, consistent with the objectives established in basin plans. No specific process or format should be

required, in order to stimulate local innovation and flexibility; watershed councils will utilize integrated databases of federal agencies, state agencies, tribes, and other parties, as well as gather new information to establish baseline conditions and resources.

Watershed councils will provide a forum to educate stakeholders about applicable laws and requirements.

(5) A greater consistency of proposed projects with federal, state, tribal, and local laws and regulations.

Any project which is submitted by watershed councils to comply with the objective set at the basin level shall be presumed consistent with prevailing laws unless within 60 days it is found inconsistent by relevant authorities; this approach would be tested in pilot projects.

(6) A greater reliance on adaptive management.

There will be an orderly process for establishing baseline conditions and measuring results of specific projects to document the achievement of objectives and to adjust the basin plan and objectives as appropriate.

These new governance processes are already providing federal and state agencies, tribes, local agencies, and local organizations with tools to solve problems which, though complex at any level, are most effectively addressed by those most directly concerned. There may be a need for new federal authority to address the unique needs of these emerging governance structures, and it is the recommendation of the Commission that authority

be given for pilot efforts to test these approaches. It is hoped these ongoing efforts and future pilot projects will provide the executive branch and the Congress with the insight necessary to develop policies which maximize the efficiency of federal expenditures, increase effectiveness of the administrative programs, and unify governmental actions to achieve federal and other goals.

The following are brief summaries of the remaining Commission recommendations. More details are provided in the main report.

Tribal Water Rights

A key objective of federal water policy is to assist tribes in meeting tribally defined goals regarding the use, management, and protection of their water and water rights. The federal government needs to fulfill its trust responsibilities to Indian nations and tribes to secure and protect tribal water rights and to assist the nations and tribes in putting those rights to use. Federal contributions toward meeting these obligations should not be limited to potential federal liability for breach of trust but should recognize moral and legal obligations to protect and assist the tribes as well. The federal government should recognize that it has often failed to protect prior and paramount Indian water rights while encouraging and financing non-Indian water development.

The Congress should appropriate funds and authorize the development of water supply and sanitation systems to ensure that residents of reservations have sufficient potable water and modern sewage treatment facilities to maintain the public health and protect the environment. The Congress should also appropriate funds to support the rehabilitation and betterment of existing Indian irrigation projects to improve their efficiency and reduce their adverse impacts on the environment.

Restoration of Aquatic Ecosystems

Many aquatic systems in the American West are degraded and must be restored if they are to be sustainable. By "restoring" aquatic ecosystems, the Commission does not mean returning these systems to predisturbance or predevelopment conditions; rather, the Commission's overall goal is to restore the systems in order that important functions can be recovered and benefits can be realized and sustained over time.

The Commission notes that, in general, federal environmental laws such as the Endangered Species Act and the Clean Water Act have played important roles in protecting and, in some cases, requiring the restoration of aquatic ecosystems. While some changes are necessary to improve the implementation of these laws, the Commission believes these laws continue to be important in ensuring that aquatic and other ecosystems are protected and in setting the parameters within which locally driven watershed initiatives operate.

No comprehensive river restoration program exists. To date, river restoration efforts have not always been formulated in a coordinated and prioritized manner. Ecological risk assessment should be used across the West to gauge where federal support is most needed for restoration. Federal agencies should work with states, tribes, and others to develop and implement comprehensive project plans which take into account social and economic factors to:

1. Improve water quality in western waterways to meet state water quality standards and to support designated uses established by states and tribes pursuant to the Clean Water Act (such as swimming, fishing, and support of aquatic life).

2. Recover and protect threatened and endangered aquatic species and other species at risk.
3. Specifically recognize the benefits of conserving native species, communities, and ecosystems; take steps to sustain native species through activities and programs which will maintain, restore, and enhance instream, riparian, and upland habitat and wetlands; and remove barriers to fish migration, spawning, and rearing. Such actions can potentially prevent additional listings under the Endangered Species Act.
4. Insure sufficient instream flows to achieve and protect the natural functions of riverine, riparian, and flood plain ecosystems. Provide consideration for upstream reservoir and lake habitat.
5. Eradicate and control the spread of exotic and non-native species and pests (e.g., zebra mussels, purple loosestrife) as appropriate by establishing monitoring, inspection, eradication, and public education programs.
6. Identify and remediate contaminated sites that are degrading aquatic ecosystems.

Water Quality

Despite progress in the quality of western water resources, significant problems remain to be addressed. These include: (a) nonpoint source runoff and discharges; (b) poor integration of land and water management; (c) inadequate management of some specific sources of water quality impairment; (d) inadequate water quality standards

for some uses of water; (e) poor integration of groundwater and surface water pollution control programs; (f) poor coordination of water quality and water use programs; (g) insufficient attention to more holistic and integrated approaches to water quality protection and improvement; and (h) inadequate water quality monitoring.

Water Quality Standards

The water quality of western rivers presents issues that are often different from those in the eastern United States. There is little recognition of this in the Clean Water Act or in the programs of the Environmental Protection Agency (EPA).

1. EPA, the U.S. Geological Survey (USGS), and the states should broaden their water quality monitoring to enable them to knowledgeably assess the condition of western (and the nation's) aquatic ecosystems.
2. Western ephemeral streams in arid areas, dry many months of the year, with aquatic ecosystems that can be vastly different from year-round water bodies, present a unique challenge under the Clean Water Act. The Commission supports EPA's effort to find ways to treat these aquatic ecosystems as a separate type of water use and to develop a more appropriate, though equally protective, set of water quality criteria that states and tribes may use in setting water quality standards that protect these ecosystems and their species and habitats. The Commission also encourages states to develop biological criteria to help define the biological integrity of the state's waters.
3. Hydrologic modification activities are increasingly a source of concern in western

aquatic ecosystems, ranking third nationally as a source of water quality impairment for rivers. Water quality criteria and best management practices should be aggressively developed that encourage states to pursue instream flow and other standards for protection of the physical and biological aspects of instream water quality as appropriate.

Nonpoint Sources of Pollution

Despite extensive program efforts and expenditures under the voluntary programs of the Clean Water Act and the farm bills, and establishment of soil loss limits by the Natural Resources Conservation Service of the Department of Agriculture, the problem of nonpoint source discharge continues and threatens to undermine the considerable national success in addressing point sources of water pollution. Nonpoint source programs must be implemented more aggressively by states, with active support and cooperation of the federal government. These programs should, from wherever feasible, emphasize incentives for adoption of best land management practices and be designed so that they can be implemented flexibly at the watershed level. The Congress should consider modifying or changing the Clean Water Act approach to nonpoint sources (found in sections 208 and 319) to that of the Coastal Zone Management Act.

The EPA and the states should more actively pursue cooperative implementation of the watershed-based total maximum daily load process. Two promising areas are a reformed system of nonpoint source best management practices and pollutant trading systems developed on a watershed basis.

Integrating Land and Water Quality Management

The federal government is a substantial land and water manager in the West and, therefore, has important obligations in this area. The mission and authority of each federal water and land management agency—including the Corps of Engineers, Bureau of Reclamation (Reclamation), Forest Service, Bureau of Indian Affairs, Bureau of Land Management, U.S. Fish and Wildlife Service, and National Park Service—should explicitly include land management goals and strategies to improve water quality, particularly from nonpoint sources. Federal agencies should be held to the same water quality protection practices as others.

Specific Sources of Water Quality Impairment

Discharges from publicly owned wastewater treatment works that are utilized beyond their capacity are a potential cause of water quality impairment in specific western water bodies. The states and EPA should carefully monitor the water quality impacts of growth in the West and assure that growth does not outstrip current and future waste treatment capacity.

Among the most serious unregulated forms of water pollution is that generated by irrigated agriculture through irrigation and drainage districts. Irrigation return flows can, in certain situations, contain toxic constituents as well as salts, pesticides, and fertilizers. Some of these discharges are particularly well-suited to be designated as "point sources," as they often enter waterways through discrete and specific points—pipes and ditches—after being collected in carefully engineered systems. These point source discharges were exempted by the Congress from Clean Water Act requirements; that exemption should be reconsidered.

The large and growing number of sizeable confined animal-feeding operations represents an ever-increasing threat to surface water and groundwater quality. Under the Clean Water Act, most such feedlots are point sources in the technical sense only, but they are generally treated as exempt from regulation in the practical sense. Clean Water Act authorities should be applied to require that all confined animal feeding operations operate under the National Pollutant Discharge Elimination System (NPDES).

Groundwater-Surface Water Linkage

Because of the hydrologic link between surface and groundwater, the discharge of pollutants into groundwater from a wide range of sources should be subject to a rigorous system of management under the Clean Water Act, such as the NPDES or the nonpoint source best management practices programs, or through watershed management approaches.

Water Use and Water Quality Linkage

The Commission joins with many other voices in noting that water quality and water use systems are not integrated or effectively coordinated at the federal, state, or local level. The relationships between water use (water allocation and water rights) decisions and water quality management should be recognized at all levels of government decisionmaking, while acknowledging that the Congress determined that "the authority of each state to allocate quantities of water within its jurisdiction shall not be superseded, abrogated, or otherwise impaired by this [Clean Water] Act." Federal agencies with water management responsibilities should recognize that storage and diversions for water use can have a locally significant adverse effect on instream water quality in western states.

Management of Water and Water Facilities

Water Supply

The Commission recognizes that additional water supplies will be needed to address growing consumptive needs, environmental needs, and tribal water rights. Emphasis in new supply development should be given to smaller, offstream storage; to more efficient storage such as conjunctive use of surface and groundwater; to water recycling; and to risk-sharing approaches.

Groundwater Management

State law should recognize and take account of the substantial interrelation of surface water and groundwater. Rights in both sources of supply should be integrated, and uses should be administered and managed conjunctively. The Congress should require state conjunctive management of groundwater and regulation of withdrawals as a condition of federal financial assistance for construction of new water storage projects or other federally funded activities.

Drought Management

An interagency task force should be established to develop an integrated national drought policy and plan that emphasizes a preventive, anticipatory, risk management approach to drought management and promotes self-reliance. (Work has begun toward this goal. A task force has recently been initiated for the western United States by cooperative agreement among the Department of Agriculture, Department of the Interior, the Federal Emergency Management Agency [FEMA], and the Western Governors' Association; this task force should be expanded to include other federal agencies.)

Water Conservation and Efficiency

Water conservation, or improved efficiency of use, can have many benefits and should be the first approach considered for extending or augmenting available supplies. The Commission, therefore, recommends that the Secretaries of the Interior, Defense, and Agriculture should actively encourage and work with users of federal project water to improve project water use efficiency and onfarm water use efficiencies wherever there is reasonable expectation that significant public purposes might be served. In these cases, the Administration should provide incentives and technical and educational assistance for contracting agencies and water users. Many Reclamation irrigation districts have very limited information on water deliveries and use, making a basic calculation of system efficiency difficult. Such data are prerequisite to assessing feasible options for improving water management.

Pricing

For new or renewed water service contracts, federal agencies should seriously consider pricing their services closer to the full cost to the taxpayers of providing the service and, if appropriate, promote water rate structures that encourage efficient water use. In considering proposals for new projects for water-related services, the Congress should carefully evaluate the merits of proposed financial arrangements that provide water and other services to project beneficiaries at less than their full cost.

Operation of Dams and Water Delivery Systems

The Commission recommends that the Secretaries of the Interior and Defense and the Chairman of the Federal Energy Regulatory Commission be directed to prepare and submit to the Congress for each of

the dams they manage a brief assessment of the value of undertaking a systematic review of the dam's purposes, authorities, and operations. Public scoping should be part of this process. The agencies should then be authorized and directed to undertake such reviews, prioritized based on the results of the scoping. Any need for modifying a facility's structures, project authorities and purposes, operations, project beneficiaries, or cost allocations should be identified through a public planning process and reported to the Congress if statutory changes are required. The Congress should provide funding and authority for those changes which appear to improve the way water projects serve public needs, while addressing equitably the rights as well as the financial obligations of current water users.

Water Marketing and Transfers

The Commission finds that water transfers are an essential part of any discussion of the future of the West and its water, particularly given growth projections. Voluntary water transfers are occurring throughout the West and are helping to meet the demand for new urban supplies and for environmental flows in a manner that is both fair and efficient. They are also a critical aspect of viable Indian water rights settlements. However, water transfers that occur without attention to their potentially damaging effects on local communities, economies, and environments can be harmful to ecosystems and social systems that are dependent on irrigation economies.

In view of the potential usefulness of voluntary water transfers as a means of responding to changing demands for use of water resources, federal agencies should facilitate voluntary water transfers as a component of policies for overall water management, subject to processes designed to protect well-defined third party interests. The Congress should review existing water resources

legislation in order to assure that federal law does not impede voluntary water transfers.

State and local jurisdictions should provide clear rules governing a community's right to participate in proceedings regarding transfers from an area.

Enforcement of Reclamation Law

Reclamation should also take steps to ensure that water use from Reclamation projects is in compliance with project authorities and federal Reclamation law.

Flood Plain Management

The 1997 floods in California, Nevada, and the upper Midwest, along with the 1993 Midwest/ Mississippi floods, demonstrate the need for an overarching flood plain management policy to consistently achieve the nation's policies of flood control, disaster prevention and mitigation, disaster relief, and environmental restoration.

1. The major recommendations of the 1994 report, *Sharing the Challenge: Floodplain Management into the 21st Century* (the Galloway Report) should be adopted and implemented.
 - a. The responsibility for flood plain damage reduction through flood plain management should be shared among all levels of government and by those at risk of flooding.
 - b. Enhanced organization and consistency of government activities would further flood plain management and reduce future flood damage.

- c. The reduction of vulnerability to flood damages should be pursued by giving full consideration to all possible alternatives, including permanent evacuation of the flood-prone areas, flood warning, floodproofing structures remaining in the flood plain, creating additional natural and artificial storage, and adequately sizing and maintaining levees and other structures.
2. Development of flood plains should not be subsidized by the federal government. This recommendation is made, in part, to minimize the increasing losses of life and property as a result of flooding events and, in part, to provide the flood storage, flood conveyance, and environmental benefits associated with healthy riparian and riverine ecosystems.
3. All federal expenditures for flood plain management and disaster relief should consistently encourage responsible behavior and discourage behavior likely to lead to future loss of life and property. The Administration should establish a policy that communities and individuals that are eligible to purchase flood insurance and have failed to do so are not eligible for major federal disaster assistance, except for such assistance as is needed to provide for immediate health, safety, and welfare and to provide a safety net for low-income flood victims. The Administration should increase incentives for communities that participate in flood plain management planning through FEMA's National Flood Insurance Program Community Rating Systems.
4. The Administration should pursue, and the Congress should adopt, a change in law to require 50/50 cost sharing among federal

and local governments for funding future structural flood control projects. For nonstructural approaches to flood mitigation, the federal government should fund up to 75 percent.

5. The federal government should more aggressively pursue nontraditional solutions, including purchasing flood plain lands or flood easements, creating setback levees, restoring wetlands and natural storage areas, requiring floodproof structures on the flood plain, and allowing for natural pooling of rivers in lightly populated areas.

Maintaining the Water Infrastructure

The Commission recommends that the Congress and the federal water agencies:

1. Acknowledge the importance of sufficient funding for operation and maintenance of significant federal facilities upon which the public relies for water supply.
2. Recognize the fiscal benefits of preventive maintenance.
3. Place greater importance on maintenance and rehabilitation of key existing federal water infrastructure than on funding for new projects.
4. Develop a long-range approach to maintenance, considering expanded use of user fees and other cost-sharing approaches.
5. Explore further application of revolving funds and similar mechanisms which allow

needed maintenance to be accomplished in a more timely and efficient fashion.

6. Continue to vigorously pursue means to reduce costs of operation.

Transfer of Federal Facilities

The Commission believes that it is desirable to transfer assets out of federal ownership in those situations in which the new owner can manage those assets as well as or better than, and at less cost than, the federal government. We concur with the Administration's requirement that transfers be in compliance with environmental laws, that the public be involved in the transfer process, that Native American trust responsibilities be met, and that taxpayers' interests be protected.

We recommend that agencies contemplating facility transfers establish criteria for the transfer of title such as those prepared by Reclamation and that such criteria be consistent among the agencies.

The Commission recommends that the federal government continue to retain ownership of and control over large multipurpose federal water projects. It is important to recognize that these projects have critical functions important to multiple users, stakeholders, beneficiaries, and the public which should be protected. Few, if any, owners outside the federal government can provide adequate protection to these multiple, conflicting, and, often, interstate interests.

Similarly, the Commission is wary of privatization of federal hydropower assets. These assets are usually one component of multipurpose facilities that serve irrigation, municipal, recreation, and fish and wildlife purposes as well as power. It is not clear how these other needs might be met after privatization.

Protecting Productive Agricultural Communities

Over the last century, the farm population in the United States has declined steadily and dramatically, while the value of food production has increased. For the better part of this century, substantial assistance to agricultural production encouraged the expansion of low-priced food production for the United States and for export to the rest of the world. Some of the expansion occurred in areas which were economically marginal or which damaged important natural resources. As federal supports are reduced, further contraction and restructuring of agriculture are likely, and the family farm and ranch are at risk.

At the same time, farm and ranchlands in many parts of the West are giving way to urban growth, suburban sprawl, and the growth of "ranchette" and luxury second homes in rural areas. While this has been financially beneficial to many individual farmers, in some areas the conversion of agricultural lands to other uses has had a serious impact on traditional economies and cultures.

Particularly in the interior West, existing ranching and farming operations are concentrated along riparian corridors, in flood plains and rich bottomlands. While these operations sometimes have negative environmental impacts on riparian resources, they also maintain the area as relatively undeveloped land, providing important benefits to wildlife and open space.

Maintaining these important benefits from farming and ranching operations in the face of changing national and international economies and the tidal pressure of urban growth is a complicated and difficult task, requiring attention from the federal, state, and local levels. It is the judgment of the

Commission that, in the majority of cases, federal water policy affects but does not drive these trends or changes. We do recommend:

1. That federal water policy not subsidize nonagricultural growth and development into agricultural areas.
2. That state and local officials give more attention to putting growth on a sustainable basis.
3. That federal agencies participate with and encourage local efforts to develop plans for land use that preserve the important economic, environmental, cultural, and amenity value of open agricultural and ranchlands.
4. That federal water agencies develop or continue programs that support sustainable agriculture by:
 - a. Strengthening locally led conservation partnerships by ensuring a strong base program of technical assistance and financial incentives to address the array of water resources issues.
 - b. Assisting in development of water conservation plans for districts contracting for federal water supplies.
 - c. Providing loans, grants, and other financial assistance that promote flexible water conservation on farmlands and other lands.
 - d. Conducting research to improve and promote water conservation.
 - e. Facilitating water transfers and marketing of federally supplied water within states that benefit both water conservation and the financial viability of agricultural operations.
5. That irrigation districts, water management agencies, tribes, local and state officials, stakeholders, and affected publics work together to anticipate demands for water conversion and to develop approaches for such conversion that protect the integrity of communities and the environment.

Improving Decisionmaking, Reducing Conflict

Coordinating Federal Policy

The most recent institution charged with coordinating federal water policy was the Water Resources Council, created by the 1965 Water Resources Planning Act and defunded in 1981. Since then, coordination of federal water programs, when it has occurred, has come variously from the Office of Management and Budget, the Council on Environmental Quality at the White House, and such ad hoc bodies as the Task Force on Floodplain Management. Today, most recognize that the world in which federal water policy functions is vastly changed from that overseen by the Water Resources Council. New, large federal water projects are not being funded or even proposed. Today, the need for policy development and coordination stems from the many environmental and social crises affecting the nation's rivers. In the West, federal agencies are responding to tribal water rights, endangered species listings, and Clean Water Act lawsuits in nearly every river basin.

The Commission believes that functioning river basin forums and processes as described above can play a major role in shaping, coordinating, and implementing federal policy at the regional level. However, we believe that there remains a need for national coordination of water policy and programs, especially as federal resources decline and the need for prioritysetting becomes more acute. At a time when our water resources policies are in such rapid transition, it is remarkable that there is no regular forum for discussion of these issues by involved federal officials.

Coordinating Federal Strategy

The water problems that federal agencies deal with in the West today span the jurisdictions of several agencies and several departments (a detailed description of the jurisdictions and authorities of the various congressional committees and federal agencies related to water resources is in appendix C). However, only issues of major political or national significance can get sufficient attention from a Secretary or the President to resolve interdepartmental or intradepartmental conflict. For most problems, there is no forum to develop a coordinated approach; hence, the common criticism of federal agencies not "speaking with one voice." The Commission recommends, for issues of regional significance, the appointment of a designated official who has the responsibility to shepherd the issue on behalf of the President or Secretary as appropriate. This person would undertake to develop a clearly articulated federal objective to be clearly conveyed to field organizations and managers. The official would name a lead organization at the field level to coordinate federal activities and budgets and would designate a single point of legal counsel to coordinate all involved federal agency counsels.

The Federal Role in Research and Data Collection

Using Good Science

Sound, unbiased data and analysis are a prerequisite to the success, efficiency, and economic prudence of many federal activities. The Commission recommends that when federal agencies undertake projects or programs which depend on new scientific research or knowledge, the agencies should bring expert review and contribution to research and monitoring plans, data analysis, and assessment of conclusions. Options include external review panels, such as National Research Council review committees, and publication in peer-reviewed journals. Also, joint investigations with universities and professional groups, project conferences, and symposia should be utilized.

Adaptive Management

When natural river systems and their associated biota are combined with extensive water control structures, the resulting network of inter-relationships is extraordinarily complex. The Commission endorses and encourages the use of adaptive management wherever long-term programs or projects are implemented or facilities are operated that may have significant impact upon valued environmental, social, economic, or other resources, and where significant uncertainty exists about the best management action or about its effects.

Monitoring

In its review of the first 25 years of implementation of the National Environmental Policy Act, the

Council on Environmental Quality concluded that, "In most cases at present, agencies do not collect long-term data on the actual environmental impacts of their projects. Nor do agencies generally gather data on the effectiveness of mitigation measures." Therefore, in addition to supporting the increased use of adaptive management, the Commission recommends that agencies give more attention to monitoring significant environmental resources, programs, and mitigation efforts.

Water Research

The Congress and the Administration should acknowledge the scarce nature of western water resources and should recognize that water resources research is a legitimate federal interest that should be supported. To address these issues, the Administration should propose and the Congress should fund a tightly structured research program. A substantial effort must be made to consult with state and other water managers to ensure that research is directed at high-priority problems and to coordinate research across the federal agencies so that limited research funds may be spent most efficiently.

National Water Data

Two critical needs have emerged related to federal water data collection programs: (1) improving efficiency and coordination in data collection, and (2) ensuring continuity and coverage in data collection.

The longstanding programs of the USGS to collect and publish basic streamflow information provide very important information to a broad community of water users and water management organizations. For many reasons, including increasing data collection costs and tighter state and federal budgets, the number of gauging stations

being maintained has declined substantially. The Commission received considerable comment about the need to maintain and ensure the continuity in this basic data collection program. Steps should be taken to develop among the agencies and cooperators a plan for this program that results in greater financial and programmatic stability, and this plan should be presented to the Congress for additional funding if needed.

Similarly, the collection, analysis, and publication by the USGS of water use data from the states has served as one of the few sources of information about regional or national trends in stream diversions, water supply, and use. As our focus on water management is increasingly on the river basin or watershed, often spanning multiple states, it is important to maintain this source of information for both its broad and historic view.

The USGS and the EPA are engaged in several water quality data collection programs, in concert with the states. The largest of these is the National Water Quality Assessment (NAWQA). To improve the coordination and efficiency of these data programs, we encourage the efforts of the Interagency Taskforce for Monitoring, which includes representatives from all levels of government, to conclude the development and implementation of a national strategy under the National Water Quality Monitoring Council. We strongly recommend that further steps be taken to add a focus within NAWQA on critical biological indicators, in addition to the physical and chemical variables currently assessed.

While groundwater use is an area of water management that is arguably the least sustainable in many areas given current practices, data on this resource is not systematically collected and coordinated, either by the states or the USGS. Groundwater management is an area often involving complex interrelationships, and it creates an increased need for data collection and analysis.

A more coordinated approach by local, state, and federal agencies seems prudent, given the heavy reliance on groundwater by agriculture in some regions and by municipal water users in many areas. The western states need good information about groundwater to make informed water management decisions. The resources to perform these studies vary by state, and the federal government's role in providing information can be critical. The USGS, in conjunction with state officials, should help quantify existing data bases and should make available any computer models, geophysical methodology, seismic information, or other tools that could be used to assist decisionmakers. The USGS should also engage in analysis of groundwater resources and provide policy relevant information such as forecasts of aquifer life to the water resources community.

Reasons for Hope

The challenges ahead are daunting. Progress will require significant changes in our water institutions and the way that we manage our water resources. Steady political leadership will be essential. Yet, there are already many signs of progress.

All around the nation, individuals and communities are taking a greater role in stewardship of their natural resources. Hundreds if not thousands of watershed groups now exist nationwide. They have been organized for many reasons—to monitor water quality, to restore fish habitat, to improve recreation, to promote water-related economies. They are providing a community-based forum for resolving, at the local level, some of the most difficult kinds of water conflicts—instream flows, nonpoint source pollution, fish passage, and subdivision of riparian areas. They are achieving success often without regulatory intervention and with very meager funding because they capitalize on the sense of ownership and obligation to others that exists foremost at the community level.

These efforts illustrate an important point: individuals are most likely to recognize unsustainable resource use first when it affects their local environment. Thus, local watershed groups play a critical educational role and also represent a force for sustainable management at the basin level.

Residents of the West are also supporting improved resources management with their votes and dollars. The most notable example is the recent bond election in California, where voters approved hundreds of millions of dollars to help restore the Bay-Delta estuary and improve the reliability of water supplies.

Public support such as this is being mobilized frequently by strong federal-state partnerships, such as the Bay-Delta Accord, which demonstrate that with forward-looking political leadership, very difficult problems can be addressed in a collaborative way. Solutions are not simple or quick; but where good-faith efforts are undertaken, citizens have shown their willingness to provide the necessary funds.

As in the Bay-Delta effort to solve water problems, states in general are taking on a range of roles that is broader than their historic mission of enforcing water rights. They are becoming much more proactive in addressing issues that in the past might have been left to federal agencies or not addressed at all. For example, the Western Governors' Association is addressing the issue of land use planning and protection of open space from uncontrolled growth, traditionally not a politically profitable topic in the West.

The federal government, in turn, is experimenting with ways to make achievement of national environmental goals easier. The use of Habitat Conservation Plans, for example, is showing some promise of enlisting private landowners in cooperative efforts to more effectively protect ecosystems and habitats, rather than just individual

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species. Concerted efforts are also being made to coordinate federal agency activities to make more efficient use of limited budgets as is being done for the Bay-Delta program, the Northwest Forest Plan, and the Everglades restoration.

In this report, the Commission has highlighted some of these promising new initiatives. Our governance recommendations build on these initiatives and seek to improve integration of federal programs with

state, tribal, and local efforts. Our other recommendations address persistent water problems that must be confronted in order to meet the challenge of 21st century western water management. The West is growing, our water resources are going to be called upon to work harder and harder, and we all must work together to achieve wise management of this most precious resource. Water defines the West, and our use of it will define the West of the 21st century.



Chapter 1

Introduction

The West is defined . . . by inadequate rainfall, which means a general deficiency of water. We have water only between the time of its falling as rain or snow and the time when it flows or percolates back into sea or the deep subsurface reservoirs of the earth. We can't create water, or increase it. We can only hold back and redistribute what there is.

Wallace Stegner,
The American West as Living Space, 1987

How does one portray the sudden blossoming of western cities that took place in this century? Los Angeles, up seventy-fold since 1900. Honolulu twenty-fold over the same period. Aptly named Phoenix two-hundred-fold, from 5,000 in 1900 to almost a million today. I have lived with this locomotive all my life, and only recently did I ask: Where is it headed?

Former Secretary of the Interior Stewart L. Udall,
Pausing at the Pass: Reflections of a Native Son,
in *Beyond the Mythic West*, 1990

Water management transcends and encompasses nearly every other aspect of natural resources management. For too long, the state and federal governments have tackled individual resource problems without regard for the effects on other environmental elements. The time has come for a new, holistic approach to water and natural resources management which works toward a set of mutually agreed upon goals.

Senator Mark O. Hatfield, The Long's Peak
Working Group and River Basin Trusts,
Environmental Law, 1994

Water and the Changing West

As these brief quotations capture, the West today sees rapid population and economic growth upon a landscape characterized by limited and highly variable water supplies. A vision is growing that changes must be made in the way that we manage water; that this most precious of natural resources must be used in ways that can be sustained for generations; that our use and management of the resource must consider the broader consequences for the watershed and river basin; and that our efforts must be better coordinated and more cost effective.

At the same time, individuals and communities whose livelihoods directly depend upon historically established practices of water use—farmers, ranchers, industries, municipalities—are concerned that changes in how we manage water will violate their property rights or place intolerable or unfair burdens upon them. Not surprisingly, they resist these changes.

Major social change such as this is always difficult and contentious. Unfortunately, the institutions we have for the allocation and management of water are not always well equipped to carry out such changes in an effective and forward-looking fashion. As Senator Mark Hatfield said,

As a U.S. Senator, I am astounded by the overlapping and conflicting jurisdictions and

authorities of federal water law. . . . At least thirteen Congressional committees, eight Cabinet-level departments, six independent agencies, and two White House Offices are charged with responsibilities relating to national water policy development and management. This has created considerable confusion among the ranks of water policy makers and water policy implementors.

Our state and federal water institutions are a quilt of historic programs and laws aimed at developing water for economic purposes and protecting those uses against change. These are interwoven with more recently created laws seeking to limit the negative environmental effects of the historic programs. The result is a large array of agencies and programs working at cross-purposes under different congressional direction and organized around different geographic units.

This institutional maze evolved from and reflects the diverse values and interest groups in society historically and today. As the West grows, and as demands on western rivers and streams exceed the water available, sharp conflicts occur among cities that need more water for growth, farmers who need water for crops, environmental groups that want more water for native fish, hydropower users that want rivers managed for electrical generation, anglers who want trophy fisheries, and rafters who want whitewater. Billions of dollars are spent annually in the West on these conflicts.

It was in this setting that Senator Hatfield envisioned an investigation and review of western water policy and institutions.

The Charge to the Commission

Section 3 [3003] of the Act of 1992 (Act) directs the President

. . . to undertake a comprehensive review of Federal activities in the nineteen Western States which directly or indirectly affect the allocation and use of water resources, whether surface or subsurface, and to submit a report on the President's findings, together with recommendations, if any, to the Committees on Energy and Natural Resources, Environment and Public Works and Appropriations of the Senate and the Committees on Interior and Insular Affairs (now Resources), Public Works and Transportation, and Appropriations of the House of Representatives.

To assist the President, the Act authorizes an advisory commission composed of eight citizen members appointed by the President, a representative from both the Secretary of the Army and the Secretary of the Interior, and 12 congressional members to serve as ex officio members of the Western Water Policy Review Advisory Commission (Commission). From the United States Senate: the Chairmen and the Ranking Minority Members of the Committee on Energy and Natural Resources; the Committee on Appropriations; and the Subcommittee of the Committee on Energy and Natural Resources, which has jurisdiction over the Bureau of Reclamation (the Water and Power Subcommittee). From the United States House of Representatives: the Chairmen and Ranking Minority Members of the Committee on Interior and Insular Affairs (now, Resources); the Committee on Public Works and Transportation (now, Transportation and Infrastructure); and the Committee on Appropriations.

The Congressional Charge to the Commission

Section 3305 of the Act of 1992 provides:

The Commission shall —

(1) review present and anticipated water resource problems affecting the nineteen Western States, making such projections of water supply requirements as may be necessary and identifying alternative ways of meeting these requirements—giving considerations, among other things, to conservation and more efficient use of existing supplies, innovations to encourage the most beneficial use of water and recent technological advances;

(2) examine the current and proposed Federal programs affecting such States and recommend to the President whether they should be continued or adopted and, if so, how they should be managed for the next twenty years, including the possible reorganization or consolidation of the current water resources development and management agencies;

(3) review the problems of rural communities relating to water supply, potable water treatment, and waste water treatment;

(4) review the need and opportunities for additional storage or other arrangements to augment existing water supplies, including, but not limited to conservation;

(5) review the history, use, and effectiveness of various institutional arrangements to address problems of water allocation, water quality, planning, flood control and other aspects of water development and use, including, but not limited to, interstate water compacts, Federal-State regional corporations, river basin commissions, the activities of the Water Resources Council, municipal and irrigation districts and other similar entities with specific attention to the authorities of the Bureau of Reclamation under reclamation law and the Secretary of the Army under water resources law;

(6) review the legal regime governing the development and use of water and the respective roles of both the Federal Government and the states over the allocation and use of water, including an examination of riparian zones, appropriation and mixed systems, market transfers, administrative allocations, groundwater management, interbasin transfers, recordation of rights, Federal-State relations including the various doctrines of Federal reserved water rights (including Indian water rights and the development in Several States of the concept of a public trust doctrine); and

(7) review the activities, authorities, and responsibilities of the various Federal agencies with direct water resources management responsibility, including but not limited to the Bureau of Reclamation, the Department of the Army, and those agencies whose decisions would impact on water resource availability and allocation, including, but not limited to, the Federal Energy Regulatory Commission. #

In his remarks in support of H.R. 429, the bill in which the Act was incorporated, Senator Hatfield stated that the Commission's purpose was to study and evaluate western water policies. He added that upon completion of this study, the "Commission will recommend necessary changes in the existing water policies to the President."

The duties of the Commission, as enumerated in the Act, are extensive and appear in the sidebar that follows. They include charges to:

1. Review present and anticipated water resource problems, making such projections of water supply requirements as may be necessary, and identify alternative ways of meeting these requirements—giving consideration, among other things, to conservation and more efficient use of existing supplies, innovations to encourage the most beneficial use of water, and the most recent technologies.
2. Review the history, use, and effectiveness of various institutional arrangements to address the problems of water allocation, water quality, planning, flood control, and other aspects of water development and use, including, but not limited to, interstate water compacts, federal-state regional corporations, river basin commissions, the activity of the water resource council, municipal and irrigation districts, and other similar entities.

These duties and others of a similar nature are repeated in the charter of the Commission as signed by Secretary Babbitt on May 16, 1996.

The Commission was chartered roughly 25 years after the last comprehensive review of United States water resources management and policy, by the

National Water Commission, was completed. Much of the National Water Commission's report, *Water Policies for the Future*, remains relevant today, although the West and the politics of water have changed substantially since 1973. The current Commission has had 2 and a half years and \$2 million to do its work, compared to the 5 years and \$22 million (adjusted for inflation) that went into the National Water Commission's final report. Thus, we have opted to build from that study by focusing on the important, often unanticipated, developments since 1973.

Based upon the emphasis in the Act, the Commission decided to focus primarily on the status of and trends in western water resources, and how those trends are being addressed by the policies, programs, and agencies of the federal government. The Commission recognized that the states have the primary role in allocating and distributing water, and interpreted its mandate as a federal commission to focus on the evaluation of federal rather than state programs. Because state and federal water programs intertwine, the Commission sought to inform itself about state water use and management trends but to limit recommendations in these areas.

Implementing the Commission's Charge

The Commission focused its efforts on the ultimate questions: "Are the current uses of water and water-related resources sustainable and, if not, what institutional changes will enhance sustainable management?" Sustainable development has been widely adopted as both an international and domestic norm against which to measure resource use choices. The 1996 President's Council on Sustainable Development defined sustainable

development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (The President's Council on Sustainable Development, 1996).

The Commission sought to identify the specific challenges that western water managers face in achieving sustainable use of the resource. We began in the winter and spring of 1996 by holding meetings in 10 locations: Oklahoma City, Denver, Omaha, Casper, Salt Lake City, Lewiston, Phoenix, Sacramento, Albuquerque, and Washington, DC. Participants were asked to identify key issues, questions, and challenges for the future of water in the West.

The scoping sessions produced a number of comments—some consistent, some contradictory. For example, water transfers were both opposed and endorsed. The Endangered Species Act was both criticized as an infringement on private property rights and defended as a necessary catalyst to force environmental protection. Participants addressed single issues such as the need to fulfill trust responsibilities to Native Americans or apply adaptive management. Other participants identified the need for federal agencies to clarify their new missions and to better integrate federal, state, and local planning. Still others emphasized the need for certainty in water rights and to reaffirm the primacy of the doctrine of prior appropriation. The need to decrease regulatory uncertainties that result from conflicts among agencies was stressed by many commentators. They also cautioned against advocacy of simplistic solutions, such as increased water conservation, without a full understanding of the long-term social and environmental effects of such a solution on a specific stream system. Many participants stressed the need to understand the intense pressures being felt by irrigated agriculture.

On the whole, the Commission was encouraged to look to the future rather than to refight past battles.

Based upon these meetings and review of the current literature, the Commission identified the following key areas of challenge for western water managers.

1. *New Methods of Governance*: How can we create institutions that can integrate and streamline the process of making policy, implementing water regulations, reaching decisions, and managing water from the local watershed level up to the river basin, across the many local, tribal, state, and federal jurisdictional and agency boundaries?
2. *Sustainable Water Supply and Water Use*: How can we ensure the availability of adequate water supplies for a growing West? How do we bring water use into balance with water supply?
3. *Meeting Our Water Obligations to Native Americans*: How can we expedite the process of addressing tribal water rights and providing safe water supplies to reservations?
4. *Aquatic Ecosystems*: How can we restore and maintain rivers in the West so that they can provide clean water, functioning aquatic and riparian habitats, and self-sustaining fish and wildlife populations?
5. *Water Quality*: How can we better achieve state and federal water quality standards for all water bodies?

6. *Flood and Flood Plain Management*: How can we provide flood protection and mitigation in ways that effectively reduce flood damages and are more financially and environmentally sustainable?
7. *Protecting Productive Agricultural Communities*: How can we support sustainable farming and ranching operations and help avoid the unintended consequences of local, state, and federal water policy?
8. *Maintaining the Federal Water Infrastructure*: How can we ensure that the major federal water storage and delivery systems in the West are adequately maintained to provide long-term benefits to society?
9. *Data Collection, Research, and Decisionmaking*: How can we better collect important water data, conduct research, and make water management decisions?

The Commission's Investigations

To investigate these questions and develop recommendations, the Commission arranged for a road program of interest group and expert testimony and sponsored more than 20 research studies and symposia. A complete list of reports to the Commission appears on page vii.

Public Testimony

The Commission received testimony from hundreds of individuals at its scoping meetings and from dozens of individuals, organizations, and agencies at

its formal meetings in Portland; Denver; San Diego; Tempe; Phoenix; Boulder; Washington, DC; San Francisco; and Boise. In San Diego and Phoenix, the Commission sponsored symposia on the water programs of the western states (with the Western States Water Council) and on Native American water issues (with the American Indian Resources Institute and the Native American Rights Fund).

In Washington, DC, the Commission received testimony from the urban water use community, while in San Francisco, it was briefed on the ongoing Bay-Delta process and received presentations from the environmental community. In Boise, the Commission heard from the irrigated agriculture community. Individual Commission members and staff made presentations about Commission activities to more than 50 conferences and organization meetings. In addition, the Commission maintained regular mailings to a database of more than 3,000 interested individuals and organizations and a website with Commission schedules and reports. Hundreds of written submissions were received from the public during the Commission's tenure as well as 1,500 pages of comments on the public review draft report.

Research on the West Today

The Commission undertook a scientific review of the status and trends for water and related resources in the West today. Expert reports were commissioned on demographic and economic trends in the West, current and projected water use, climate change, drought and drought management, the status of aquatic ecosystems, water quality, land use changes and their relation to water resources, and trends in hydropower regulation.

Other studies were commissioned on the use of alternative dispute resolution methods to address water conflicts and on the historic disparities between upper and lower basin water development on the Missouri and Colorado Rivers. These studies have been published and distributed to more than 800 libraries nationwide, as well as to the National Technical Information Service repository.

River Basin Studies

Based on many of the concerns voiced at scoping meetings and from member input, the Commission opted to focus a great deal of its attention on river basin and watershed management. This decision reflected the longstanding recognition that the river basin is the appropriate management unit for water resources. During this century, there have been many attempts to develop effective river basin management institutions, but none have been fully successful for various reasons discussed in more detail in this report. The consistent theme has been the idea that rivers are complex natural and modified hydrologic units, each with its unique history and features, and policies should reflect this reality. In the 1990s, there has been a revival of interest in basin and watershed management because most water problems demand place-specific solutions, and these solutions are best formulated and implemented by the relevant stakeholders.

To better understand the myriad developments in basin and watershed management, the Commission authorized assessments of current conflicts in six key basins and the capability of existing management institutions to resolve them. Two large basins, the Colorado and Columbia, two medium-sized basins, the Platte and the Rio Grande, and two

more self-contained basins, the Sacramento-San Joaquin and the Truckee-Carson, were studied. In addition, the Commission contracted with the Natural Resources Law Center at the University of Colorado, Boulder to take advantage of the Center's extensive work in western watershed management initiatives. Its report, *Resource Management at the Watershed Level: An Assessment of the Changing Federal Role in the Emerging Era of Community-Based Watershed Management*, provided the Commission with a great deal of useful information about the strengths and limitations of local watershed management (Rieke and Kenney, 1997).

Because of the complexity of the river basin studies, the Commission first convened in each basin a group of federal and state representatives to meet with and assist the researchers. Also, the drafts of the basin studies were widely distributed and posted on the Commission Internet website for public review and comment for the researchers to consider in their final revisions.

All of the studies funded by the Commission, including the river basin reports, were independent reports for the Commission's use in its deliberations and preparation of its own report. While the Commission established the goals of the various research efforts, it did not control the products, nor did the Commission endorse or reject the individual reports.

Agency Reports.—One of the statutory charges to the Commission was to

. . . review the activities, authorities, and responsibilities of the various federal agencies with direct water resources management responsibility, including but not limited to the Bureau of Reclamation, the Department of the

Army, and those agencies whose decisions would impact on water resource availability and allocation, including, but not limited to, the Federal Energy Regulatory Commission.

Such analysis was to include considering "the possible reorganization or consolidation of the current water resources development and management agencies."

The web-like structure which defines the functions of these agencies and hence their institutional relationships with each other is overly complex and illogical. Overlapping roles, conflicting programs and convoluted enforcement procedures are inevitably created by this snarled framework. While this Report makes immediate recommendations to lessen these problems by coordinating programs and budgets of the existing institutions, more complete efficiency and effectiveness may ultimately depend upon thorough administrative restructuring inside and out, including agency consolidation.

The dozen federal agencies with significant water resources responsibilities were each requested to provide a report to the Commission describing how the agency was addressing the key water management challenges described above. Not all agencies responded to this request. Especially comprehensive reports were provided by the Bureau of Reclamation, the U.S. Army Corps of Engineers, the Department of Agriculture, and the Federal Energy Regulatory Commission. These reports and other sources were used to assess the direction key federal agencies are taking in meeting the West's water problems. Neither time nor resources allowed the Commission to conduct a comprehensive and detailed review of all federal water programs.

This Commission has studied the 1973 report of the National Water Policy Commission, *Water Policies for the Future*, with great attention. The 1973 report provides the benchmark for this Commission's work. By the standard that a commission report should establish the policy agenda for the next quarter-century, the National Water Commission's report stands up well. Our objective is to extend *Water Policies for the Future* by reiterating policy recommendations that remain sound and to address issues that have arisen since 1973, some predicted accurately by the Commission, some unanticipated.

Organization of the Report

As interesting as the individual reports to the Commission are, their value to the Commission comes from viewing the reports in aggregate, with a focus on westwide issues. This collective view is presented in the Commission's report as follows:

Chapter 2 describes the demographic, economic, and social trends underway in the West that are directly impacting water and related resources.

Chapter 3 assesses the challenges that these trends pose for water managers in achieving sustainable use of the West's water resources.

Chapter 4 surveys the history and evolution of federal agencies and their missions.

Chapter 5 examines the activities and the role of states and the federal government in meeting the challenge of sustainable resource management.

Chapter 6 concludes with the Commission's recommendations for sustainable water management, for new approaches to river basin

and watershed governance, and for other changes in federal water resources policy.

Appendix A contains biographical sketches of the Commission members.

Appendix B contains observations and comments on the Commission's Report submitted by individual Commission members.

Appendix C is a detailed description of the jurisdictions and authorities of the various congressional committees and federal agencies related to water resources.



Chapter 2

The West Today and Tomorrow

Water Defines the West

Topography and Climate

Water defines "the West." In this sense, the West is the 17 coterminous states located on and westward of the 100th meridian (North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Texas, Montana, Wyoming, Colorado, New Mexico, Idaho, Utah, Arizona, Washington, Oregon, Nevada, and California). The 100th meridian is a useful dividing point in the context of water use and management. As figure 2-1 illustrates, precipitation rates east of the Great Plains average 40 inches or more but, beginning around the 100th meridian, much of the West sees less than 20 inches each year (Guldin, 1989). John Wesley Powell, in his classic report on settlement possibilities in the region, pointed out that areas receiving less than 20 inches of rainfall annually would require supplemental irrigation to support agriculture (Powell, 1879).

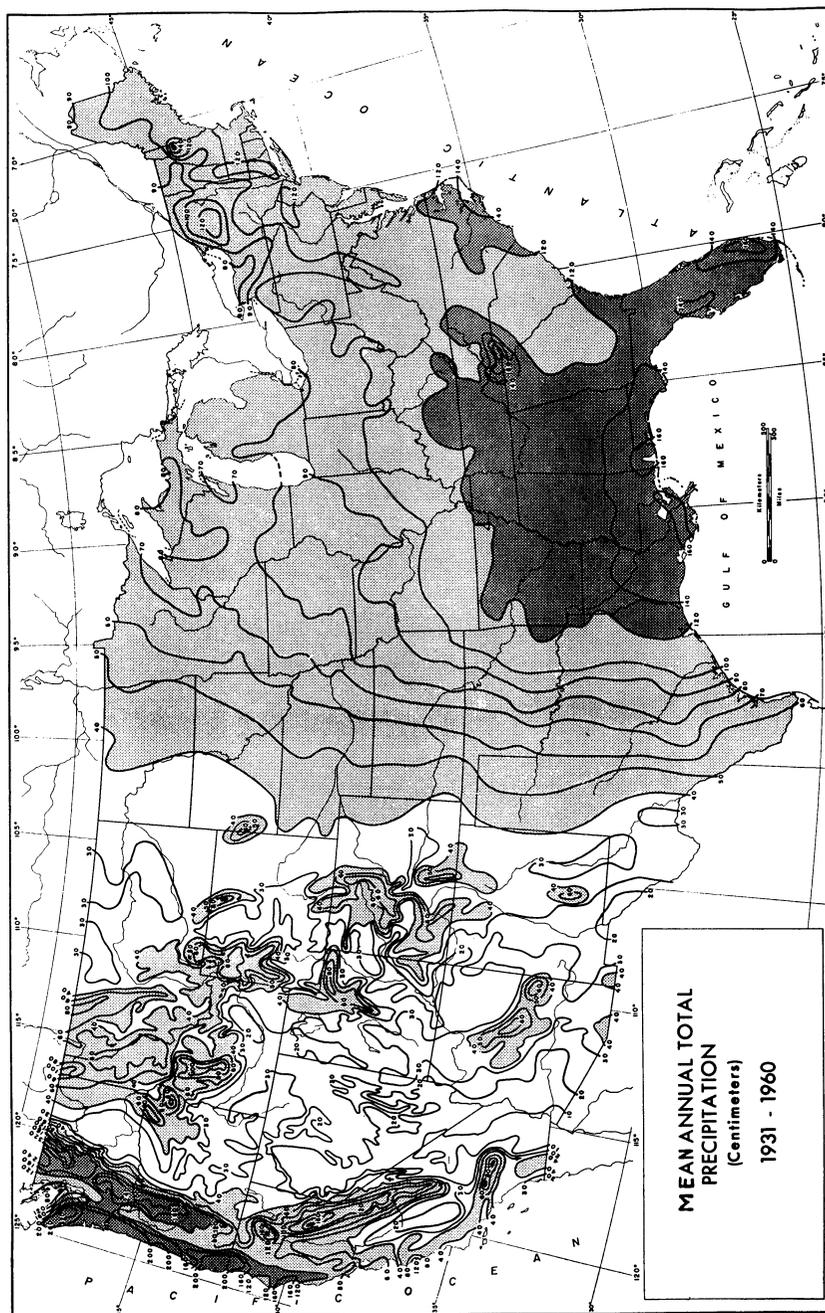
Not all of the land contained within the western states meets the definition of "arid," however. Western Washington and Oregon and parts of the northern Rockies experience annual precipitation well above the 20-inch mark. The greatest amount of precipitation in the western United States occurs on the Olympic Peninsula in western Washington, where more than 100 inches of rain falls each year (Office of Technology Assessment, 1988). Streamflow to the Pacific Ocean, mostly from the

Pacific Northwest region, is estimated to be over 335 million acre-feet per year, or nearly 70 percent of all runoff for the entire 17 western states (Office of Technology Assessment, 1988).

Western precipitation is determined by the interaction of topography and marine influences (Miller, 1997). Air masses carrying atmospheric moisture over the region move generally from west to east, releasing moisture as they are forced to climb over the Sierra Nevada and Cascade mountain ranges of the Pacific coast and the Rocky Mountains (Office of Technology Assessment, 1988). The lands to the east of these ranges experience a "rain shadow" effect, as the descending air masses are relatively dry. Precipitation also may vary dramatically from one year to the next as a result of a phenomenon called "El Niño/Southern Oscillation," in which changes in atmospheric pressures over the South Pacific affect sea surface temperatures in the Pacific Ocean and, consequently, influence precipitation through the western region (Miller, 1997).

In the years to come, the West's water supplies may also be influenced by human-induced climate change. The report prepared for the Western Water Policy Review Advisory Commission by Dr. Kathleen Miller describes a growing body of research indicating that many parts of the region may experience reduced water availability, particularly during the high-demand summer

Figure 2-1
United States Precipitation, in centimeters



Source: Reprinted from: Bryson, R.A., and F.K. Hare, *Climates of North America, World Survey of Climatology Volume 11*, Copyright 1974, with kind permission from Elsevier Science—NL, Sara Burgerhartstraat 25, 1055 KV, Amsterdam, the Netherlands.

months. At the same time, the risk of winter or early spring floods may increase, especially in the West Coast states where warmer winter temperatures could be coupled with precipitation increases and an increased frequency of rain or snow in some areas (Miller, 1997). After reviewing the literature, Miller concluded that

...the potential impacts of climate change on western water resources are serious enough to warrant attention in discussions of long-term policy directions and in the design of programs and institutions that are expected to have enduring impacts on the control and allocation of water resources (Miller, 1997).

In particular, she suggested that water policies should include sufficient flexibility to respond to a wide range of possible hydrologic changes (Miller, 1997).

Streamflows and the River Environment

Once it leaves the atmosphere, water moves through the terrain in a variety of forms that determine the availability of water for human use and influence how aquatic systems function. Many areas of the West get the majority of their streamflows from melting snow, while parts of the Southwest depend on summer thunderstorms. Streamflow is made up of three components, all related to precipitation:

- (1) Surface runoff, which depends on evaporation, plant transpiration, and the rate of soil infiltration.
- (2) Subsurface runoff, composed of precipitation that infiltrates the soil and moves laterally toward water bodies.
- (3) Base flow, or precipitation that percolates through the soil into groundwater and then enters the stream channel after a time lag (Miller, 1997).

Western streamflows are noted for their great variability because they are dependent on unstable and unpredictable atmospheric processes that operate well beyond the region (Graf, 1997). Each year, approximately 1.5 billion acre-feet of water is added to the western United States as precipitation, the majority of which is consumed by evapotranspiration; roughly 500 million acre-feet (maf) constitute the measured flow in western streams, and 50 maf are added annually to groundwater (Office of Technology Assessment, 1988).

The Colorado River illustrates the great variability in western riverflows. During the period immediately preceding negotiation of the Colorado River Compact in 1922 (from 1906-21), the estimated natural annual flow of the river averaged 18.1 maf. Negotiators assumed they had a surplus of water by basing their discussions on an estimated flow of 16.5 maf, but subsequent experience and tree-ring studies revealed that the river's annual natural flow from 1906-94 averaged 15.1 maf. Moreover, yearly fluctuations have been dramatic, ranging from 4.4 maf to more than 22 maf (Getches and Meyers, 1986).

Native plant and animal communities have adapted to the dramatic variations in western water supplies. For example, the Southwest once contained many marshlands (ciénegas) adjacent to rivers, which moderated fluctuations, retained and recycled nutrients, and served as refuges, nurseries, and rich feeding grounds for aquatic animals (Power, 1997). Many riparian plant species have evolved to depend on periodic flooding for successful propagation. Native fish, too, adapted their reproduction patterns around natural fluctuations. Some species require the slow, warm backwaters created by seasonal drops in river levels for successful egg and young fish survival; others depend on fast runoff flows to flush young fish out to sea.

River ecosystems extend beyond their flowing waters. The riparian zone includes virtually all of a river's flood plain, where river water supplements

Precipitation Variability: Nemesis of Western Water Managers

Precipitation in the West is highly variable, not just from one year to the next, but within a given "water year." This makes the job of forecasting annual runoff and storage difficult for water managers and vexing for those who must make investments based on expected water supply, especially farmers who rely on irrigation water. The 1996-97 water year in California vividly illustrates the dilemma.

Managers of the State Water Project and the Central Valley Project monitor rainfall and snowpack during early winter to predict the amount of water that will be available to farmers and other water users in the summer. The 1996-97 water year started normally enough; in October and November, the accumulated precipitation in the Northern Sierra, source of much of the state's water, tracked the 68-year average almost exactly. In December and January, a series of massive storms hit the state, causing the "January 1997 floods" and millions of dollars in damages. Several state dams made record releases to maintain safe flood storage space for any additional inflows. January finished with accumulated precipitation in the Northern Sierra nearly 35 inches above average, almost 200 percent of normal. If the rest of the winter had brought only average monthly precipitation, the totals for the year would have approached record levels (State of California, 1997). Based on this information, Reclamation announced on February 14 that water deliveries to contractors in the Central Valley Project would be 100 percent of their allocation (Reclamation, 1997c).

But the weather in California seldom is average. The next 4 months brought record low precipitation and temperatures well above average. As a result, water supply projections began dropping, and by April 17, 1997, Reclamation had to announce that irrigation deliveries for irrigation would be reduced to 90 percent of normal (Reclamation, 1997d). Not surprisingly, reaction by water contractors to what Reclamation described as an "unprecedented revision in water allocations" was not positive because, by that time, farmers had begun planting operations and made financial commitments.

As this case illustrates, managers of water projects must operate their dams within an ever shrinking margin of error. Demands for water for the environment, hydropower, and urban growth are increasing, which argues for holding all river flows in storage. In contrast, urban and suburban encroachment into the flood plain argues for leaving reservoirs sufficiently empty, ready for big floods. Serving these competing masters, in the face of uncertain and extreme weather, is a tough job. #

water available from other sources (Patten, 1997). The abundant vegetation growing in a riparian zone serves many purposes: reducing soil erosion rates; slowing floodwaters; enhancing groundwater recharge and maintaining an elevated water table; improving water quality by filtering sediment, nutrients, and pollutants from surface runoff; maintaining biodiversity by providing critical habitat to species using adjacent uplands; supplying shade and overhanging banks for fishes and other aquatic organisms; and offering diverse and increasingly popular recreational opportunities for human populations (Patten, 1997). Until recently, many of these important functions were not recognized, and riparian zones were under-appreciated as important components of functioning rivers.

Western Water: A Working Resource

Harnessing Water for Human Uses

Given the variable precipitation (seasonally and year-to-year), storage of water during high-flow periods has been necessary to ensure reliable deliveries during times of high demand. In the United States as a whole, there are 2,654 reservoirs and controlled natural lakes with capacities of 5,000 acre-feet or more; together they hold about 480 million acre-feet of water (Guldin, 1989). Over two-thirds of this total capacity (324.6 million acre-feet) is provided by reservoirs in the western water regions (Guldin, 1989). Reservoir capacity as a proportion of land area is greatest in the Upper Colorado region (defined as the Colorado River drainage above Lee's Ferry), where 366 acre-feet of water is stored per square mile; in the Great Basin region, by contrast, only 24 acre-feet of storage exists per square mile (Guldin, 1989).

Dams on the Colorado River can store 4 years of the river's typical annual flow (Collier, Webb, and

Schmidt, 1996). Figure 2-2 (at the end of this chapter) shows the ratio of reservoir storage to annual water supply in North America.

Groundwater aquifers serve as both primary and secondary sources of water supply. In 1985, approximately 92.7 maf of the United States' freshwater supply came from groundwater—nearly a quarter of the total supply for the nation (Guldin, 1989). Of the pumped groundwater, 62.5 maf (67 percent) went to irrigation (Guldin, 1989). In 1990, water uses in the 17 western states pumped about 58 maf of groundwater, of which nearly 46 maf (79 percent) went to irrigation (Bureau of Reclamation, 1996). About two-thirds of all the groundwater pumping in the nation was concentrated in eight states: California (23 maf), Texas (8.9 maf), Nebraska (8 maf), Idaho (7 maf), Kansas (6.3 maf), Arizona (4.7 maf), Arkansas (4.5 maf), and Florida (4.2 maf) (Guldin, 1989).

A large proportion of the West's groundwater comes from the High Plains regional aquifer, which underlies about 174,000 square miles in six states (Nebraska, Colorado, Kansas, New Mexico, Texas, and Oklahoma) and includes the 134,000-square-mile Ogallala aquifer. The High Plains aquifer sustains 20 percent of the irrigated acreage and provides 30 percent of all irrigation water pumped within the United States (Kromm and White, 1992). About 16,000 square miles of the regional aquifer experienced water level declines of more than 50 feet as of 1980, and 50,000 square miles declined more than 10 feet, attributed to accelerated pumping for irrigation (Kromm and White, 1992). A maximum decline of almost 200 feet occurred in Floyd County, Texas. In some locations in Nebraska, aquifer levels have risen as a result of recharge from canal irrigation using water directly from the Platte River (Kromm and White, 1992). Overall, however, the U.S. Geological Survey (USGS) has projected severe depletions in the High Plains region by the year 2020, with Texas suffering more than the other

states that share this water source (Kromm and White, 1992). Throughout the region, groundwater overdraft continues to be a problem.

Water is being increasingly reclaimed through wastewater treatment and reuse. In 1990, approximately 553,000 acre-feet of reclaimed wastewater was used in the 19 western states, an increase of about 25 percent from 1985 (USGS, 1997). The USGS has identified a trend in tapping reclaimed water as a source for industrial uses, with four states dominating the statistics: Arizona, California, Nevada, and Texas. Since 1960, use of reclaimed water in the industrial sector has increased from 784 acre-feet to 30,800 acre-feet in 1990 (Reclamation, 1997), but its role as an alternative source of supply remains limited because of cost and public concerns. Several studies have shown that the public is wary about accepting reclaimed wastewater for domestic uses, although people tend to view it as appropriate for such applications as fighting fires, watering golf courses and parks, and cleaning streets (Reclamation, 1997). Water recycling is particularly advantageous in Pacific or Gulf Coast States where wastewater is otherwise discharged to the ocean, or in states where wastewater is irretrievably lost to saline sinks.

Water supplies are being augmented by new technologies to supplement the West's traditional reliance on storage. Most experts agree that the era of large federal dam building, as experienced in the first 70 years of this century, is over. However, municipal and industrial water suppliers expect to construct smaller facilities, many of which will provide offstream water storage. Several such projects are under construction in California, among them the Eastside Reservoir in Riverside County and Los Vaqueros Reservoir in Contra Costa County. In addition, existing dams are being altered to enlarge reservoir capacities. In Arizona, for example, the Theodore Roosevelt Dam was renovated to add 300,000 acre-feet to its reservoir, and the New Waddell Dam enlarged the existing Lake Pleasant Reservoir by nearly 700,000 acre-feet.

Other strategies to stretch water supplies include: groundwater recharge and conjunctive use of surface and groundwater (managing surface and groundwater supplies as a single source); reoperation or management modification of existing storage facilities; encouraging water efficiency improvements; providing incentives for land fallowing, either permanently or only on a "dry-year option"; desalination and treatment of seawater or other brackish waters; using "gray water" for irrigation; weather modification (cloud seeding); delaying snowmelt through vegetative manipulation in upper watersheds; and importing water from areas of available water supply to areas of growing demand.

Major Water Uses

The most current USGS statistics for western water use are for the year 1990 and are drawn from the 19 western states including Alaska and Hawaii. The patterns of use and comparisons with previous periods are discussed in more detail under "Changing Patterns of Agricultural and Urban Water Uses" but are summarized here. Note that the figures summarized here are for water diversions, not consumptive uses of water.

Of 179 maf of freshwater withdrawals in the West in 1990, the largest portion (140 maf) went to agriculture (USGS, 1997). Irrigation water sources and withdrawals by state are displayed in figure 2-3.

The second largest demand for freshwater withdrawals was for domestic and commercial purposes, which totaled 17.5 maf, followed by withdrawals for thermoelectric power generation at 16.2 maf (USGS, 1997). Industrial and mining water uses required diversions of 5.6 maf, and commercial water uses demanded 3.5 maf. (USGS, 1997).

Hydroelectric power generation does not require diversions and therefore is not included in the figures above for freshwater withdrawals. Water

Groundwater Resources in the Western United States—Sustainability and Trends

Groundwater is an important source of water in the 19 western states, contributing about a third of the water supply. In many areas of the arid West, groundwater is the only source of water. In 1990, 87 percent of self-supplied domestic water in the West was groundwater, much of this being withdrawn from aquifers with limited capacities. While pumpage for domestic and public supply has continued to increase throughout the West from 1960 through 1990, the dominant usage of groundwater is for irrigation, and that usage peaked in 1980. Reduced pumpage for irrigation may be attributed to economic or management controls in many aquifers that had shown major water level declines. The following provides brief summaries of the status and use of major groundwater aquifers in the West.

Edwards aquifer—supplies water for more than 1 million people in the San Antonio area and large quantities of water for agriculture, industry, and the military. Annual volume of recharge is highly variable. Strict groundwater management has been enacted to control additional development.

Albuquerque basin aquifer—water supply for the city of Albuquerque, a 1995 population of approximately 450,000. Water levels have declined up to 140 feet in some areas since 1960, with declines of greater than 40 feet in recent years.

High Plains aquifer—underlies about 174,000 square miles in an eight-state area ranging from Texas and New Mexico to South Dakota. Water level declines appeared soon after extensive groundwater irrigation development first began in about 1940. By 1980, water levels in parts of the Texas High Plains, Oklahoma Panhandle, and southwestern Kansas had declined more than 100 feet. Declines by 1994 were up to an additional 40 feet, forcing a reduction in pumpage and irrigated acres, with many acres converting back to nonirrigated agriculture. Declines of as much as 50 feet (up to 20 feet since 1980) have occurred in the three southwestern Nebraska counties, now under strict controls administered by the local Natural Resources District.

Hueco-Bolson system—near El Paso, Texas, has freshwater in its upper 3,000 feet and has exhibited considerable water-level decline in areas of intensive municipal and irrigation uses.

San Luis valley—Early (1900-50) development of the confined system in the San Luis valley of Colorado lowered water levels to the point that flowing wells ceased, and much of the current production is now from the unconfined aquifer.

San Juan basin in New Mexico—declines up to 300 feet from 1950 to 1980.

Rush Springs aquifer and **Dog Creek-Blaine aquifers** in Oklahoma—declines up to 40 feet and up to 50 feet, respectively.

Garber-Wellington aquifer that supplies Oklahoma City areas—declines from 100 to 200 feet.

Denver basin aquifer, primary source for development south of Denver—significant loss of artesian head has occurred.

Trinity aquifer, in the Dallas-Fort Worth area—significant loss of artesian head.

Other areas within the **Edwards-Trinity Plateau** also have had large water-level declines in areas of intensive development. The Gulf Coast aquifer system—including the **Chicot, Evangeline, and Jasper** aquifers, pumped by the Houston area—suffered lowered water levels and decreased artesian pressure, resulting in land subsidence as great as 10 feet.

Central Valley of California—by the 1960s, withdrawals greatly exceeded recharge, and water levels declined by as much as 400 feet, causing widespread land subsidence. Importation of surface water and reduction in groundwater withdrawals during the 1970's slowed or stopped the decline of groundwater levels. In many cases, this has allowed recovery to pre-1960's water levels and prevented further land subsidence.

Coastal basin aquifers in California—marked water-level declines, accompanied by increased pumping costs, land subsidence, and saltwater intrusion. Careful management now lets total supply meet demand, and water levels have recovered in many areas.

Central Arizona basin—water-level declines of 50 to 200 feet common and as much as 500 feet. The Central Arizona Project was built to help alleviate overdraft pumping.

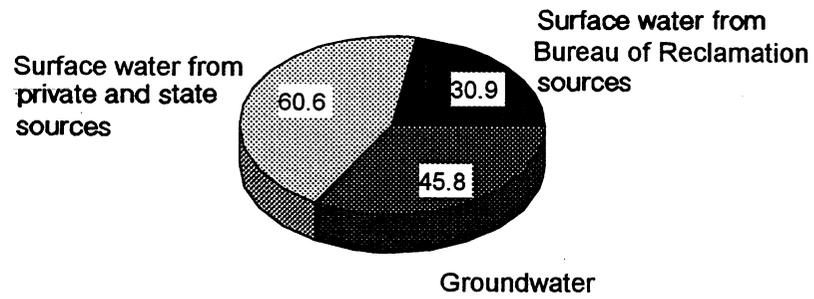
Snake River Plain in Idaho—provides irrigation water and suffered declines from 5 to 10 feet between 1971-82.

Central Columbia plateau basalts of Washington—persistent declines of groundwater levels.

Columbia River Basalt aquifer of Washington and Oregon—supports irrigation, public supply, and industry. Several areas have shown large declines (over 100 feet) although management efforts to reduce withdrawals have reversed some of the declines. #

—Summary by Alan Burns, Groundwater Specialist, Office of the Regional Hydrologist, Central Region, USGS.

Total withdrawals in maf



Withdrawals in major states

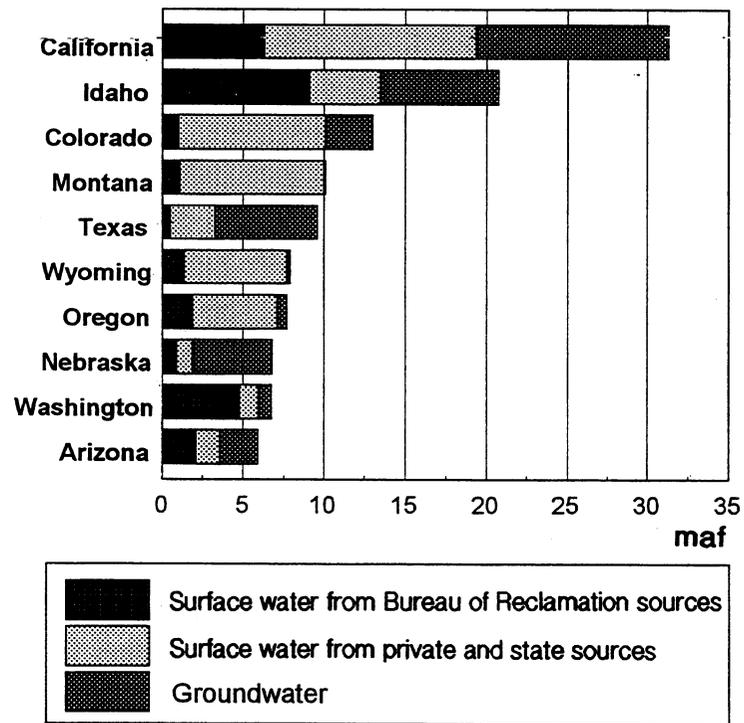


Figure 2-3.—Western states irrigation water sources, 1990.

use by hydroelectric facilities in 1990 totaled approximately 1,730 maf, nearly 10 times the quantity of water for offstream uses (USGS, 1997). Other human instream uses of water include navigation, recreation, aesthetic enjoyment, and dilution of waste. Instream flows also benefit the environment by providing habitat for fish and wildlife, transporting sediment, maintaining estuary salinity balances, and supporting the diversity of riparian vegetation.

Benefits of Federal Water Storage and Delivery Systems

In physical terms alone, the accomplishments of water developers in the West are impressive, and the key role of the federal government is obvious. Working together, federal and state governments and local interests have provided the water infrastructure to support a high level of agricultural and urban growth.

The U.S. Bureau of Reclamation (Reclamation) is responsible for the largest portion of water storage in federal reservoirs in the West. Reclamation has sole responsibility for the operation of reservoirs with a total capacity of more than 119 maf and shares responsibility for the operation of reservoirs with an additional 16 maf of storage (Federal Emergency Management Agency, 1995a). A recent report by the General Accounting Office estimated that the federal government, through Reclamation, has spent \$21.8 billion to construct 133 water projects in the western United States (General Accounting Office, 1996). Water provided by Reclamation in 1991 produced agricultural crops valued at nearly \$9 billion; 48 billion kilowatt hours of electricity sold for \$727 million; and more than 50 million recreational visitor days (Reclamation, 1991).

The U.S. Army Corps of Engineers (Corps) is solely or partially responsible for the operation of

reservoirs in the West with a total capacity of more than 103 maf. The U.S. Department of Agriculture (USDA), primarily through the Forest Service, operates and maintains reservoirs totaling more than 25.7 maf. The Bureau of Indian Affairs operates and maintains reservoirs with a total storage capacity of more than 2.3 maf, and the U.S. Fish and Wildlife Service (Service) operates reservoirs with a total capacity of slightly more than 704,000 acre-feet. The Department of Energy, through the Federal Energy Regulatory Commission, shares responsibility for the operation of more than 2.1 maf of storage throughout the West.

As it has in irrigation water supply, the federal government has played an important role in hydroelectric power generation constructing and operating more than half of the total hydroelectric generating capacity in the West. The total installed hydropower capacity in the United States, according to Federal Energy Regulatory Commission, is 73,494 megawatts, or roughly 10 percent of total national electric generation capacity (Federal Energy Regulatory Commission, 1992). (By comparison, coal is used in 40 percent of the nation's capacity) (Energy Information Administration, 1996). However, in the West, especially in the Pacific Northwest, hydropower plays a larger role.

Table 2-1 sets forth the amount, in megawatts, of installed hydropower capacity by western water resource region.

As this table shows, there are 51,468 megawatts of installed hydropower capacity on western river basins. This is roughly 70 percent of national hydropower capacity. It amounts to about one-third of all installed electric generation capacity in the region, a substantially higher percentage than its share nationally. The higher percentage of hydropower in the West is largely a result of hydropower's dominant position in the Pacific Northwest, where hydropower comprises about 68 percent of all generation capacity.

Table 2-1.—Hydroelectric capacity in the West
by water resource region: 1992

Region	Number of plants	Installed capacity (megawatts)	Average plant size
Missouri River basin	76	3,719	50
Arkansas-White-Red	31	1,966	63
Rio Grande	7	153	22
Upper Colorado	34	1,823	54
Lower Colorado	21	2,412	115
Great Basin	76	235	3
Pacific Northwest	314	31,998	102
California	410	9,162	22
Regional total	969	51,468	53
U.S. total	2,304	73,494	32
Region as percent of U.S. total	42%	70	

Source: Federal Energy Regulatory Commission, 1992.

Not only is the West the home of most of the nation's hydropower capacity, it is also the home of 9 out of the 10 largest dams in the U.S. Federal dams comprise about 55 percent of total hydropower capacity in the West (Driver, 1997).

Federal dams also provide substantial protection from floods along the waterways in the West. About 45 percent of the annual flood damage reduction budget of the Corps is spent in the West. By the Corps' calculation, roughly \$5 billion in flood losses are prevented each year in the West through operation of Corps' flood control projects (Corps, 1997).

The region's vast water storage and conveyance system supports many activities and amenities that otherwise would not be available in arid country. Access to reliable water supplies made possible the remarkable expansion of irrigated agriculture in the past 50 years, just as it aided placer miners in the last century. Urban development at present scales could not have been possible in such places as Los Angeles, Phoenix, or Las Vegas without the pipelines that connect these cities with distant rivers.

Federal dams provide affordable power for westerners—power that otherwise might be produced by coal- or nuclear-powered generation facilities whose waste creates serious pollution problems. And the flood control provided by federal works has helped make the region a safer, more reliable place for a variety of activities.

In addition, a number of secondary benefits are attributable to the West's dams and regulated riverflows. Many wetlands and wildlife habitat areas, as well as late-season base flows, have developed due to the use of irrigation water from federal facilities. Outstanding cold-water fisheries downstream from dams—such as the Colorado River below Glen Canyon Dam—draw anglers from around the world. And rafters enjoy late-season floating in rivers whose flows are regulated by dams. There are almost 4,350 recreation areas at Corps reservoir projects throughout the country, hosting nearly 400 million visits each year—second only to facilities managed by the U.S. Forest Service. About half of this visitation occurs in the

The Federal Water Agencies

Agency/Department	Major water-related activities and responsibilities
Reclamation/Interior	Irrigation, municipal and industrial, flood control, hydropower, fish and wildlife enhancement, recreation.
Corps/Army	Flood control, navigational improvements, hydropower, recreation, irrigation, and municipal and industrial. Administers permit process for Clean Water Act.
Bureau of Indian Affairs/Interior	Administers federal programs for Indian tribes. Operates water storage and irrigation projects with total storage capacity of more than 2.5 maf.
NRCS/USDA	Formerly Soil Conservation Service. Helps farmers and ranchers establish conservation systems; helps urban and rural communities reduce erosion.
Western/Energy	Markets and transmits power in 15 western states—from 55 powerplants. Has 599 wholesale power customers, selling enough power to meet needs of more than 10 million people for 1 year.
Federal Energy Regulatory Commission/ Energy	Regulates nonfederal hydroelectric projects that effect navigable waters, occupy U.S. lands, use federal water, or affect interstate commerce. Reviews rates for all electric utilities.
USGS/Interior	Provides most hydrologic data collected in the U.S. Maintains nationwide system of stream and river gaging stations, groundwater observation wells, and water quality sampling locations.
Bonneville Power Authority/Energy	Markets power generated at 29 federal plants in Columbia-Snake River basin. Sells about 46 percent of electric power consumed in Northwestern U.S.
Environmental Protection Agency	Protects public health through safeguarding and improving water resources. Helps implement and enforce Clean Water Act, Endangered Species Act, and Safe Drinking Water Act.
Service/Interior	Protects plants and animals in danger of extinction. Manages National Wildlife Refuge System and works with wetlands.
National Marine Fisheries Service/ National Oceanic and Atmospheric Administration	Supports fishery management, development; protects species and conserves habitat.
Forest Service/USDA	Helps public enjoy national forests while conserving environment. Manages more than 190 million acres. Protects natural resources, including water and watershed lands, on its lands.

#

western states (Corps, 1997). Reclamation reports that almost 90 million people visit the agency's 310 designated recreation areas annually, including 10 million visitors each year to Lake Mead (Lovejoy and Higgins, 1997). Visitation to Reclamation reservoirs is expected to exceed 100 million people annually by early in the 21st century (Lovejoy and Higgins, 1997).

As an example of recreational use of western waterways, a study conducted for the *Operation of Glen Canyon Dam Final Environmental Impact Statement* concluded that the net annual economic value of angling and white-water boating in the study area ranged from \$7.9-15.7 million, depending on the type of water releases from Glen Canyon Dam (values were higher in low-release years for anglers; values were higher in high-release years for boaters) (Reclamation, 1995b). The same study calculated that river-based recreational activity in the Glen Canyon-Grand Canyon area generated approximately \$23 million in local economic activity in 1991 (Reclamation, 1995).

In short, the federal government has played an important role in transforming western rivers into economically and socially productive assets. The "multiple purpose" dams have, indeed, accomplished their purposes. Increasingly, however, the same agencies whose missions are grounded in development are being asked to take a broader view, to help restore ecological functions of rivers that have been profoundly altered by federal dams, diversions, and other projects. Project changes include structural alterations (such as installing new outlets in dams), modifications to storage operations (maintaining higher than normal levels during critical periods, for example), changing the pattern or amount of water releases from storage facilities to more closely match the natural hydrograph, and coordinating releases from reservoirs on the same river (Natural Resources Law Center, 1996).

Environmental Consequences of Water Development

Before European settlement, the typical path of western water could be described as follows:

[R]unoff flowed slowly from undisturbed watersheds with a larger proportion passing underground. Groundwater filled porous valley soils, assuring more reliable flow. Channels were complex and only locally eroded; pools were common, scoured near boulders and fallen logs; bottoms were of diverse particle sizes; and beaver, common then, added structure through damming and other activities. Riparian vegetation was extensive, from forest to shrub and marshlands. Summer water temperatures were moderate due to shading by plants and in summer/winter alike by extensive ground and surface water exchange. Damaging floods and droughts were actually less frequent and violent, buffered by vegetated slopes, spongy flood plains, and complex, current-retarding channels. In short, there was more permanent water, habitats were more complex, and extreme conditions were less frequent (Minckley, 1997).

Human activities in the past two centuries have changed this picture dramatically, resulting in higher runoff, larger and more frequent flooding, and greater sedimentation of streams (Graf, 1997). Flood plains have been built upon, forcing unnatural containment of rivers and contributing significantly to flood disasters (California Governor's Flood Emergency Action Team, 1997).

But the most significant change to western water has resulted from the large-scale construction of dams and water conveyance facilities. Dams have flooded valleys and displaced farmers and communities, blocked or disrupted fish migrations, reduced naturally occurring flood frequencies and magnitudes, disrupted natural temperature fluctuations, altered low flows (sometimes increased, sometimes

decreased to zero), reduced sediment and nutrient loads, changed channel-sediment characteristics (especially particle size and mobility), narrowed and shrunk river channels, changed channel patterns, and eliminated flood plains (Graf, 1997; Collier, Webb, and Schmidt, 1996).

Changes in seasonal flows have been so dramatic that some river basins contain only remnants of previously existing riparian ecosystems (Patten, 1997). Riparian zones have been damaged by accelerated pumping of groundwater that is hydrologically connected to surface flows (Patten, 1997). Their integrity has been further compromised by the spread of exotic ornamental shrubs such as Russian-olive and tamarisk. In some areas, tamarisk occupies up to 90 percent of the area originally dominated by cottonwood-willow riparian forests (Patten, 1997).

Wetlands associated with riparian zones have been destroyed by water development as well. In one example, the extensive flood plain wetlands that occupied nearly 52,000 acres of the Middle Rio Grande valley in 1918 were reduced to just 3,671 acres (a 93-percent loss) by 1989 (Grimm, et al., 1997). Nationwide, agriculture development accounted for 87 percent of all wetlands lost between 1950 and 1970 and 54 percent of those lost between the 1970s and the mid-1980s (National Research Council (NRC), 1996a). Increasingly, other activities such as urbanization are playing a larger role in wetland losses. According to the USDA, agricultural activities were responsible for only 20 percent of all wetland losses between 1982 and 1992 (USDA, 1997).

Decades of habitat alteration have led to the extinction or near-extinction of many aquatic species. More than 20 native western fishes have become extinct in the past century, and 100 more are considered threatened, endangered, or of special concern (Minckley, 1997). Loss of all these species would mean destruction of 70 percent of all fish species native to the lands west of the Rocky

Mountains (Minckley, 1997). The plight of Pacific Northwest salmon has drawn a great deal of attention in recent years. Extensive damming, as well as heavy commercial fishing pressure (mainly at sea and in the lower stretches of the Columbia River basin), and development in the upper parts of the watershed have reduced salmon and steelhead from estimated annual runs of 10-16 million before non-Indian settlement of the area to about 2.5 million today. Entire stocks are gone, and others are perilously close to extinction. An estimated one-third to one-half of the habitat is now completely inaccessible to migrating fish, and the many miles of slackwater reservoirs prove fatal to salmon smolt attempting to reach the sea (Gillilan and Brown, 1997).

Native fish also have been threatened by the introduction of aggressive non-native species, many of which are more suited to river environments altered by dams. These introduced fish have been stocked intentionally by federal, state, and local agencies for sport, forage, pest control, and food purposes (Minckley, 1997). The proportion of non-native fish is greatest in the Colorado River basin, where there are nearly twice as many introduced species (60) as native species (32) (Minckley, 1997). Many of the introduced species have adapted to their new environments and outcompete native fish. Many are also highly sought by recreational anglers.

In short, the West's water is made to work incredibly hard. It is not surprising that many of the region's waterways are simply overworked and are suffering the consequences. For example, a water budget presented by the U.S. Forest Service (1989) calculated average annual net streamflows for the nation's water resource regions and then deducted estimated needs for instream flows. The analysis showed that "instream flows in the Rio Grande, Upper Colorado, and Lower Colorado water resource regions are insufficient to meet current

needs for wildlife and fish habitat, much less allow any additional offstream use" (Guldin, 1989). New and changing needs for water will need to be met through more creative management of this limited resource.

The West in Transition

Population Growth and Change

A concerted national effort for over a century to attract people to the West has succeeded in recent decades, ironically often for the very reasons people were deterred from the region originally. The New West's "commodities" include climate, scenery, and open space, combined with the public and private infrastructure to support what millions perceive of as a high quality of life in a series of urban archipelagos.

Once the outpost of a young nation, today's West is home to nearly one-third of the American population. The region has experienced rapid population growth in recent years: western states grew by about 32 percent in the past 25 years, compared with a 19-percent rate in the rest of the nation (Case and Alward, 1997). By the year 2025, the West will add another 28 million residents, representing only a slight reduction in growth rate.

About 60 percent of the region's population reside in the large and populous states of California and Texas, but an increasing number are relocating to the mountain states. From 1990 to 1995, for example, 10 of the nation's 50 fastest growing counties (including the county at the top of the list) were in Colorado (Riebsame, 1997b). As shown in

table 2-2, the West also dominates the list of the fastest growing cities in the country from 1990-94 (Riebsame, 1997b).

Table 2-2.—Ten fastest growing cities in the country, 1990-94

State	1990-94 population growth (percent)
1. Las Vegas, Nevada	26.2
2. Laredo, Texas	22.4
3. McAllen, Texas	20.2
4. Yuma, Arizona	19.4
5. Boise, Idaho	17.6
6. Naples, Florida	16.0
7. Brownsville, Texas	15.2
8. Fayetteville, Arkansas	15.0
9. Las Cruces, New Mexico	14.7
10. Richland, Washington	14.6

According to the U.S. Bureau of the Census, nine of the 10 fastest growing states in the nation are in the West; the other one is Georgia (Case and Alward, 1997). The list in table 2-3 shows that growth has occurred most rapidly in the booming interior West (Riebsame, 1997a).

The maps in figure 2-4 (at the end of the chapter) show population growth in the western states for four periods since 1960. In terms of population numbers, most of the growth has occurred in California and Texas. These two states are gaining people both by births and immigration. California contained 12 percent of the nation's population in 1995 and is expected to have 15 percent in 2025. California and Texas together are expected to account for nearly half of the nation's growth from births during the 1995-2025 period (Case and Alward, 1997).

Table 2-3.—Ten fastest growing states in the nation, 1990-94

State	1990-94 population growth (percent)
1. Nevada	21.2
2. Idaho	12.5
3. Arizona	11.2
4. Colorado	11.0
5. Utah	10.7
6. Alaska	10.2
7. Washington	9.8
8. New Mexico	9.1
9. Georgia	8.9
10. Oregon	8.6

Whereas the years immediately following World War II saw a national migration from the East and Midwest to western coastal cities, the pattern began to change in the 1970s. Large numbers of people from the West Coast began to move into the interior West—bringing rapid population growth to Arizona, New Mexico, and southern Nevada, in particular. Immigrants from the northern Great Plains states, Great Lake states, eastern coastal states, and the South added to these rapidly growing populations (Case and Alward, 1997). This pattern accelerated in the early 1990s. In fact, all of the country's other four census regions sent more people to the interior West than they received—a "positive net migration" for the interior West—during 1990-94 (Riebsame, 1997a). See figure 2-5 at the end of this chapter.

Throughout the past several decades, the new residents of the interior West have collected into a series of "urban archipelagos"—areas of high population density surrounded by large rural areas with sparse and often declining populations. In contrast to the more confined "urban oases" of the past, each of the new western archipelagos is characterized by a number of central cities typical of

a metropolitan area surrounded by a ring of (often quite extensive) suburbs. Some of the cities into which the western population has concentrated include Boise, Salt Lake City, Spokane, Denver, Colorado Springs, Las Vegas, Sacramento, Eugene, El Paso, Dallas, Albuquerque, Tucson, Phoenix, and Missoula (Case and Alward, 1997).

With such substantial growth, much of the interior West is no longer accurately called the nation's "empty quarter" (Riebsame, 1997a). Yet the pattern of settlement has left the areas between metropolitan areas sparsely populated. Few counties away from western cities contain population densities of even 25 people per square mile, and Nevada's rural Eureka County has 3.5 square miles of land per county resident (Riebsame, 1997a). Moreover, large parts of the region—particularly the Great Plains—have not experienced anything approaching the growth rates observed along the Rocky Mountains and in the desert Southwest. In short, most westerners live in a few fast-growing urban areas, leaving the rest of the region relatively unsettled. While about three-quarters of those living in eastern states are urban dwellers, fully 86 percent of westerners live in or near cities (Riebsame, 1997a).

At the same time, the region is also seeing the growth of suburban-like residential and commercial development in rural areas—a phenomenon sometimes called "exurban" development, rural development, or rural gentrification. Exurban development is encouraged by the migration of jobs to suburban fringes of urban areas (making it possible for commuters to drive in from more rural settings) and an increase in telecommuting. A rapid growth in dispersed rural development has been documented throughout the region and likely will pose new challenges for western land and water planners in the future (Riebsame, 1997b).

Lake Tahoe: Can We Keep From Loving It to Death?

Lake Tahoe is one of the Sierra Nevada's crown jewels, renowned for its breathtaking clarity. The tenth deepest lake in the world, Lake Tahoe sits 6,225 feet above sea level and is 22 miles long and 12 miles wide. The high-altitude, clear blue lake and its surrounding basin, which lie on the California-Nevada state line, are spectacular natural resources that provide great environmental, economic, and recreational benefits.

Lake Tahoe's transparency and cobalt blue color are attributed to the lake's historically low nutrient levels and corresponding minimal algae growth. The rapid commercial and residential development of the Lake Tahoe basin since the 1950s has adversely affected the pristine waters of this deep alpine lake. The basin has nearly 43,000 residences; 11,500 tourist accommodations, and 9,600 vacation homes, bringing some 22 million visitors a year. Because the lake has an extremely slow rate of water exchange (it is said that a drop of water remains in the lake for 700 years), any pollution that reaches the lake accumulates almost indefinitely. Sediment from development of the basin's fragile and erodible land, sewage plant discharges, as well as traffic fumes, send phosphorous and nitrogen compounds into the lake which spur algae growth. Algae and suspended sediments cloud the lake and reduce transparency. The lake has lost about 1-1/2 feet of transparency each year since the early 1960s.

The problem is aggravated by the loss of wetlands and marshes which would normally catch sediments and minimize the amount of nutrients reaching the lake, as well as provide habitat for more than 260 wildlife and fish species. Today, more than 75 percent of the basin's marshes, 50 percent of its meadows, and 35 percent of its riparian areas are gone.

The Lake Tahoe basin encompasses about 500 square miles, including parts of two states and six counties. This means that no one entity can restore and preserve the lake. A multijurisdictional, multilevel approach was needed to address the range of development and land use activities that were impacting the lake. In 1969 the Tahoe Regional Planning Compact between California and Nevada was created and approved by the Congress. This agreement created the Tahoe Regional Planning Agency, which enacted a Code of Ordinances to regulate land use, density, rate of growth, land coverage, excavation, and scenic impacts. To date, the federal, state, and local agencies have expended approximately \$300 million on land acquisition, erosion control, and restoration projects. These efforts have helped slow degradation of the lake's waters, but the lake's clarity and quality continue to decline.

To bring a more national focus to the effort, the Lake Tahoe Presidential Forum (Forum) was recently established. The Forum—comprised of federal, state, and local agencies; tribal governments; environmental groups; and commercial interests—will focus on water quality, transportation and forest health, and funding to restore water quality and ecosystems.

Many stakeholders in the Forum hope it will lead to increased federal involvement in the basin and an infusion of federal funds to achieve the desired environmental goals. Some estimate that as much as \$1.4 billion of public and private money is needed to reach the goal of threshold attainment over the next 20 years.

The Tahoe story illustrates how sensitive some of our most valued aquatic resources are to pollution, and how difficult, expensive, and politically challenging it can be to address nonpoint sources of pollution. This is especially true for those pollutants that result directly from basic growth and land development, which ironically are driven by our attraction to the natural resource. #

What is driving the migration to "hot spots" in the interior West? Some new residents surely have been driven by economic forces—drawn by expanding telecommunications, computing, and advanced technology jobs in Denver and Salt Lake City, or fleeing the previously stagnant Southern California or rural Midwest economies (Case and Alward, 1997). Others, including retirees and high-tech "footloose" entrepreneurs, are able to live where they wish and are relocating to areas with attractive natural amenities and fewer social problems. For example, from the 1970s to the 1990s, counties with federally designated wilderness areas grew two to three times faster than all other counties in the country, both rural or urban (Riebsame, 1997a). A recent survey of demographic trends concluded that nearly a quarter of interior West immigration may be retirement-based and that there will be an even larger retirement boom in the region in the next two decades (Riebsame, 1997b).

The West's pattern of growth is not expected to abate any time soon. Between the years 1995 and 2000, the 17 western states will add 5,427 million people, or about 6.1 percent, distributed as shown in table 2-4.

In the following 25-year period (through the year 2025), the fastest growing states in terms of percentage growth rates are expected to be California, New Mexico, Texas, Arizona, Washington, Wyoming, Utah, and Idaho (Case and Alward, 1997).

Continued urban growth, combined with the economic changes described below, will exert increasing pressure on the West's largest water user—irrigated agriculture. A recent National Academy of Sciences report concisely stated the relative position of irrigated agriculture:

Table 2-4.—Projected growth in western states, 1995-2000
(adapted from Case and Alward, 1997)

State	Population 1995	Population 2000	Percent increase
Nevada	1,530,000	1,871,000	22
Idaho	1,163,000	1,347,000	16
Arizona	4,218,000	4,798,000	14
Utah	1,951,000	2,207,000	13
Colorado	3,747,000	4,168,000	11
New Mexico	1,685,000	1,860,000	10
Montana	870,000	950,000	9
Wyoming	480,000	525,000	9
Oregon	3,141,000	3,397,000	8
Washington	5,431,000	5,858,000	8
South Dakota	729,000	777,000	7
Texas	18,724,000	20,119,000	7
Kansas	2,565,000	2,668,000	4
Nebraska	1,637,000	1,705,000	4
North Dakota	641,000	662,000	3
Oklahoma	3,278,000	3,373,000	3
California	31,589,000	32,521,000	3

The value of water in agriculture is generally less than in industrial or municipal uses . . . [and] because it is so expensive to develop additional water supplies, only the higher-value water uses are likely to be justified economically (NRC, 1996a).

Economic Growth and Change

Perhaps nowhere is the transformation of the West more evident than in the region's changing economy. Much of the early European development of the West was driven by the opportunities to extract and process natural resources, treating the region more or less as a colony for commercial interests in eastern states. Today, however, the West has moved beyond a role as material supplier and is a major player in its own right in the global economy.

This change is reflected in the declining proportion of jobs provided by resource development. As late as 1940, almost half of the West's people were directly employed in farming, ranching, mining, and agricultural or mineral processing (Case and Alward, 1997). By 1969, however, all the natural resources industries together provided about 11 percent of direct employment and 9.6 percent of personal income for residents of the Rocky Mountain states. And in 1991, these combined industries supported less than 6 percent of the region's employment and less than 5 percent of all personal income (Rasker, 1994).

Even more dramatic than the relative decline of the extractive industries is the growth of the service sector—not surprising, as the information age is well underway. In 1993, the top four sources of dollar earnings in the western states were services, trade, construction, and fabrication of materials (Case and Alward, 1997). The service sector, which

is not only the largest sector but also the fastest growing (Case and Alward, 1997), includes the "knowledge-based" professions (doctors, lawyers, engineers, management consultants, software designers, data processors, and telecommunications specialists), as well as lower-paying jobs such as retail sales clerks and hotel maids (Rasker, 1994). Services account for 72 percent of the United States' gross domestic product, 76 percent of employment, and, since 1982, 91 percent of new jobs in the country (Rasker, 1994).

In their report prepared for this Commission, Case and Alward separated out services catering exclusively to individuals (such as hairdressers, restaurants, motels, and others) into their own category ("consumer services") to allow analysis of the growth of industries consuming discretionary dollars. Their listing of dollar earnings for western industries shows that "services," excluding these consumer services, generate far more revenue in the West than any other category (table 2-5).

An economic picture of the West would be incomplete if it looked only at wages, which make up less than half the region's income. An increasing proportion of the money comes from such nonlabor sources as returns on investment and transfer payments (pensions and retirement benefits, trust fund income, and welfare). Nonlabor income is of growing importance in amenity communities and retirement hot spots (Riebsame, 1997a).

For its part, agriculture has declined in terms of its proportional size in the overall economic activity of the West, yet the western states continue to play an important role in national agricultural production. Nationally, the 15 percent of harvested cropland that is irrigated produces 41 percent of the total value of crop sales. In the West, the 27 percent of the harvested cropland that is irrigated produces

Table 2-5.—Dollar earnings by firms organized into 20 industrial sectors in 1993 (Case and Alward, 1997)

Rank	Industrial sector	Earnings
1	Services	1,292,740.53
2	Trade	569,806.40
3	Construction	268,095.74
4	Fabrication of materials	201,461.19
5	Transportation	193,078.02
6	Computers and telecommunications	142,018.01
7	Mining	121,223.73
8	Consumer goods	110,638.76
9	Consumer services	81,298.66
10	Advanced technology products	77,748.96
11	Agriculture	74,164.85
12	Food products	69,460.94
13	Power generation	58,078.74
14	Industrial machinery	44,406.64
15	Livestock	27,531.04
16	Finished goods	22,740.99
17	Wood products	22,086.88
18	Paper and paper products	17,912.32
19	Forestry	5,774.20
20	Fishing ¹	3,117.42

¹ Fishing was not considered to be an industrial sector until 1978. No earnings information exists for fishing prior to this time. Our table for 1977 excludes fishing and contains 19 sectors. The remainder of our analysis treats fishing as a separate sector and includes it to make up 20 sectors.

66 percent (\$22 billion) of the total value of crop sales on 35.3 million acres with average sales of \$600 per acre. In contrast, the 73 percent of the harvested cropland that is nonirrigated in the West produces 34 percent (\$10 billion) of the total value of crop sales of 97 million acres with average sales of \$116 per acre (USDA, 1997). Clearly, the availability of irrigation water adds a great deal to the value of western farmlands.

The total value of U.S. agricultural exports is projected to increase from \$43.4 billion in 1994 to \$78.8 billion in 2005 (USDA, 1996a). The western states (with California's strong influence evident) provide approximately 45 percent of the value of crop commodity exports and much higher percentages of several commodities: fruits and preparations (69.6 percent), vegetables and preparations (77.3 percent), and tree nuts (96.6 percent) (USDA, 1996b). Figures 2-6 and 2-7 show current and projected agricultural exports. On the other hand, increased imports of fruits and vegetables as a result of liberalized trade policies mean more competition and possibly lower prices for western farmers. Those able to respond quickly to new demand will be best suited to adapt to changing global markets.

Farms and ranches have decreased in number and grown in size during the past 25 years as agriculture is practiced as an increasingly corporate activity (Case and Alward, 1997). Where there was one large farm or ranch (those with sales of \$100,000 or more) in 1969, there were six in 1992. While total farm and ranch counts have dwindled from 2.7 million in 1969 to 1.9 million in 1992, the number of large farms and ranches has jumped from 51,995 in 1969 to 333,865 in 1992.

Many large farms and ranches are not just relatively large economically but also are large in acreage terms. Though large farms and ranches in 1992 comprised less than 20 percent of all such operations in the United States, they operated 54 percent of the total land in agriculture and produced approximately 83 percent of all farm and ranch products sold. Large farms and ranches average 1,542 acres in size compared to 271 acres for smaller operations (Case and Alward, 1997).

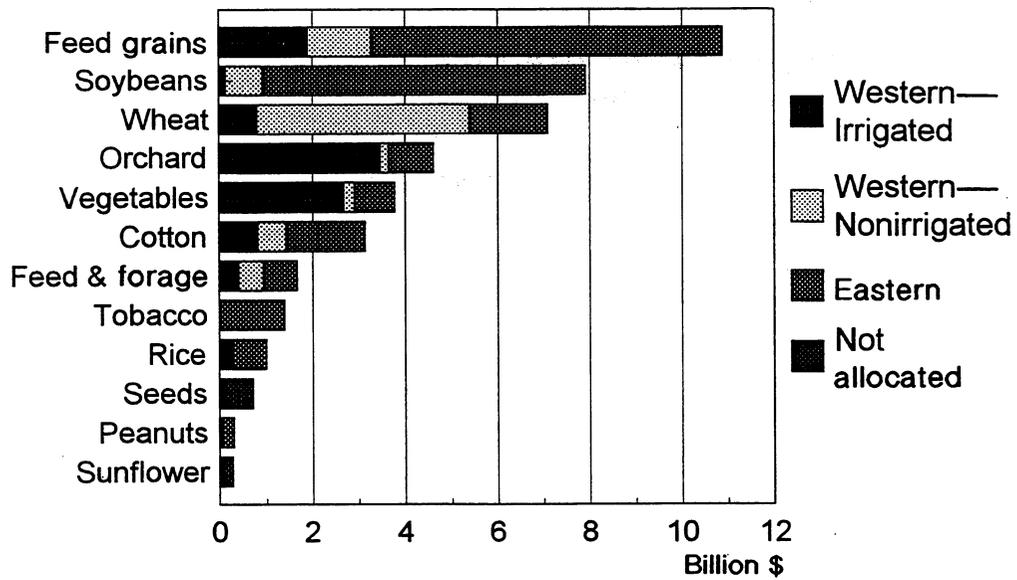


Figure 2-6.—Crop exports and estimated share from western irrigation.

Exports by Commodity

Western Irrigation's Share of Exports

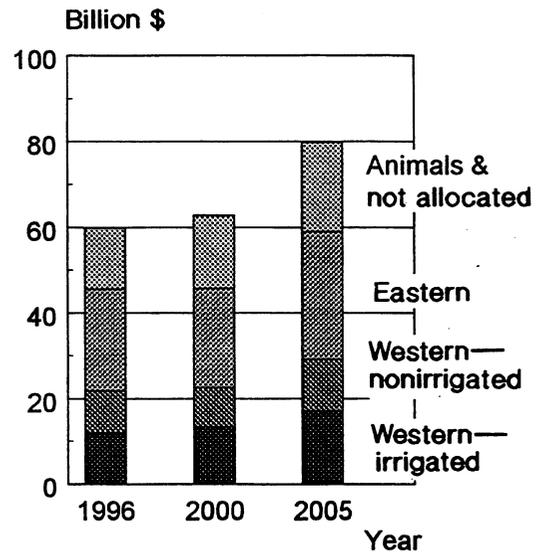
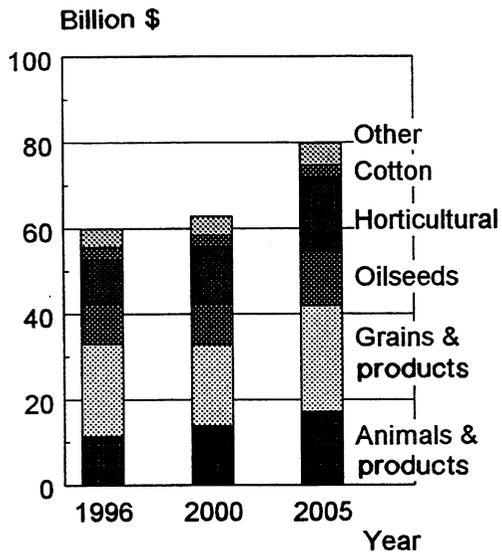


Figure 2-7.—Agricultural exports, 1996 and projected years.

The very structure of the agricultural industry is changing. Agricultural production, processing, and marketing activities are becoming more vertically integrated (NRC, 1996a). Moreover, farming operations increasingly make use of contracts, under which producers promise to provide (and buyers promise to purchase) a set amount of a product of a particular quality. Contracts, which are more common with higher-value crops, place the burden on a farmer to reduce uncertainty. Irrigation is one of the means of minimizing risk and ensuring one's ability to meet the contract terms. Although they comprised only 11 percent of total farms in the nation, operations with contracts accounted for 40 percent of gross sales in 1993 (Hoppe, et al., 1993). The industrialization of agriculture, including the increasing use of contracts, is likely to continue.

Federal policy toward agriculture has changed in recent years, as evidenced by the Federal Agriculture Improvement and Reform Act of 1996 (also known as the 1996 Farm Bill). This legislation removed the link between income support payments and farm prices by providing for seven annually fixed but declining "production flexibility contract payments," whereby participating farmers may receive government payments independent of current farm production and prices. Farmers will have much greater flexibility to make planting decisions with the elimination of annual acreage idling programs. They will be able to plant any crop on contract acres, with limitations on fruits and vegetables. As a result, farmers will rely more heavily on the market as a guide for production decisions and will bear greater income risk because payments are fixed and are not related to market prices (USDA, 1997). These changes may have detrimental impacts over the long term on small full-time farming operations with less ability to cope with fluctuations in return from year to year.

Changing Patterns of Agricultural and Urban Water Uses

The distinction between water withdrawals and consumptive use is important, and both must be taken into account when addressing water-related issues. Consumptive use of water is most important in the determination of water rights because return flows are credited to compute a water rightholders's net depletion. Further, consumptive use represents more accurately the amount of water lost permanently from the system.

Withdrawals are important to understand and quantify for the effect they have on streamflows and water rights between the point of initial diversion and the point that return flows re-enter the stream.

As it relates to overall trends, USGS has historically accounted for water use primarily in terms of withdrawals, or diversions, not consumptive use. For this reason, the following paragraphs compare water uses in terms of related withdrawals, not consumptive use. As the discussion turns to various applications of water, consumptive use rates are more relevant and are the general measure employed.

After several decades of expansion, water withdrawals in the 19 western states appear to have stabilized in recent years. Total freshwater withdrawals in the region in 1990 totaled approximately 179 maf, of which 120 maf came from surface water and 59 maf were drawn from underground (USGS, 1997). This represented a 2-percent decrease in surface water withdrawals and a 5-percent increase in groundwater withdrawals

since 1985 (USGS, 1997).¹ Irrigation has the highest ratio of consumption to withdrawals, at 51 percent (Reclamation, 1996a). Thermoelectric steam cooling, at 3 percent, is the lowest (Guldin, 1989).

Figure 2-8 (at the end of this chapter) summarizes the geographic distribution of water withdrawals based on USGS data. The two states with the largest populations accounted for the largest withdrawals in 1990: California (39.3 maf) and Texas (22.5 maf) (USGS, 1997). The third largest state for water withdrawals, however, was the thinly populated but heavily irrigated Idaho (22.1 maf) (USGS, 1997).

Figure 2-9 summarizes the source, use, and disposition of the West's freshwater withdrawals in 1990 (USGS, 1997). The "use" category includes withdrawals and deliveries. It shows, for example, that domestic and commercial water use totaled 17.5 maf (including losses in the public supply distribution system), or 10 percent of the total freshwater withdrawn in the 19 western states. The disposition column shows the quantity of consumptive use and return flow after use. It indicates that of the total freshwater withdrawn, consumptive use was 81.7 maf, or 46 percent, and return flow was 97.3 maf, or 54 percent (USGS, 1997). (This figure does not show consumption for separate categories of water use.)

Figure 2-10 compares four categories of water use in the 19 western states in 1960 and 1990 (USGS, 1997). In these three decades, agriculture has remained the dominant water use category in the West, although total withdrawals for this purpose

have declined from 86 percent of the total in 1960 to 78 percent today. Domestic demands rose from 5 percent of the total in 1960 to 8 percent in 1990, and water used for thermoelectric power generation rose from 4 percent of the total in 1960 to 9 percent in 1990 (USGS, 1997).

The U.S. Geological Survey analyzed these water use trends along with population trends for the western United States. They found that the population of the West is projected to increase by 51 percent from about 78.3 million in 1990 to about 118 million in 2020 according to the U.S. Bureau of Census. Demand for water for agricultural, domestic, industrial, commercial, and thermoelectric purposes is projected to increase by about 5 percent from 179 million acre-feet in 1990 to 188 million acre-feet in 2020. The comparatively small overall increase in water demand is based on the projection of reduced irrigation demands. The 2020 projection indicates that irrigation will probably account for about 71 percent (133 million acre-feet) of total freshwater demand in 2020 compared to 77 percent (137 million acre-feet) of the total in 1990. However, water demand in sectors other than irrigation and thermoelectric are projected to increase about 51 percent from 25.6 million acre-feet in 1990 to 38.6 million acre-feet in 2020—an increase in percentage which corresponds more closely to the projected growth in population.

Because of the uncertainty of the effect of deregulation on the power industry, water use is assumed the same for thermoelectric power generation for 1990 and 2020 at 16.2 million acre-feet (Hutson, 1997, written communication).

As mentioned earlier, the distinction between withdrawals and consumptive uses is important. An accurate understanding of the effects of water diversions must also compare the net water uses,

¹ Estimates of water use are difficult to verify; Reclamation recently concluded that total withdrawals in the 17 western states in 1990 were 197 maf, a number not significantly changed for the past several decades (Reclamation, 1996a).

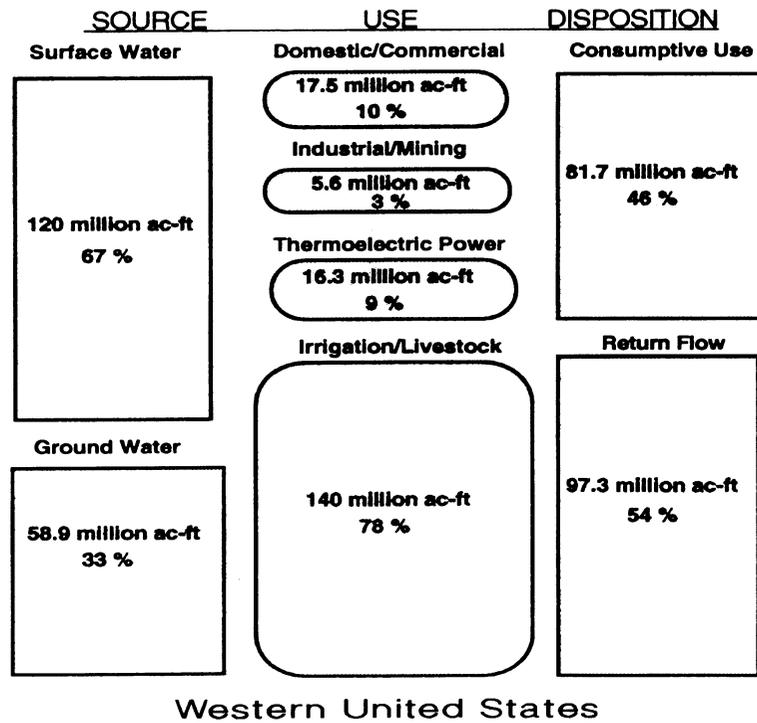


Figure 2-9.—Source, use, and disposition of fresh water (179 maf) in 1990 in the western United States. (Source: USGS, 1997.)

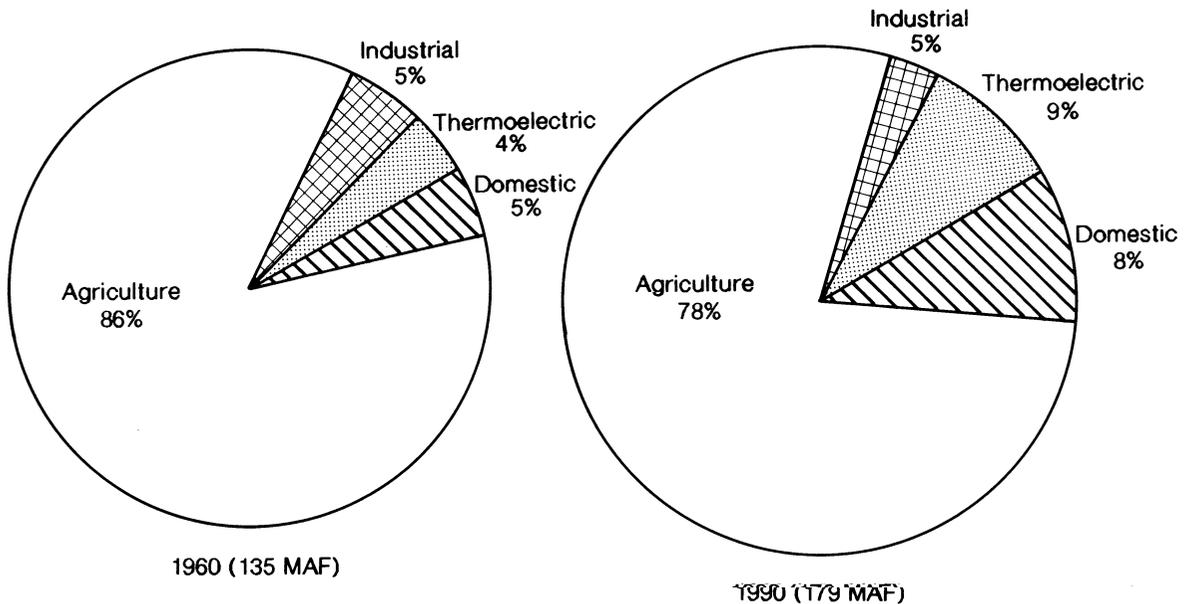


Figure 2-10.—Freshwater withdrawals by water-use category in the western states, 1960 and 1990. (Source: USGS, 1997.)

represented by consumptive use rates. As is described below, such a comparison shows a proportionally greater demand for water by irrigated agriculture.

Agricultural

As a direct result of the arid conditions in the region, irrigated agriculture is largely, but not exclusively, a western phenomenon. The 17 western states, together with Arkansas, Florida, and Louisiana, account for 91 percent of all U.S. irrigated acreage and 82 percent of all irrigated farms (NRC, 1996a). Four-fifths of all irrigators are located in the West (NRC, 1996a). USDA reports that about 27 percent of all harvested cropland in the West is irrigated, producing 66 percent of the value of crop sales in the region (USDA, 1997).

In turn, irrigated agriculture is by far the largest water user in the West. In the 19 western states, a total of 140 maf was withdrawn for irrigation in 1990, of which approximately 54 percent (75 maf) was consumptively used (USGS, 1997). Thus, irrigated agriculture represents 78 percent of total water withdrawals in the region and 90 percent of total consumptive uses. The largest irrigation withdrawals occur in California, Idaho, Colorado, and Montana, which together withdrew more than 75 maf in 1995 (NRC, 1996a). The greatest acreage under irrigation is in California (7.6 million acres), Nebraska (6.3), Texas (4.9), and Idaho (3.3). Nearly half of all western irrigation water is used to grow crops for livestock (USDA, 1997).

The West has seen several expansions of irrigated agriculture, most recently in the period from roughly 1950 to 1975 as large new dams and conveyance works were completed and groundwater withdrawals increased threefold (Frederick, 1988). Irrigation of

about 25 million additional acres in the region during this period raised U.S. crop production by 70 percent without any net increase in total harvested acreage in the country (Frederick, 1988). Water withdrawals for irrigation in the 19 western states increased 35 percent between 1960 and 1975. Agricultural withdrawals peaked in 1980 at 150 maf (USGS, 1997).

Withdrawals for agricultural uses declined 5 percent between 1980 and 1985 and dropped 2 percent between 1985 and 1990 (USGS, 1997). This change is credited to the use of more water-efficient irrigation systems, introduction of crops that use less water, and reduction of acreage irrigated by wells in some areas because of declining water levels (USGS, 1997). USDA reported that irrigators reduced water application rates from a national average of about 25 inches per season during the late 1960s and early 1970s to about 20.5 inches in 1994, a decrease of almost 20 percent (USDA, 1997). The agency estimated that irrigation water conservation and management practices were implemented on approximately 6.2 million acres in the West between 1982 and 1992 (USDA, 1997). Reclamation reported that water deliveries from its facilities declined from an average of 3.03 acre-feet per acre in 1970 to an average of 2.88 acre-feet per acre in 1990 (Reclamation, 1996).

These changes in farmers' application rates may be attributed to a number of variables: crop type, temperature, precipitation, and irrigation methods. Among the crops grown in the West, rice and alfalfa are among the thirstiest (each requiring about 30 inches per year); soybeans, by contrast, require only about 10 inches per year (NRC, 1996a). As illustrated by the figures below, western irrigated cropland is dominated by corn for grain and alfalfa hay. More irrigation water is applied to alfalfa hay than to any other single crop. Irrigated alfalfa produces about 35 percent of the harvested forage in

the West. One of the reasons irrigated alfalfa does not rank among the top crops in terms of sales is the onfarm use of alfalfa. Irrigated crop sales, on the other hand, are led by high-value orchards, vegetables, and nursery crops (see figures 2-11 and 2-12) (USDA, 1997).

Surface irrigation using gravity remains the most common form of irrigation in the West, but more land is increasingly being irrigated using sprinkler and microirrigation techniques. Among the technologies available to farmers today are: gated pipe, low-pressure precision application systems, surge valves, and onfarm ditch lining and piping, all of which reduce evaporation and seepage losses; soil-moisture monitoring devices such as gypsum blocks; improved scheduling; and recovery of irrigation tailwater (Dyer, 1996). Although these techniques can be very effective at conserving water, they often are not cost effective for the individual water user. Reduction or elimination of federal funding, such as the Great Plains Conservation Program, has eliminated a source of funding available to farmers for implementation of these more effective technologies.

Factors encouraging agricultural water conservation include labor availability and cost, energy costs, limited water availability, and environmental concerns (NRC, 1996a). Constraints on agricultural water conservation include scarcity of capital and low-cost existing irrigation systems, inaccessible technology, limited management skills, and institutional disincentives to conservation. However, farmers often find that efficiency improvements are more than justified by reduced pumping and energy costs, reduced salinity and reductions in other water quality problems, reduced erosion and sedimentation, and increased crop yields (Dyer, 1996).

Agricultural water efficiency improvements can have unintended consequences. Water that leaks out

of unlined ditches and laterals may help to recharge groundwater supplies or may serve as a source of supply for a wetland area. The water-loving plants (phreatophytes) growing along ditches or near irrigated fields may provide aesthetic benefits as well as valuable wildlife habitat (Natural Resources Law Center, 1996). Any efforts to improve water use efficiency must consider these incidental water users.

Urban

With rapidly growing western populations, it is not surprising that urban demands for water have risen in recent years. Between 1960 and 1990, withdrawals for domestic uses of water in the West more than doubled, rising from 6.5 to 14 maf. During this same time period, the region's population increased by about 75 percent (USGS, 1997). Thus, the trend has not only been toward greater overall domestic water demands but also toward higher per capita use rates.

Nationally, per capita water use is about 40 gallons of water daily; in the desert Southwest (where residents use a large part of their urban water supplies to water lawns and gardens), the average per capita daily use is three times as high, and the per capita use for Las Vegas and Phoenix is over 300 gallons per day (Riebsame, 1997a). USGS estimates that, on average throughout the 19 western states, domestic per capita water use increased from 129 gallons per day in 1960 to 160 gallons per day in 1990 (USGS, 1997).

Average per capita use rates are a bit misleading when studying changes over a region as large as the American West. For example, Reclamation notes

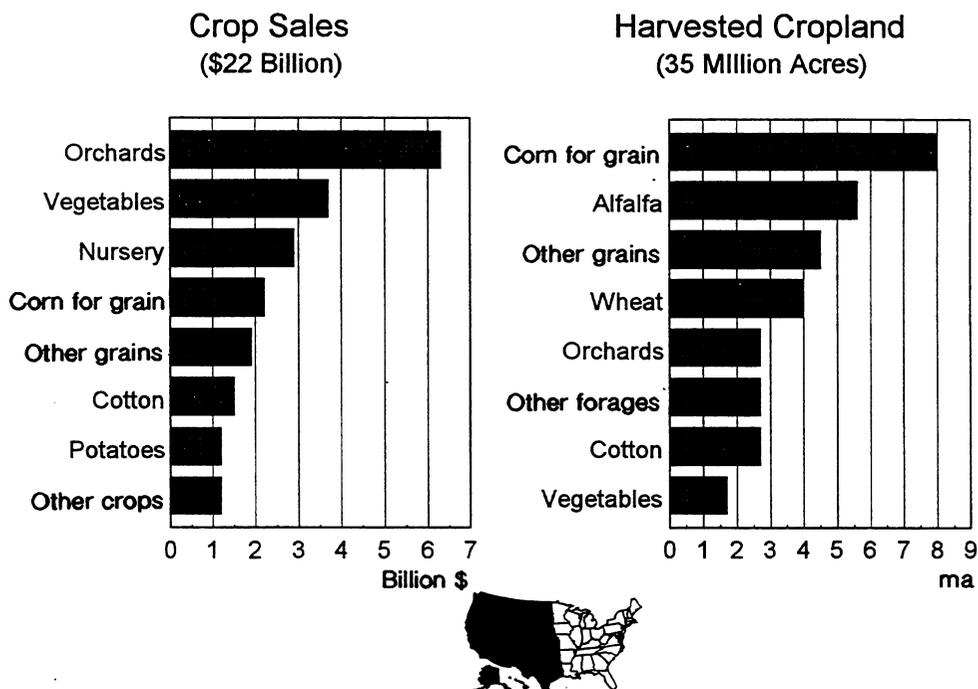


Figure 2-11.—Crop sales and irrigated cropland in the West by crop, 1992.

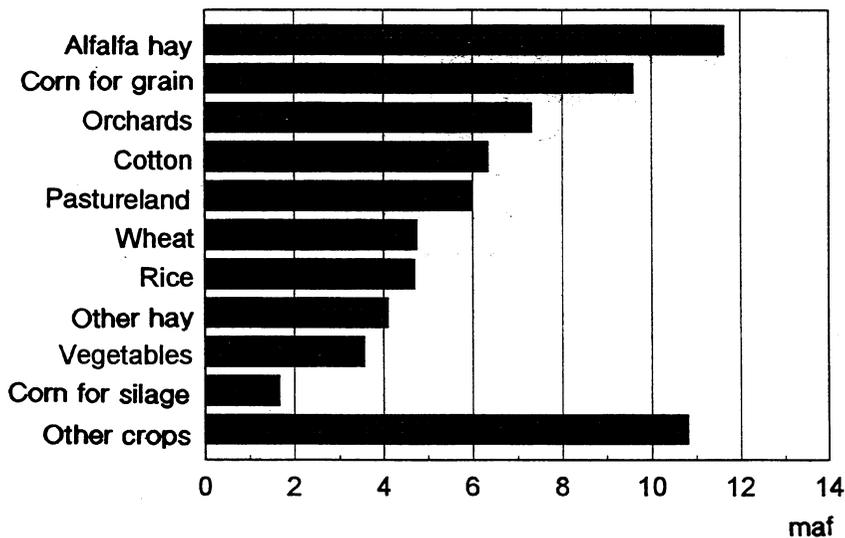


Figure 2-12.—Western irrigated water applications by crop, 1994, based on data from 17 states.

that data may be skewed by local climatic conditions (extended droughts or wet periods), shifting local economic conditions, and the status of local water delivery infrastructure (Reclamation, 1997a). Moreover, per capita use rates tend to increase as more people install and use modern water appliances (dishwashers and clothes washers) and as much of the western population shifts from self-supplied water sources in rural areas to public supply facilities. In many cases, however, the increased per capita use of water is related to suburban and exurban sprawl and the accompanying needs of larger landscaped yards. Approximately one-half of residential water use is consumed outside the house, nearly all of which is used to irrigate lawns, shrubs, and home vegetable gardens (Bradshaw, et al., 1982). Overall, municipal water prices (adjusted for inflation) have declined since 1965, providing another possible explanation for increased per capita use rates (Maddock and Hines, 1995).

As new water supplies become more difficult to obtain, many urban areas are pursuing aggressive water efficiency campaigns, sometimes with dramatic results. There are many options for managing customer demand for water. Water conservation measures to decrease consumptive use might require or encourage the use of low-flow plumbing fixtures and appliances, xeriscaping, drip irrigation, leak control, pressure reduction, and commercial/industrial "closed loop" systems. Water pricing can be adjusted to reduce peak demands and usage—for example, implementing an inverted block rate, which penalizes users for going beyond reasonable threshold amounts. And, although it is an unpopular approach, water managers may place a moratorium on the number of water permits or hookups when water supplies are limited (Maddock and Hines, 1995).

There are a number of examples of successful demand-side management efforts. California's extended drought in the late 1980s and early 1990s prompted education and retrofitting programs in several municipalities including Santa Barbara, where savings were as high as 50 percent. In Denver, average annual water use per customer decreased substantially after 1987, when the city stepped up its water conservation program (including a strong push for low-water, or xeriscape, landscaping) and began universal metering (Reclamation, 1997). An inverted rate structure in Tucson is credited for reducing per capita water use from about 200 gallons per day to 140-160 gallons per day (Maddock and Hines, 1995).

On the other hand, promoting water conservation can be costly for water suppliers. Reductions in water use can cause losses in revenues, at least temporarily, resulting in cash-flow problems for utilities whose operational expenses remain unchanged. Thus, while efficiency improvements may be a less expensive source of water in the long run, communities often find it easier to invest in large supply and treatment projects with much longer payback periods (Dyer, 1996). Most western cities have plans for enlarging their water supplies to meet growth projections, and current urban growth patterns are driving most water transfers in the West. Although these cities also have plans for enhanced water conservation, the net effect of these efforts will likely be to reduce per capita consumption of water but not the total increase in urban water demand. At most, conservation programs will slow the rate of increase in urban demand (Riebsame, 1997b).

Is the West's water supply sufficient for the future? A number of experts have concluded that the region can meet projected municipal needs by making modest improvements in water-use efficiencies and

by taking measures to reduce per capita use rates (Maddock and Hines, 1995). However, in a comprehensive analysis of all water needs, including environmental requirements, California water managers estimate that present supplies are inadequate to meet present urban, agricultural, and environmental demands during drought conditions. Looking ahead to the year 2020, the report predicts shortages of 3.7 to 5.7 maf in average water years and shortages of 7.0 to 9.0 maf in drought years (Bateni, 1994). This analysis substantiates what seems readily apparent—that in the fastest growing areas of the West, the demand for water for all uses already exceeds the supply.

Native American Water Management

Native Americans' rights to use water date back to the establishment of reservations or earlier. In many cases, tribal water rights have not been quantified, leading to an inequitable situation for Indians and considerable uncertainty among all other water users. As of 1995, there were more than 60 court cases pending, potentially affecting the distribution of 45 to more than 60 maf of water (NRC, 1996a). Native American water rights settlements reached in the past decade have resolved claims to 4.6 maf (NRC, 1996a).

Some tribes have enacted water management codes and have included protection for instream flows, water quality, and fisheries, in addition to such consumptive uses as agricultural irrigation and domestic supplies. With enactment of the Water Quality Act of 1987, tribes became eligible to assume primacy (similar to states) for water quality protection under the Clean Water Act. As of 1995, more than 135 tribes had met eligibility requirements to initiate water quality programs (Environmental Protection Agency [EPA], 1994).

Nationwide, Native Americans presently irrigate about 64 percent of the 2.7 million acres of the lands on which they grow crops, producing an estimated income of more than \$1 billion annually (NRC, 1996a).

Changing Land Uses

As would be expected with a growing population, the nation's land area devoted to residential, commercial, industrial, and infrastructural uses is expanding through the conversion of cropland, timberland, and rangeland. The 1992 Natural Resources Inventory estimated a total developed land base nationwide of 92.4 million acres, which indicated an 18-percent increase from 1982. As illustrated by the map in figure 2-13 (at the end of this chapter), the increase in developed area is especially apparent in the Southeast and the West (Riebsame, 1997b). Between 1982 and 1992, net conversions total some 1.5 million acres in the western states (Riebsame, 1997b).

Developed or urbanized land in the United States is growing faster than the population, leading to what is commonly called "urban sprawl." Land developed per person varies from half an acre per person in agricultural areas of the Midwest and Plains to a low of 0.18 acre per person in the urbanized and more concentrated mid-Atlantic areas (Riebsame, 1997b).

Changes in land use patterns relate to changing water demands, particularly when they result in conversion of irrigated agricultural lands. Although total irrigated acres in the nation have remained constant since the early 1980s, a significant shift from the West to the East of more than 4 million acres has taken place (USDA, 1997). Declines in irrigated acreage show up in the Lower Snake River

around the rapidly growing city of Boise, in the Truckee-Carson River system near Reno, and in the San Joaquin valley of California. All types of western agricultural land are experiencing a net conversion to other uses—chiefly residential, commercial, and infrastructure—though the rate, magnitude, and geographical pattern of this land use conversion is poorly known (Riebsame, 1997b).

In a paper prepared for the Commission, USDA attributes the conversion of irrigated land to the following:

- Irrigation becoming less economical as a result of low commodity prices or increasing water costs
- Over-expansion of agricultural production, given the available technologies of the early 1980s
- Groundwater depletion, concentrated mostly in the southern High Plains and California's Central Valley
- Transfers of land and water to meet urban demands
- Calls to reallocate surface water flows for environmental purposes (USDA, 1997)

Stated another way, lands presently under irrigation may be converted to other uses if (1) the alternative uses offer a higher economic return, as when the lands are subdivided for residential development; or (2) the present uses are too costly, either in an economic or an environmental sense.

When irrigated agricultural lands are converted to urban uses, their water typically makes a similar shift. And, although municipal water users typically consume a smaller proportion of the water they

receive than do farmers (see discussion above under "Changing Patterns of Agricultural and Urban Water Uses"), a recent comparison of agricultural and residential water uses revealed some interesting numbers. Data collected by the California Department of Water Resources show that water applied for single-family-dwelling residential uses in the northern San Joaquin valley ranges from 2-3 acre-feet per acre, depending on the housing density. By comparison, agricultural applied water in the same area ranges from about 1 acre-foot per acre for grain to slightly over 5 acre-feet per acre for pasture. Crops with water demands comparable to the residential uses included tomatoes, grapes, corn, almonds/pistachios, and other field and truck vegetables (Matyac, 1997). In other words, conversion to urban use does not necessarily mean a reduction in per-acre demands for water.

Not all types of land areas are equally appealing for development. Settlers long have been attracted to rivers' flood plains to cultivate their rich alluvial soils, to secure access to water for transportation and consumptive needs, and for their aesthetic appeal. In some cases, residents are unaware of fluctuating hydrological conditions and are lulled into complacency by a series of relatively dry years. In other instances, the very risk of flooding has reduced the cost of flood plain properties, making them the only economical option for lower-income residents (and, as demonstrated in the 1997 flood in Fort Collins, Colorado, placing those residents at greater risk of property damage, injury, or death). Today, our flood plains are extensively developed, and the inevitable flood events are of mounting importance. The past decade has witnessed record-breaking flood events in the Midwest in 1993 (damages of \$12-16 billion, 50 deaths, and more than 55,000 homes flooded) (FEMA, 1995b) and in California's Central Valley in late 1996 and the early days of 1997 (damages totaling \$2 billion and an estimated 30,000 residences and 2,000 business properties

damaged or destroyed) (California Governor's Flood Emergency Action Team, 1997).

A survey conducted by the Natural Resources Conservation Service in 1997 showed that in the 19 western states, nearly half of the average annual flood damages occur to rural property and facilities. (Rural communities are defined as those with populations below 50,000.) Rural flood damages average nearly a billion dollars annually in the region, with about 55 percent of the total occurring in California. Washington and Alaska also have significant flood damages. Over 400,000 rural buildings are within the 100-year flood plain in the western states. Flooding of agricultural land impacts more than 30 million acres throughout the region and produces damages costing nearly \$460 million annually—with more than half occurring in Texas and Oklahoma. (Agricultural damages include damage to crops and pasture, farm roads, fences, conservation practices, irrigation facilities, farm equipment, and all farm buildings except the farm house [USDA, 1997].)

Water Quality in the West

Federal water pollution control laws enacted over the past several decades have brought measurable improvement in the quality of the nation's waterways. The 1994 *Water Quality Inventory*, a biannual compilation of data from each state and some Native American tribes, reported that about two-thirds of the state- and tribe-assessed rivers, lakes, and estuaries nationwide were unimpaired for their designated uses (USDA, 1997). (The assessment looked at only 17 percent of the nation's river/stream miles, 42 percent of the nation's lake area, and 78 percent of the nation's estuary area.)

Water quality improvements have resulted primarily from control of pollutants discharged from point

sources. Some kinds of pollutants—salts, agricultural chemicals, sediment, and silt—have increased, despite years of water quality programs (Getches et al., 1991). Moreover, water released from reservoirs causes changes in downstream water temperatures, sediment levels, and oxygen content, which can impact fisheries, riparian ecosystems, and recreational opportunities (Getches et al., 1991).

In an assessment prepared for this Commission, EPA characterized western water quality as "generally good" but noted that degradation has occurred from a number of sources: energy development, urbanization, industrial expansion, farm and grazing practices, forestry, natural resources development, and human activities of many other kinds. The extent and nature of water quality also depend on such natural environmental variations as climate, geology, and soils (EPA, 1998). A survey of water quality trends in the region showed approximately equal increases and decreases in dissolved oxygen, improvements in fecal coliform bacteria, continuing problems with dissolved solids, significant problems with nitrate concentrations, overall decline in phosphorus, and inadequate data to judge trends in suspended sediment (EPA, 1998).

As the major water user, it is not surprising that irrigated agriculture is responsible for a considerable number of the West's water quality problems. Diversions during irrigation season often reduce streamflows well below natural levels, sometimes dewatering them completely in the stretches between diversion and return flow points. Depleted streamflows are less able to dilute pollutants from all sources—natural, as well as human induced (Getches et al., 1991). After the water percolates through the soil, return flows can cause unnatural concentration of salts and metalloids, such as selenium, which are toxic when they bioaccumulate up the food chain (Power, 1997).

Western irrigated cropland accounts for 89 percent of quality-impaired river mileage, and irrigated agriculture accounts for more than 40 percent of the pollution in impaired lakes (NRC, 1996a). Irrigation return flows are the most common source of pollution in national wildlife refuges (NRC, 1996a). Pollution from agrochemical runoff and spraying has jeopardized plant and animal biodiversity in the prairie potholes, threatening a region that provides more than half the North American waterfowl production (Power, 1997).

Agricultural Return Flow as a Point Source

When first passed, the Clean Water Act allowed EPA to view agricultural return flow water as a point source of water pollution that required a National Pollutant Discharge Elimination System permit (EPA, 1996). The logistical impossibility of permitting all such return flows led to EPA exempting through its regulations these return flows along with other point sources (EPA, 1996).

This led to a suit against EPA by the Natural Resources Defense Council challenging EPA's authority to create such exemptions via regulations (*Natural Resources Defense Council v. Train*, 396 F. Supp. 1393 (D.D.C. 1975), *aff'd sub nom. Natural Resources Defense Council, Inc. v. Costle*, 568 F. 2d 1369 (D.C. Cir. 1977)). EPA argued that it was infeasible to permit all the possible point sources, to which the Federal Circuit Court of Appeals said, if that is so the "remedy is with Congress" (*NRDC v. Costle* 568 F. 2d at 1383). Later that same year, the Congress provided the "remedy" by amending the term "point source" to exclude "return flows from irrigated agriculture" and further prohibiting EPA from requiring agricultural return flow sources to have a National Pollutant Discharge Elimination System permit (Clean Water

Act of 1977, Pub. L. No. 95-217, §33, 91 Stat. 1577 (1977) [codified at 33 U.S.C. § 1362 (14)(1994)]). The Congress again amended the definition of "point source" in 1987 to exclude "agricultural stormwater discharges" (U.S.C. § 1329 (b)(1994)). As nonpoint source pollution, these sources are outside the regulatory mandate of Clean Water Act. Instead, the Clean Water Act calls for states to develop their own "management programs" for nonpoint source pollution (U.S.C. § 1329(b) (1994)) but calls for no federal intervention beyond a report being filed with the Congress if a state fails to do so (U.S.C. § 1329 (b)(1994)).

The Effects of Irrigated Agriculture Drainage

The need to avoid the buildup of dissolved salts in soil of irrigated fields leads to the need for drainage of large amounts of water from fields (NRC, 1989). All water contains dissolved salts in varying degrees; so when water is introduced to a field through agricultural irrigation, it brings with it salts that are left behind when the water evaporates or is taken up by the plants (NRC, 1989). This can lead to a high level of salinity in the root zone of an irrigated field. This salinity will greatly decrease the viability of the field for crops if the salts are not removed (NRC, 1989). Most farm fields will have a drainage system in place that will enable the introduction of enough water to leach the salt from the soil; this leaching water must be drained away, or the soil will be waterlogged, and the water table will rise (NRC, 1989). This drainage water can be high in the salt content as well as in concentrations of other soluble material naturally found within the soil. The removal of soluble minerals from soil by water is a natural process that is greatly accelerated by the irrigation process (NRC, 1989). Any material added to the field such as fertilizer or pesticides may also be contained in this drainage

water. Natural drainage ecosystems will eventually bring the salt to the sea or perhaps to some closed basins. Human created basins are used to gather some of the drainage from irrigated agriculture. Just as the irrigation process accelerates the leaching of soluble minerals, the basins that collect this drainage have a greatly increased salt content along with the other material introduced via agriculture, such as phosphates, nitrates, and pesticides (NRC, 1989). This causes a severe and rapid deterioration of the water quality. As these basins gather the irrigation drainage waters, evaporation causes the levels of the dissolved materials in the waters to increase. In the arid western states, this process is accelerated further, due to high levels of soluble minerals in the soil.

Alternatives to Reduce or Avoid Irrigation Return Flow Pollution

Three approaches to reducing this type of pollution are by the management of irrigation at the source, treatment of the return flow water, and removal of the salt from the water prior to its use there by eliminating the need to flush them from the soil later.

Due to the high cost of the treatment of such a high volume of water, the removal of salts and dissolved minerals from return flow water is of limited feasibility. The removal of salt from the water prior to its use for irrigation has also been tried and was found to be costly, as well as producing a high salt content waste byproduct (NRC, 1989). Biological methods have also been looked at to remove particular pollutants. Certain fungi and other microorganisms that incorporate selenium into their energy cycles without any toxic response have been tested

for removal of this mineral from the return flow water. The feasibility of these methods on a large scale is unknown (NRC, 1989).

Source control can be accomplished by the retirement of land after the salt load from irrigation gets to a certain level. This reduces the import of salt into runoff water and also reduces the acreage of available farmland. Any subsequent use of the land would need to be assessed for the possibility of the introduction of these salts into any created runoff (NRC, 1989). Source control is also possible by irrigation management in the form of spray or drip irrigation. Recycling and diluting the water and the use of subsurface trickle technology can reduce the volume of drainage to under 10 percent of the amount of water applied (NRC, 1989). The drawbacks are that such technological systems, while increasing water use efficiency and crop yield, carry a high cost in terms of capital investment. Also, these methods do not solve the salt buildup problem but only delay the process, letting the land remain agriculturally active longer, yet requiring greater care per acre (NRC, 1989).

Disposal methods of solving the problem have also been looked into, such as ocean disposal and deep well injection (NRC, 1989). To dispose of the water in the ocean would present the possibility of creating water quality problems in transit, while also severely polluting the oceans. The volume of drainage water from agriculture makes the idea of deep well injection less feasible than this method is in the oil and gas industry (NRC, 1989). The water would probably require pretreatment to reduce volume, and the cost of these two processes make this a dubious choice at best.

It may be quite valid to say that the permit methodology under the Clean Water Act for point sources of pollution is inadequate for controlling the return flow of irrigation water. This does not justify not

addressing the issues associated with these return flows. Conversely, the recognition of the return flows as point sources would not alone solve the problem, or even guarantee a solution in the future.

The scope of the problem needs to be addressed by a comprehensive approach that is effective and feasible.

Another water quality problem gaining attention in recent years is the impact of concentrated animal feedlot operations (CAFOs), where large numbers of animals or poultry are grown for meat, milk, or egg production. Animal waste generated from these operations can be considerable. In the nation as a whole, there are 450,000 farms with confined (not pasture) feedlot operations (EPA, n.d.). It is estimated that dairy cattle produce 85 pounds of manure per day per 1,000 pounds of live weight. Thus, in 1 year, a 500-cow herd of 1,000-pound cows can produce about 7,750 tons of manure (EPA, 1998). Waste products produced at these facilities add significantly to the biological waste loads introduced into western rivers, groundwater, and lakes.

Animal manure typically contains nutrients (such as nitrogen and phosphorus), pathogens, salts, and heavy metals (such as copper) (EPA, n.d.). About 150 diseases can be contracted from drinking water or eating shellfish contaminated by animal wastes or by direct contact with such wastes (EPA, n.d.). Furthermore, livestock wastes can impact animal welfare by adding excess nutrients to aquatic habitats and spreading diseases to wildlife (EPA, 1996a). Contaminants from animal wastes seep into groundwater as well as flow into surface waters.

EPA considers pollution from smaller facilities as nonpoint source pollution but views discharges from CAFOs with more than 1,000 animal units as point sources subject to the National Pollutant Discharge

Elimination System permit program. Approximately 6,600 CAFOs meet this definition (EPA, n.d.), leaving the vast majority of feedlot operations outside the permitting requirement. EPA estimates that only 30 percent of the 6,600 CAFOs that are supposed to have obtained permits have, in fact, done so (EPA, 1998). A recent investigation by the EPA Inspector General recommended that the agency take action to streamline and strengthen the definition of CAFOs to ensure more adequate and equitable coverage nationwide. The agency has included CAFOs as a fiscal year 1998 national enforcement priority.

The Changing Political, Fiscal, and Legal Landscape

As we enter the 21st century, the competition for water is increasing faster than the ability of traditional federal and state governance structures to address the full range of conflicts in a fair, timely, and effective manner. There is increasing interest in river basin and watershed management, in part because it replaces centralized with more localized control, but also in recognition that existing governance institutions contribute to increasing delays and inequitable resolution of water resource issues.

We find ourselves in a situation today where cities seek more water; Native Americans seek to enjoy their reserved water rights; and states and basins continue to fight over interstate rivers and aquifers. State and federal water law exists to deal with these conflicts in a relatively structured and equitable fashion, but there is a complicating factor. Federal environmental mandates—especially the Clean Water and Endangered Species Acts—have placed federal agencies into the role of environmental regulator and manager. Moreover, these

Coordinating Federal Programs

The President's Northwest Forest Plan is an effort to resolve a very complex resource issue through the close cooperation and coordination of multiple federal agencies and programs. The plan provides excellent insight into the difficulty of program coordination at the field level across multiple jurisdictions. The following are excerpts from *The Northwest Forest Plan—A Report to the President and the Congress*, dated December 1996.

Various federal laws and executive orders have historically encouraged or directed agencies to work together to implement environmental laws. . . . Even with these . . . directives, achieving interagency coordination has been elusive and difficult for a variety of reasons; a major one is the way agencies were established and structured under law. Each department has different legislative mandates. . . . Each agency has its own budget. . . . These institutional factors alone can limit interagency coordination and collaboration.

Each agency's mission may overlap with those of other agencies or have completely different objectives. For example, land management agencies . . . share similar missions to manage federal lands for resource uses and to protect the environment; regulatory agencies . . . share responsibility for enforcing the Endangered Species Act.

. . . most [agencies] have tended to concentrate on their own mandates and responsibilities, generally viewing their missions as independent and of little concern to other government agencies. . . .

Implementing the Northwest Forest Plan would require the unprecedented coordination of seven departments and sixteen agency programs across three states. The Plan thus provides an ideal opportunity to serve as a model of how government agencies could work together to become more efficient, responsive, and effective.

Interagency coordination officially began on October 8, 1993, with the signing of the Memorandum of Understanding for Forest Ecosystem Management. . . . The document created several interagency groups that would be responsible to "develop, monitor, and oversee the implementation of the comprehensive forest management strategy for federal forests within the range of the northern spotted owl." The memorandum was signed by the Director of the White House Office of Environmental Policy, the Secretaries of the Interior and Agriculture, the Administrator of the Environmental Protection Agency, and the Under Secretary of Commerce for Oceans and Atmosphere. . . .

With the interagency committees established, implementing the Northwest Forest Plan began to move forward. The various committees began meeting regularly, creating new channels of communication, coordination, and cooperation between the agencies and with state, local, and tribal governments and the public.

The Initiative has been funded largely without additional appropriations for the participating agencies, though Congress has played a significant role in ensuring the availability and use of monies for certain programs within the region. Significant increases in USDA Rural Development (formerly Rural Development Administration, Farmers Home Administration) appropriations and accompanying base allocations to state operations were made between fiscal years 1993 and 1994. More than \$248 million were available in the Initiative's programs in fiscal year 1994; the amount available increased to more than \$268 million in 1995, and \$209 million in 1996. #

statutes are not integrated with state water law or federal Indian law. Federal environmental mandates intensify conflicts because they often overlay demands for substantial instream uses of water in

fully allocated basins, and they require other substantial environmental mitigation. The net result is widespread anxiety about the future direction of

federal water management. There are three basic reasons for this condition.

First, no single agency has the legal authority to implement comprehensive basinwide solutions to problems of a national scope. While the principal federal role is shifting from water developer to water manager, power is diffused among agencies. This situation is exacerbated by the federal government's decreasing funding devoted to water resources problems. Thus, historical federal policies put in place to promote water development for specific constituencies have been overlaid with environmental protection policies serving more diverse constituencies. Each of the major federal agencies is faced with redefining its role in an environment where there is no explicit agreement—at any level of government or among the agencies' old and new constituencies—about their appropriate missions. It is unlikely that the Congress will mandate radical changes in the activities of these agencies, but it is likely that budgetary pressures will force an increasingly focused re-examination of the appropriate federal roles related to western water use and management.

Second, the federal government is unlikely to expend the amounts of money on western water development that it has in the past. The original rationale for coordinated river basin planning has largely ceased as federal project development has been drastically reduced in the past 20 years. Federal involvement in western water historically involved constructing and operating federal water resources projects based upon substantial state input and participation. The agencies were able to form powerful alliances with user interests and congressional committees to secure new project authorizations and appropriations. Since the 1930s, coordinated federal water management has been the objective of most every administration and the river basin has been the desired management unit. The

historical purpose of these efforts was to provide a mechanism to decide which projects, from a larger list of potential projects, would be built and where. Likewise, cabinet-level coordination of federal water resources activities was proposed for the same reason. However, these efforts were only somewhat successful in achieving effective coordination.

A new reality exists today. The bipartisan commitment to balance the budget by 2002 suggests that it is likely that there will be fewer federal dollars allocated to water generally in future. While it is impossible to predict how the Congress will allocate available federal dollars in the future, we can only extrapolate from recent trends with this caveat—the long-term decline in new project starts, which began in the 1970s, will be unlikely to reverse in the future. Another trend is that more of the scarce federal dollars allocated for water will go to water quality rather than supply augmentation and project operation. Although more federal funds are being spent to maintain the environmental quality of rivers and to restore aquatic ecosystems, these are often being dispersed in a piecemeal, uncoordinated manner.

An analysis prepared for the Commission of the effects of the budget agreement between the Congress and the President on May 16, 1997, identified a slight increase (from \$281 billion to \$288 billion) over the following 5 years in nondefense discretionary spending. Table 2-6 shows a relatively flat nondefense discretionary budget over the past 25 years, while the total budget increased by nearly 80 percent in constant dollars

Water in the West: The Challenge for the Next Century

Table 2-6.—Water-related outlays in the President's February 1997 budget by agency
(\$ in billions)

	1997	1998	1999	2000	2001	2002	Percent change from 1997
EPA	3.6	3.7	4.0	4.1	4.2	4.1	14
Corps of Engineers	3.7	3.4	3.3	3.3	3.3	3.3	-9
Agriculture	1.2	1.0	0.9	0.9	0.9	1.0	-17
Bureau of Reclamation	1.0	0.8	0.9	0.9	0.8	0.7	-24
Other Department of the Interior	0.5	0.4	0.4	0.4	0.4	0.5	6
Other	0.4	0.4	0.3	0.3	0.3	0.3	-25
Total	10.3	9.8	10.0	10.2	10.2	10.0	-3

Water-related outlays in the President's February 1997 budget
(constant 1997 \$)

	1997	1998	1999	2000	2001	2002	Percent change from 1997
EPA	3.6	3.6	3.8	3.8	3.8	3.6	-1
Corps of Engineers	3.7	3.3	3.1	3.1	3.1	2.9	-20
Agriculture	1.2	1.0	0.9	0.8	0.8	0.9	-27
Bureau of Reclamation	1.0	0.8	0.8	0.7	0.7	0.6	-33
Other Department of the Interior	0.5	0.5	0.5	0.5	0.5	0.5	-7
Other	0.4	0.4	0.2	0.2	0.2	0.2	-34
Total	10.3	9.5	9.5	9.4	9.2	8.7	-15

Source: EOP Group analysis of backup data provided with the Budget of the United States government, fiscal year 1998.

(EOP Group, 1997). During the fiscal year 1998-2002 period, spending for water-related programs is reduced from \$10.3 billion to \$10.0 billion (table 2-6). Considering the effect of inflation, this represents a 10-percent reduction in nondefense discretionary funding and a 15-percent reduction in real spending on water programs. These reductions continue a trend that began in the early 1980s (EOP Group, 1997). These reductions are not evenly distributed but are generally absorbed in the civil works and water supply programs. For instance, in real dollars, the Corps, USDA, and Reclamation water resources programs are down 20 percent, 27 percent, and 33 percent, respectively, while the EPA budget remains constant

(EOP Group, 1997). The analysis shows that spending for water supply programs in constant dollars is about 50 percent of what it was in the early 1960s, and this downward trend is expected to continue. By 2002, water supply dollars will constitute less than 10 percent of the water budget (EOP Group, 1997).

Third, the legal mandates of the regulatory agencies often preclude them from making the tradeoffs necessary for comprehensive solutions, and thus prolong conflicts. Regulatory agencies, especially the environmental ones, are often reluctant to compromise with other agencies and interests out of a legitimate concern that a third-party lawsuit will

conclude that the agency acted illegally. The most potentially successful basinwide solutions that the Commission studied, such as the CALFED Bay-Delta program, substitute physical solutions and risk management for the strict enforcement of entitlements and the full assertion of federal regulatory authority.

Throughout the West, the federal water agencies are caught in a fundamental paradigm shift which affects their ability both to fulfill their traditional missions and to adapt to new missions. A consistent theme in both the citizen presentations and the studies prepared for the Commission is the lack of coordination within and among federal agencies. Part of the lack of coordination reflects the difficulties of adapting traditional agency missions to new demands. Agencies are creatures of the Congress and must administer the programs the Congress has put in place. Most existing river basin plans were put in place to provide for new development or to manage existing facilities for the four major uses—irrigation, municipal and industrial, hydropower, and flood control. With the exception of the Northwest Power Planning Council, historic river basin entities were not designed to address the full range of modern uses and functions of river systems. Today, federal agencies often lack the legislative mandate, the budgetary flexibility, or the political support needed to rapidly respond to these new interests within the basin and watershed management units. For example, on the Missouri, the Corps is the de facto river basin agency by virtue of its control of the Pick-Sloan reservoirs. The Corps has made some attempts to accommodate new uses (Thorson, 1994) but has not been able to completely reflect the full range of basin interests given the lack of clarity in statutory language and the lack of consensus to make certain operational modifications.

The performance of federal agencies charged with water management is the subject of intense and

justifiable concern at the present time. The basic criticism is that water resources decisionmaking is gridlocked. Throughout the West, there is an urgent sense that water resources decisionmaking must be reformed before successful, consensus-based, sustainable water use policies can be formulated and implemented. "Gridlock" may be an overly sensational metaphor, but it captures the basic problem. Multiple federal agencies with multiple, often conflicting, mandates make it very difficult to solve problems that require a balance among an expanded number of competing interests. Federal agencies are not the sole reason for the gridlock, but the absence of a governance mechanism to address the fragmentation of power within the federal government fuels conflict rather than consensus and, thus, contributes significantly to the problem

There are successful examples of gridlock apparently having been overcome. In the CALFED Bay-Delta process, the state of California, the federal agencies, the major water users, and other stakeholders, motivated by a desire to avoid both lawsuits and unilateral federal enforcement of water quality standards, are working together to develop consensus-based technical and institutional solutions which will both protect a vital and sensitive ecosystem and meet statewide demands for reliable water supplies. However, the Bay-Delta resolution also required the intervention of federal officials who were willing to take risks to forge an agreement. The sustainability of these ad hoc consensus-based processes has not yet been proven.

Several factors, discussed below, account for today's gridlock, including:

- Competing legislative mandates
- A shrinking pie
- The rise of nongovernmental organization litigation

- The role of state water rightholders

Competing Legislative Mandates

Civil works agencies, like Reclamation and the Corps, historically were directed to pursue water development with a focus on regional economic development and with little regard for impacts on natural ecological systems including native species. This was the public agenda for more than half of the century. In the 1970s, the environmental movement raised the nation's awareness of these values and interests that had been subordinated in the pursuit of economic growth, including water development. The Congress responded by passing a series of public laws that provided for resource protection (the Endangered Species Act and the Clean Water Act), and for public involvement and informed decisions (the National Environmental Policy Act). The Congress also created an agency to enforce some of these laws (EPA) and empowered others with new authorities (e.g., the Fish and Wildlife Service, the National Marine Fisheries Service, the Corps of Engineers). This achieved the purpose of slowing the pace of development and forced development to address difficult environmental issues. Thus, one person's "gridlock" is another's "appropriate balance."

Today, there are a number of federal, state, tribal, and local agencies with competing interests and missions related to water, but none with a sufficient political or legal mandate to override the concerns of the others. This means that implementing any proposal, for almost any purpose, requires working through a complicated web of laws, regulations, and constituencies. This is the fundamental result of distributed power and authority.

A Shrinking Pie

Modern water resource disputes are increasingly seen as zero sum rather than positive sum endeavors. In most modern river basin conflicts, the issue is not how to expand the benefits to each group, but how increased risks will be shared among the stakeholders. As we move toward adaptive management, the risks assumed by all stakeholders in a basin or watershed often are increased by new management initiatives. Water rightholders may face increased risks that previously expected flows will not be available in drought years; environmental interests must accept that altered flow patterns and other measures may not achieve targeted environmental objectives. To make risk sharing attractive and fair, substantial amounts of money will often be needed for water infrastructure construction, management, and monitoring, and perhaps for transfer payments. The federal government will no longer be the sole source of these necessary funds. Thus, conflict resolution will require not only consensus about how risks are to be shared but also about how the financial burden will be shared. It will be harder to reach agreements in these situations than it was in the past when there were only a limited number of participants, each receiving increased benefits.

The Rise of Nongovernmental Organization Litigation and Participation

Prior to the environmental decade of the 1970s, it was very difficult for nongovernmental organizations to sue federal agencies over the way they carried out their legislative mandates. Today, however, more liberal rules of standing make it easier for nongovernmental entities, as well as project beneficiaries, to sue government agencies.

The National Environmental Policy Act and other laws have opened decisionmaking processes to new voices and new ideas. Agencies must consider more data and more alternative courses of action than they did prior to 1970. These laws make it much easier to attack decisions as procedurally flawed. Lawsuits or the threat of lawsuits have both positive and negative impacts. Sometimes a lawsuit is necessary to force interested parties to the table. In other cases, lawsuits impede consensus-based and balanced solutions.

The Role of State Water Rightholders

Many proposed solutions to basin and watershed conflicts require that all stakeholders bear a portion of the risks associated with the solution. This is often unattractive to state water rightholders. Their response is to insist that any change must fully protect vested water rights. Both state and federal governments can condemn water rights, but the costs are often prohibitive. In addition, many states have undertaken McCarran Amendment adjudications. These adjudications have proved to be long and costly and have not yet produced the desired quantification of existing rights. The more uncertain rights are, the more water rightholders resist participation in conflict resolution processes because of concerns that claimed rights will be diminished.

Conclusion

The demographic and economic trends described in this chapter, and the decline of political support for additional large-scale federal water projects, suggest that the West will have the following characteristics in the future:

- **Continued urbanization**, characterized by continued growth of the large oasis urban centers, as well as the growth of smaller regional centers as communities continue to diversify their economies. Commodity production is declining as a proportion of the West's economy, although it remains an important source of employment in most rural counties. The West is increasingly a service economy, with expanding jobs both in the lower-paying consumer services sector and in the higher-paying "knowledge-based" professions.
- **Stabilization of irrigated agriculture**, which will become more concentrated in areas such as the Central and Imperial valleys of California, the Yakima valley of Washington, the Snake River Plain of Idaho (all areas in which high-value crops are grown), and Nebraska's portion of the Ogallala aquifer (where there is less intense competition from other water uses). However, even in these areas there is likely to be some reallocation of water, as indicated by the fact that agricultural demands for water have been declining while population growth has accelerated. Additional irrigation expansion may also occur in some regions, such as the Upper Colorado River basin and on American Indian reservations. Various global climate change scenarios create additional uncertainties about the historic availability and distribution of seasonal supplies.
- **Re-evaluation of the role of the federal government**, which will be stimulated by the widespread recognition that its historical mission of western settlement has been fulfilled. Today's rapid population growth in the region is much more closely linked to the natural amenities of the West—climate and landscape—than to the federally subsidized

water infrastructure. And, while urban, suburban, and exurban growth patterns result in significant changes to the landscape, a national policy favoring fundamental modifications to the western landscape no longer seems necessary. Moreover, the

continued subsidization of water prices conceals the true cost of providing water to alternative uses and favors consumptive over nonconsumptive uses of water. The federal role in water resources will be to manage and adapt the reclamation and flood control systems that were constructed in this century.

- **Reallocation of existing water supplies to meet new demands**, although water supply augmentation will continue to be an option.

Reallocation may occur through such means as water marketing and conservation. Systems of incentives will evolve under existing or modified laws in response to the need to satisfy new demand. However, the assumption that states and urban water suppliers have a legal or moral obligation to provide water to support unlimited urban growth is being challenged.

- **Concerns expressed over the equity issues raised by changes in water use**, as exemplified in expansions in public interest review, area-of-origin protections, and community-based approaches to resource management. Far more interests than ever before are demanding to be heard in every water management decision.

Figure 2-2

The ratio of reservoir storage to annual water supply in parts of North America (modified from Collier, et al., 1996). The western United States and south-western Canada have the most extensive reservoir development relative to available water supply. More dams have been constructed in the Columbia River basin and in the Tennessee Valley (neither are shown), but these basins have higher water yields. Many of the largest problems with downstream effects of reservoirs are in the basins with the highest ratio of reservoir storage to annual water supply because dam operations are constrained more in those basins.

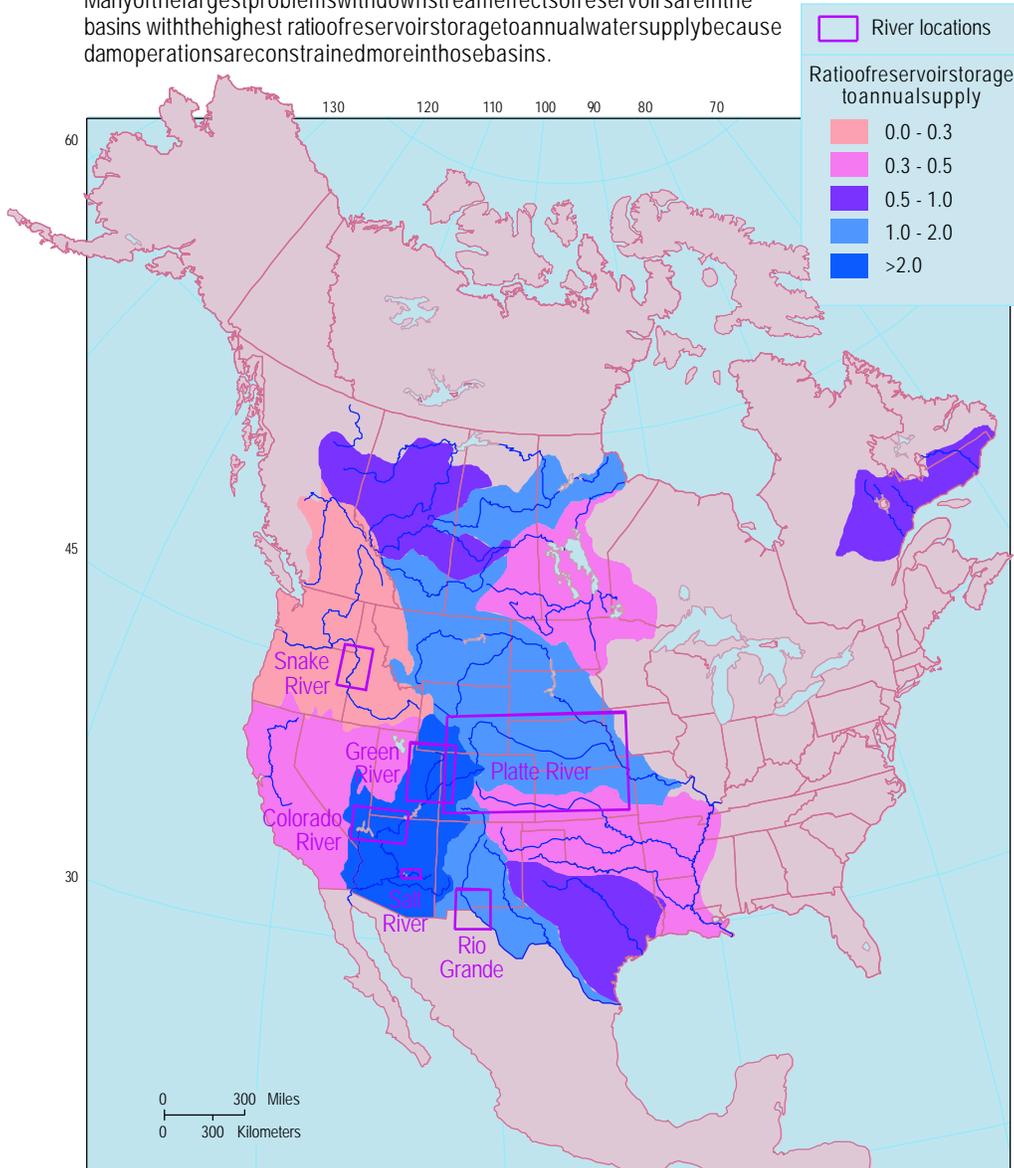
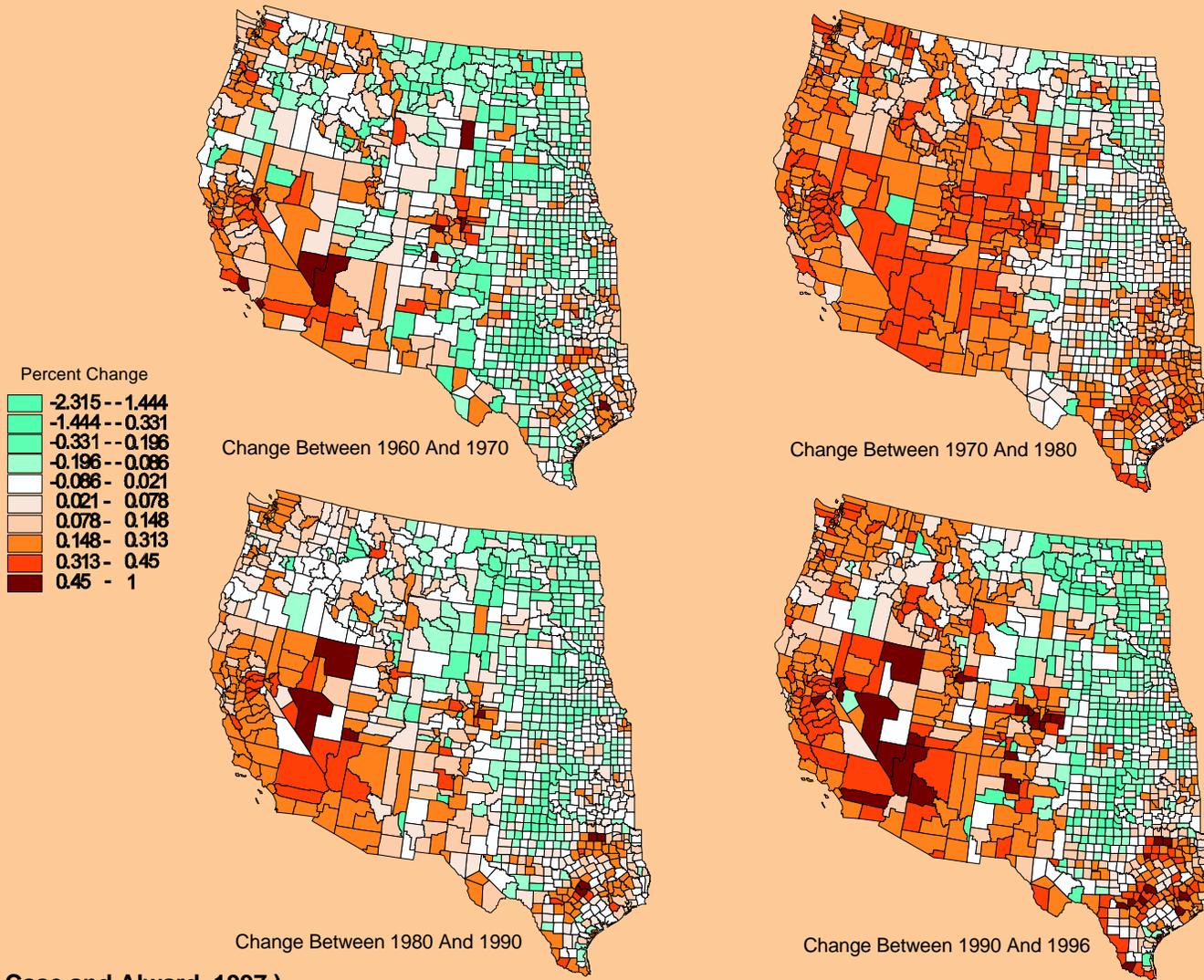


Figure 2-4.—Recent Population Change In The Western States



(Source: Case and Alward, 1997.)

Figure 2-5.—Recent Patterns Of Demographic Movement In The West

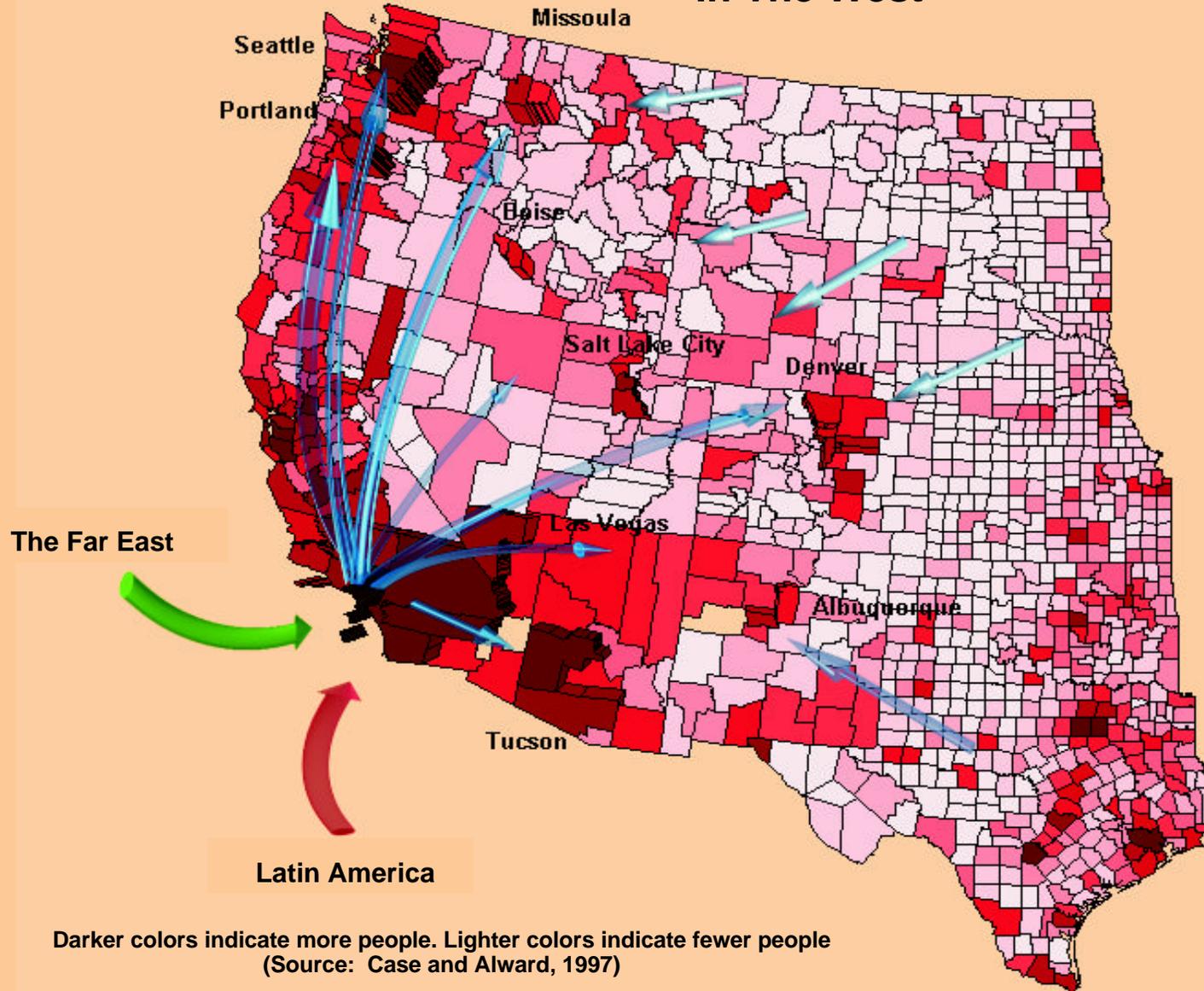
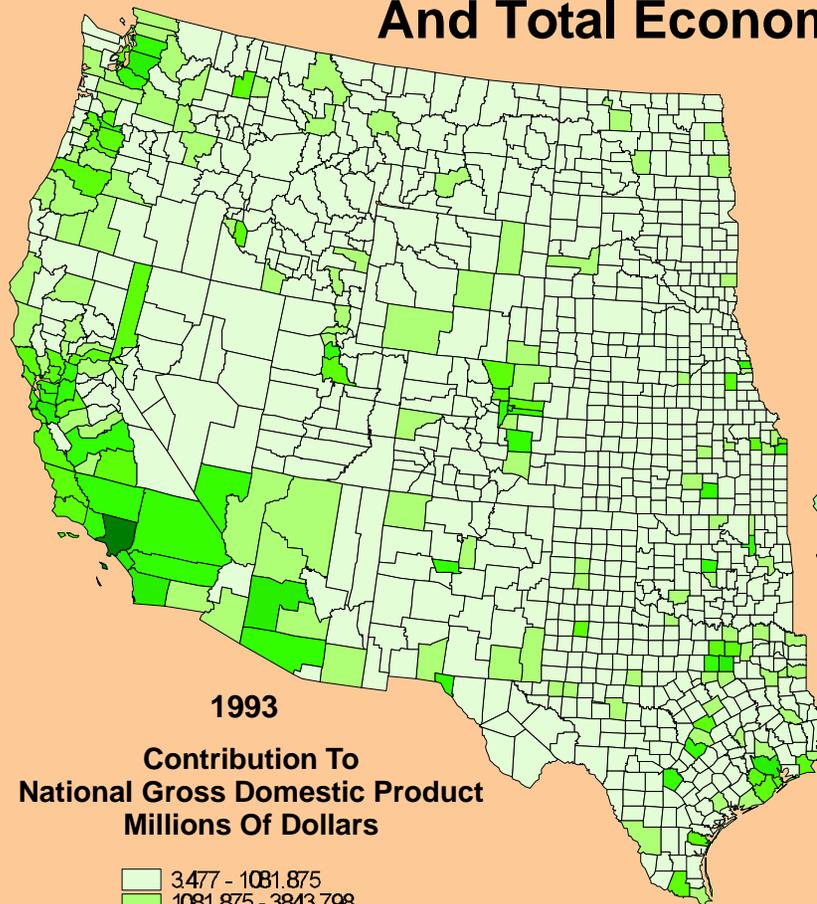
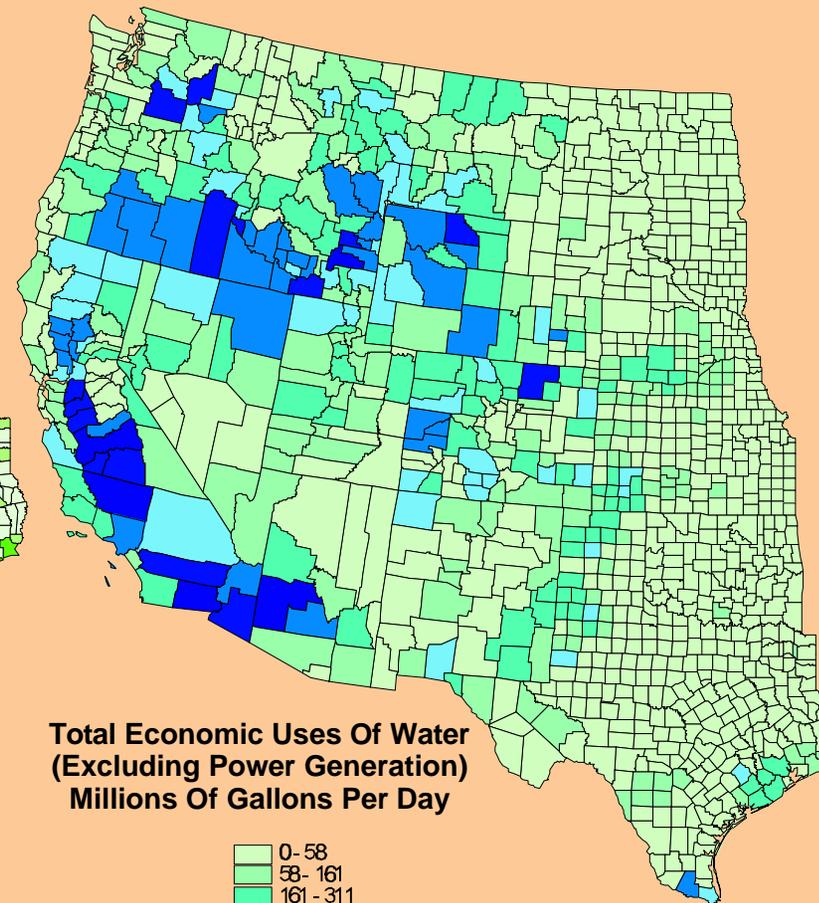
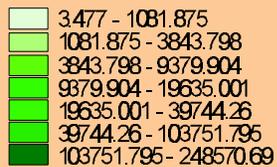


Figure 2-8.—Comparison Of Contribution To Gross National Product And Total Economic Use of Water

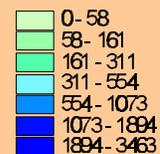


1993

**Contribution To
National Gross Domestic Product
Millions Of Dollars**

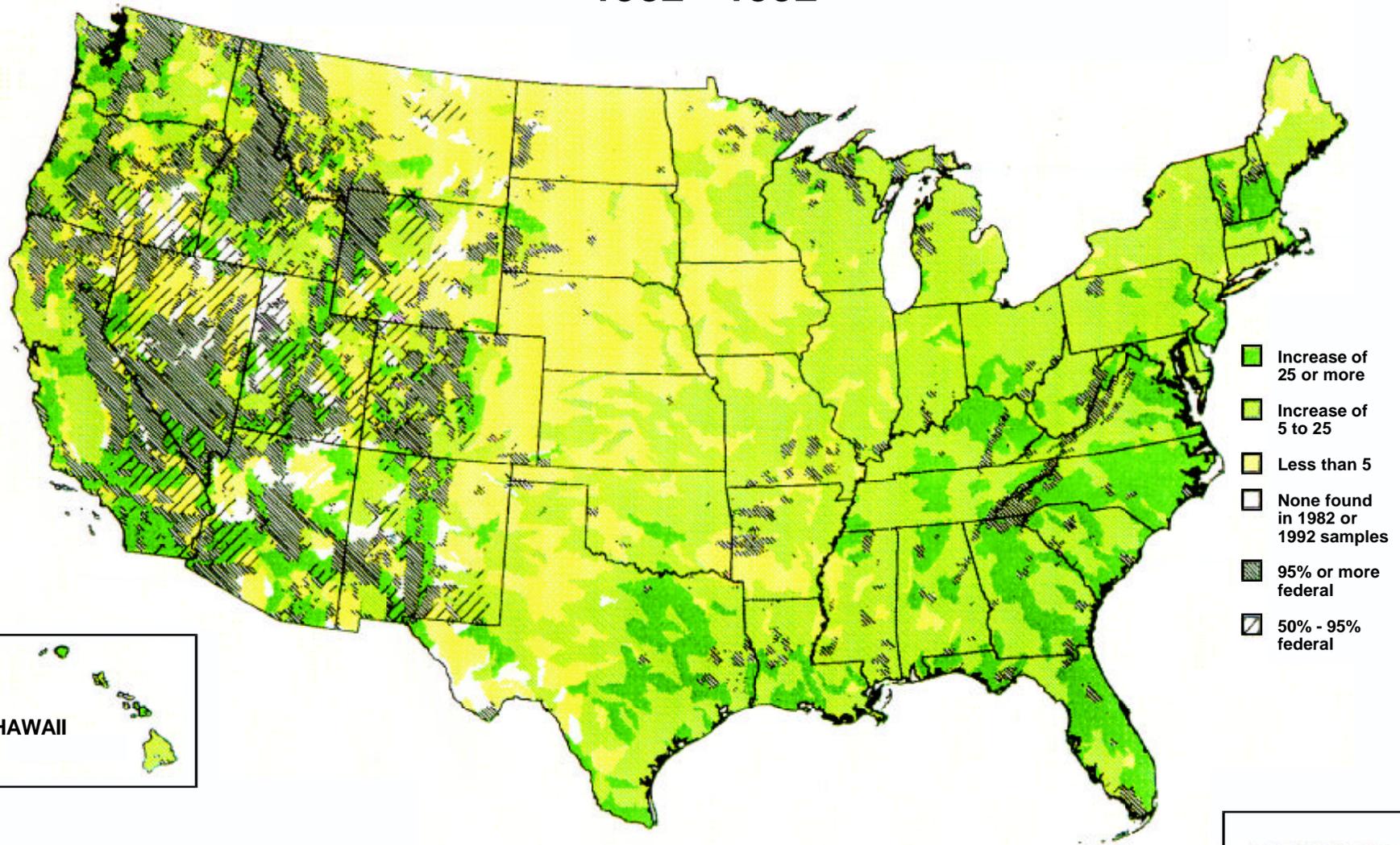


**Total Economic Uses Of Water
(Excluding Power Generation)
Millions Of Gallons Per Day**



(Source: Case and Alward, 1997.)

Figure 2-13.—Percent Change in Developed Land Area, 1982 - 1992



HAWAII

Data Source : 1992 National Resources Inventory, USDA, National Resources Conservation Service. (Source: Riebsame, 1997.)

Map I.D. D801288

PUERTO RICO and VIRGIN ISLANDS



The Key Challenges Facing Western Water Managers

Chapter 2 described how the West has been changing and the forces that are affecting both the water resources and the way water is managed. The pressures of rapid population growth and changing economies, coupled with degraded aquatic systems and unmet tribal water rights and needs, present western water managers with considerable challenges for achieving sustainable water use. This chapter analyzes the challenge of sustainable water management, exploring the range of options water managers may want to consider for the future.

Sustainable Water Management: The Overall Challenge for the Future

The Western Water Policy Review Advisory Commission's central message is that all of the West's available water supplies must be sustainably managed to ensure that adequate resources are available for future generations. Water managers face the challenge of devising sustainable use strategies that both accommodate consumptive demands and maintain the essential geomorphic and ecological functions of hydrologic systems. This will require, among other things, a fundamentally new approach to governance.

The Commission focused its efforts on the ultimate questions: "Are the current uses of water and water-related resources sustainable and, if not, what

institutional changes will enhance sustainable management?" Sustainable development is a difficult concept to define and no consensus definition exists (Meyers and Muller, 1988).¹ There is, in fact, debate about the utility of the concept as a basis for water policy. Nonetheless, the Commission chose to use the concept because sustainability is gaining acceptance as both an international and domestic norm against which to measure resource use choices.

In this report, we use the definition of sustainable development from the 1996 Report of the President's Council on Sustainable Development, which is, "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (President's Council on Sustainable Development, 1996). As applied to water resources, the core idea of sustainable use and development is that all resource management decisions must give adequate weight to accommodating both consumption and conservation as well as to the legitimate role of equity considerations. For example, the major lesson that John Volkman drew from his study of the efforts to balance competing resource demands in the Pacific Northwest is that, "[s]ustainable development requires us to understand that economic need and

¹ See this article for a summary of the debate about the meaning of sustainable development.

environmental consequences cannot be addressed separately. . ." (Volkman, 1997), and this theme runs through this report.

We echo the admonition of the President's Council that "[e]conomic prosperity, environmental quality, and social equity need to be pursued simultaneously" (President's Council on Sustainable Development, 1996). Both internationally and domestically, sustainable development serves as a bridge between the diverse elements of the water use community and provides the basis for common dialogue and problemsolving. As Sandra Postel has written, we need a water ethic that is

. . . part of a sustainable development code that entails a wholly new approach to economic progress, one that harmonizes economic goals with ecological criteria (Postel, 1997).

The challenge for the future is to manage the West's water in a way that sustains both prosperous cities and viable rural areas, allows Native American reservations to participate more fully in the prosperity of the region, and promotes and enhances healthier aquatic ecosystems.

Sustainable water resources management builds on the long tradition of state and federal water management to conserve water and apply it to a wide range of beneficial uses, but the achievement of sustainability also presents new challenges for which past management practices and institutions often provide limited guidance. Water development has been essential to the development and continued prosperity of the West. However, many of our current water management practices are not sustainable. The equity claims of many Native American tribes remain unfulfilled. Unsustainable groundwater mining continues to exist in part of the West. Many of the West's streams are vulnerable to pollution from a myriad of insufficiently controlled nonpoint sources. Many native fish species are near extinction due to a combination of natural factors,

altered riverflows, and watershed land use practices. Small communities that have practiced, or are capable of practicing, sustainable resource management are converting their land and water to meet the demands of higher population growth. Current land use practices and flood control policies are inadequate to prevent rising flood damage levels, and they can contribute to the degradation of aquatic ecosystems. In sum, many western water uses are not sustainable, and the path to sustainability poses many difficult challenges.

Establishing a New Baseline

To achieve sustainable water uses, we need to define hydrologic baselines for individual basins and watersheds that reflect the full range of valued water uses, including ecosystem uses. We also need to include tribal water rights in that baseline. Federal environmental laws provide a rough set of standards against which aquatic ecosystem health can be measured, but they must be supplemented by state, tribal, local, and private initiatives to bring about ecosystem restoration. Interested parties in the basins and watersheds must be effectively empowered to chart a sustainable future by defining resource goals and developing programs to achieve those goals.

There can be no uniform definition of sustainability because the mix of consumptive and nonconsumptive uses and the condition of the aquatic environment differ among the various basins and watersheds. Sustainable water management is inevitably basin and watershed specific and will require different management strategies. For example, some basins may require substantial new water supplies for urban uses, while others may need more water for agriculture. Still others may be more concerned with improving flows for fish and wildlife purposes. These supplies may require new storage capacity, but new water projects are likely to be smaller and selectively constructed.

Nonstructural solutions will be increasingly emphasized as a management strategy for both flood control and the satisfaction of new and existing consumptive and nonconsumptive demands.

In addition to surface flow management, we need to manage our groundwater better to balance withdrawals with recharge over defined time periods and to recognize the interconnection between groundwater pumping and base flows. We also need water prices that reflect the increasing scarcity value of the resource. We need greater investment in aquatic restoration and aquatic species recovery so that sustained biodiversity will be an integral part of all future water policy decisions.

Building Partnerships for Basin and Watershed Management

The transition from the water project construction era to the era of more effective use of existing water storage and delivery systems has influenced the role of the federal government and the relationship between the federal government and the states. The traditional federal water management agencies still play a major role in western water management, but this authority is now much more broadly shared within the federal establishment. The federal agencies have fewer funds for construction, although in some cases restoration funding is increasing. Federal authority is increasingly regulatory. Agencies often are confronted with the paradox of regulation: agencies must refrain from the full exercise of their regulatory authority in order to maintain their influence with key political constituencies. As an evaluation of the use of Endangered Species Act to induce multispecies conservation plans noted

... [i]n order for this approach to work, the threat of an endangered or threatened species listing must be close enough to motivate landowners to participate in a voluntary effort

to conserve habitat, but not so close that species might actually be listed before the voluntary program can get off the ground (Welner, 1995).

The federal government has been experimenting with a number of partnerships. Partnership federalism is characterized by federal participation in federal-state-local stakeholder teams that are designed to develop mutually acceptable solutions to problems such as longstanding conflicts between competing entitlement holders. Partnership federalism will be a critical feature of any new basin and watershed governance process. Past attempts to create basin and sub-basin management units have been top-down federal efforts to impose coordinated and comprehensive management along geographic lines—often over the opposition of interested states, water use constituencies, and federal mission agencies. Water and related land uses were subject to separate, rather than integrated, decision processes, and consumptive uses were generally preferred to nonconsumptive ones. The fragmentation of federal agencies with overlapping but different missions often led to gridlock rather than consensus.

More Players, Less Federal Influence

Today, there is a great interest among water users, basin and watershed communities, other stakeholders, and government agencies in the creation of new river basin and watershed governance mechanisms. Sustainable water management will require new institutions at the basin and watershed level that can resolve problems with less reliance on large federal investment or involvement. The role of water and the institutions that manage it have been changing rapidly in the past two decades because of an expanding list of uses that now compete for available supplies, and because of governmental and nongovernmental interests that seek a place at the table where important water management decisions are made. One of the most striking changes between water

resources management at the end of the 20th century and water management at the time of the last national commission in 1973 is the increase in the number of players and the diffusion of legal authority and political power among the players. Through the 1970s, state water agencies interacted with the two major federal water development agencies to allocate the West's rivers. The public was primarily concerned with the delivery of reliable supplies of water for major consumptive uses, along with the assurance of adequate instream flows for power generation. Less attention was given to how the water was used by the end user and the consequences of that use.

For these reasons, sustainable water management requires that past policies, institutions, and practices be modified to include government, users, and other stakeholders in important decisions about how water will be used. We agree with the conclusion of the President's Council on Sustainable Development (1996) that sustainable development requires movement away from sole reliance on command and control to more inclusive, experimental forms of governance:

Partnerships and collaborative decisionmaking must be encouraged and must involve all levels of government, business, nongovernmental organizations, community groups, and the public at large.

Partnerships are a source of shared responsibility. There is a need to turn water issues from zero- to positive-sum games, to mobilize public and private collaborative efforts, and to find ways to mobilize new sources of public and private investment in the solutions to water management problems.

The Commission views sustainable development as an ongoing, inclusive, basin- and watershed-based process that adapts general norms, reflected in the general principles adopted in this report, to specific basins and watersheds. To do this fairly and

effectively, we need new governance processes that better enable the federal government to both lead and support state and local sustainable development initiatives. The Commission concluded that sustainable development can only be achieved in the context of a new vision of river governance which combines both top-down and bottom-up management. Once basin standards have been set in the appropriate forum, implementation of these standards should be accomplished at the lowest level at which authority and responsibility can be exercised effectively.

The core challenges western water managers face in achieving sustainable use of the West's water resources are:

1. The sustainable use of existing supplies: balancing consumptive and nonconsumptive uses of existing water resources, including the problem of overallocation of supplies, groundwater overdraft, the augmentation of supplies, and using supplies more efficiently.
2. Modifying operation of existing federal projects to better address current and future needs.
3. Improving the mechanisms of governance, including linking the management of river basins and watersheds and creating new federal-state relationships.
4. Meeting obligations to Indian nations and tribes.
5. Protecting and restoring the environment, including aquatic ecosystems and water quality.
6. Protecting productive agricultural communities.

These challenges are discussed in subsequent sections of this chapter.

The Deschutes River Basin Resources Conservancy

The Deschutes River Basin is a poster child for the problems and opportunities associated with the 1990s version of settlement of the West. Its rapid transformation includes several key elements: (1) population is exploding as immigrants seek to improve the quality of their working and recreational lives; (2) timber, agricultural, and ranching communities find themselves under assault as longstanding practices are questioned by the Northwest's changing interests and values; (3) many of these new interests and values are ironically driving substantial growth and development in the basin's recreational, residential, and industrial sectors; (4) collapsing Columbia River salmon runs are mirrored in the Deschutes Basin, where ocean harvesting, hydroelectric development, and land use practices have helped push runs to near extinction; (5) the crazy quilt of federal, tribal, state, and private lands presents both problems and opportunities in land management; and (6) despite the adoption of myriad resource plans—42 at last count—important environmental trends continue in the wrong direction (Big River News, 1997).

One effort to protect and restore the fisheries and other natural values of the Deschutes River while supporting sustainable local economies is the Deschutes River Basin Conservancy (DRC). The DRC grew out of an effort by the Confederated Tribes of the Warm Springs Reservation and the Environmental Defense Fund (EDF) to improve riverflows and water quality in the Deschutes River, while seeking to put tribal and other resource industries on a more sustainable basis. In 1992, the tribes and EDF convened the Ad Hoc Deschutes Group (Group), a forum of 14 members representing all economic sectors in the basin. The Group oversaw assessment of

basin resources and development of a report describing incentive-based approaches to addressing basin problems.

The Group developed pilot projects to improve the efficiency of agricultural water distribution systems. Half of the saved water was dedicated to instream flows, the rest to farming operations. The Group also leased water for instream flows.

In 1996, the Congress passed legislation authorizing up to \$1 million per year in federal matching funds, through 2001, for projects undertaken by the Group, now chartered as a private corporation, the DRC. The DRC's board of directors includes members of the basin's cattle, agricultural, environmental, recreational, tribal, hydropower, and land development communities. In addition, the DRC has members from USDA and Interior, the Oregon Water Resources Department and Fish and Wildlife Commission, and four sectors of basin city and county government (DRC, 1997-98).

The DRC story illustrates an important process: one or two interests begin to work together to address local resource issues; they solicit participation from a wider group of interests and begin to solve some important problems; their positive approach and results attract state, federal, and congressional support, leading to formal recognition and funding. This process is typical. As local groups reach out and garner wider participation and trust, agencies and political leaders realize that these groups can resolve problems the agencies cannot and begin to invest the groups with legitimacy, agency support, and resources. #

The Sustainable Use of Existing Supplies

Overallocation of Surface Water

Sustainable development requires a new balance between consumptive and nonconsumptive uses. This is difficult to achieve because surface supplies often are fully appropriated under state law. However, there is an increasing appreciation of the need to maintain more natural river and aquifer flow patterns to support wildlife and to maintain such landscape functions as upstream floodwater retention and natural filtration. One of the more striking developments in the past two decades is the increased recognition of the importance of nonconsumptive uses. Historically, nonconsumptive uses were what was left over after consumptive demands were satisfied, but their importance is becoming better understood as we try to maintain and restore degraded aquatic ecosystems. We are struggling with the task of accommodating new consumptive water needs with consumptive water uses. We are beginning to define the baseline flows necessary for operative ecosystems.

Full allocation is not an absolute barrier to more integrated water management. The major lesson of the six basin studies done for the Commission is that consumptive and nonconsumptive uses can be accommodated within the framework of existing rights by more inclusive and creative risk-sharing processes. Water users require dependable water supplies, but they have always faced some risk of supply failure. The law of prior appropriation is designed to allocate water in times of shortage, not to guarantee full supplies. Combinations of physical solutions, conservation, and voluntary transfers can sometimes induce parties to accept increased but acceptable and controlled risk levels in the interest of basinwide solutions. In contrast to judicial processes, which continue to approach water rights conflicts as disputes to be resolved by general

principles of water law, nonjudicial processes can focus on identifying problems which require comprehensive, widely accepted solutions that share the risks more equitably. The narrow legal decisions produced by adjudication focused only on determining water rights illustrate the need to approach problems from a basin or watershed perspective in order to devise fair and effective solutions.

Groundwater Overdraft

Achieving sustainable groundwater use is one of the major water management challenges facing the West. This is primarily a state rather than a federal responsibility. Even though it is widely understood that ground- and surface-water resources are interrelated, most states continue to manage ground and surface water by different legal regimes. The majority of the western states administer surface waters under the doctrine of prior appropriation or by a mixed appropriative-riparian system. However, groundwater governance regimes display less uniformity and are typically far less well defined, making it more difficult for states to manage limited supplies.

Some western states subject groundwater use to prior appropriation and make some attempt to integrate the priority of use with surface water rights.

New Mexico, for example, has a long tradition of integrating ground and surface rights. Others do not. Three of the largest groundwater-using states—California, Nebraska, and Texas—do not allocate groundwater by the law of prior appropriation or acknowledge the potential for groundwater uses to deplete surface supplies. The net result is that state laws commonly allow groundwater overdraft—the depletion of an aquifer at a rate faster than the natural rate of recharge. However, as a recent National Academy of Sciences study indicated, "most decisions regarding groundwater

The Henry's Fork Watershed

The Henry's Fork Watershed in eastern Idaho and western Wyoming encompasses 1.7 million acres and more than 3,000 miles of rivers, streams, and canals. High mountain streams and warm natural springs form the headwaters of the Henry's Fork of the Snake River, which flows through deep canyons as it descends to the agricultural land of the upper Snake River Valley. This rich watershed supports 40,000 residents; 235,000 acres of irrigated farms; healthy populations of fish and wildlife, including several threatened and endangered species; and high-quality recreational experiences.

Over the years, the Henry's Fork has been subject to increased and competing demands to meet irrigation needs, hydropower requirements, and instream flow needs for fisheries and recreation. In 1993 the Idaho legislature passed the Henry's Fork Basin Plan to address these issues. As a result of the Plan, new developments such as dams, diversions, and hydropower projects were prohibited on 195 miles of the Henry's Fork and its tributaries. In order to implement the recommendations and achieve long-term goals in the basin, an innovative, consensus-building process was sought to include all parties with interests in the watershed.

In 1993 citizen and agency representatives began to craft a new approach to reconciling watershed issues in the Henry's Fork Basin. The various interests recognized the importance of working together as a rural community to resolve the ecological problems in the watershed and to work toward a sustainable future. In 1994 the Henry's Fork Watershed Council was organized and chartered by the Idaho legislature. The Council is comprised of citizens, scientists, and agency representatives who reside, recreate, make a living, or have legal responsibilities in the basin, thus ensuring a more collaborative approach to resource decisionmaking.

The Council is cofacilitated by the Fremont-Madison Irrigation District and the Henry's Fork Foundation. Council duties include cooperating in resource studies; reviewing proposed watershed projects and basin plans; suggesting implementation priorities; identifying and coordinating funding sources for research, planning, implementation, and long-term monitoring programs; and serving as an educational resource to the legislature and the general public. The Henry's Fork Watershed Fund was established by the state of Idaho to help fund projects in the basin and to defray Council administrative expenses.

Other Council efforts include installing the Buffalo River fish ladder, fencing riparian habitat, cleaning out culverts, investigating the use of hatchboxes on designated creeks to reestablish trout spawning, protecting native cutthroat, determining the feasibility of reconnecting tributaries to Island Park Reservoir, and facilitating recruitment of young fish into Island Park Reservoir. #

This discussion was drawn from <http://www.ser.net/~henrys/council2.htm>.

development, use, or protection are made with inadequate attention to the value of groundwater as a source of consumptive use and for the *in situ* services it provides" (National Research Council [NRC], 1997a). The tendency to undervalue groundwater use is magnified because groundwater supplies generally are deemed superior to surface water supplies in terms of public health protection, technical simplicity, economy, and public acceptance.

The tendency to undervalue groundwater presents the following challenges:

- Groundwater is often used in excess of the rate of recharge. Overdraft may be a rational strategy in certain circumstances, but states should engage in a careful analysis of the costs and benefits of the choice.
- The lack of integrated administration of ground and surface water often means that groundwater use conflicts with efforts to maintain base streamflows.
- Most states do not integrate groundwater quantity and quality considerations, although some states are beginning to do so.
- Excessive groundwater extraction can cause subsidence in the land overlying the aquifer.

Increasing Supplies and Yield

Federal involvement in western water rested on three basic assumptions that have historically driven western water policy:

- Federal water subsidies were necessary to sustain western rural economies.

- Supplies should be augmented wherever necessary to meet new demand.
- Urban and agricultural development should not be limited by water availability.

Today, each of these assumptions is being challenged as unsustainable. These challenges have profound implications for both water law and the federal agencies that have been created to manage a large percentage of the West's waters. Water allocation and management institutions have not adapted fully to the changing conditions in the West, but they are in the process of adaptation. The challenge for the future is to find more sustainable means of meeting the demand for new supplies. Meeting this challenge will require attention to more innovative technologies for storage and conservation, demand management, and increased reliance on water marketing.

New Forms of Supply Augmentation

Sustainable development will be an evolutionary process that will modify existing water supply strategies and add new ones to the policy menu. Supply augmentation is an example of this potential evolution. Sustainable water management may well require supply augmentation to meet both consumptive and nonconsumptive demands, but the number of economically and environmentally feasible engineering and institutional options are more constrained than they were in the past. In addition to traditional instream dams and reservoirs, new options include different forms of storage, such as offstream reservoirs, the conjunctive management of surface water and groundwater through underground storage, and reservoir enlargement. Financing the necessary supply augmentation may be difficult in the future because fewer federal dollars will be available, which may influence the supply augmentation options that are pursued.

Water Storage and Conveyance

Additional storage reservoirs and transmission facilities and the enlargement of existing reservoirs and extension of existing conveyance features will be a part of future water management. For example, Oregon's 1992 water storage principles recognize the role of storage in providing water resource management flexibility and control in the face of increasing demand and seasonal shortages (WSWC, 1997). However, the nature of the new projects will be different from the past. Most western states recognize the need for additional water development to meet future demands, primarily for municipal or industrial use and water quality management, but they also recognize that large projects will be very limited. New storage will be smaller in size compared to past federally constructed facilities, and new offstream surface water storage is more likely to occur than onstream storage.

California now has under construction two new offstream storage facilities—Eastside Reservoir in Riverside County and Los Vaqueros Reservoir in Contra Costa County. The \$1.9 billion Eastside Reservoir Project, including the 800,000 acre-foot Eastside Reservoir, will provide a 6-month emergency supply to Metropolitan Water District's service area and a regulated supply to help meet an additional 1.2 million acre-foot (maf) demand in southern California by the year 2030 (Metropolitan Water District, 1997). The Los Vaqueros Project, which includes the 100,000 acre-foot Los Vaqueros Reservoir, is being constructed at a cost of nearly \$450 million and will improve the reliability and quality of the Contra Costa Water District's water supply from the Sacramento-San Joaquin Delta (State of California, 1994).

The enlargement of existing facilities may be an economically and environmentally feasible option. The Bureau of Reclamation (Reclamation) has recently completed storage enlargements of existing facilities in Arizona at Theodore Roosevelt Dam and

New Waddell Dam. The renovation and enlargement of Theodore Roosevelt Dam were completed at a cost of \$430 million and increased the total reservoir capacity nearly 300,000 acre-feet (Reclamation, 1997a). New Waddell Dam, a feature of the Central Arizona Project, enlarged an existing Lake Pleasant Reservoir by nearly 700,000 acre-feet at a cost of approximately \$625 million (Reclamation, 1997a).

New water delivery infrastructure is also needed. California recently completed construction of a new water pipeline to deliver nearly 48,300 acre-feet annually to San Luis Obispo and Santa Barbara Counties. This area experienced shortages in dependable water supplies of approximately 120,000 acre-feet annually during the 1980s, which contributed to overdrafting and deteriorating water quality of the groundwater supply (State of California, 1994). North Dakota is supporting distribution of Missouri River water for municipal and industrial (M&I) purposes in water-short areas of the state. Approximately two-thirds of the state's population live in the eastern and northern portion of the state, and this area is experiencing significant growth. These municipal water systems were authorized to offset, in part, the Garrison Diversion Unit, originally authorized as a multipurpose water project to compensate North Dakota for permanent flooding of lands beneath Missouri River reservoirs. Very little of the Garrison Diversion Unit authorized irrigation has been developed, and it has been suggested that the project be changed to a water supply project for municipal purposes (WSWC, 1997).

New Mexico recognizes the need to construct a new pipeline from Ute Reservoir to meet the water supply needs of communities in three counties of eastern New Mexico. Although rapid population growth is not expected in this region of New Mexico, domestic water supply shortages exist because of lowering groundwater levels and deteriorating groundwater quality in the Ogallala

and High Plains aquifers. Use and distribution of a projected average annual 18,000 acre-feet of supply from Ute Reservoir would alleviate water supply deficits in this large area (Reclamation, 1992).

Storage and Conjunctive Use of Groundwater

Groundwater is an important source of new supply in states that have basins where existing use is less than the sustainable yield or where it is possible to store "surplus" surface water underground. The existence of underutilized groundwater basins is, however, not widespread because most groundwater basins are either in balance with local rivers and streams or are currently overused. States will have to rely on a combination of conservation regulation and supply augmentation to bring these basins into balance. Kansas foresees further development of the Dakota aquifer under a management program to guide and limit its development to assure its long-term viability (Western States Water Council, 1997). In the western part of the state, the Aguley aquifer has been the major source of water supplies. The supply, however, has been fully developed in many instances. Utah has established a policy for the management and administration of groundwater in the Weber Delta Sub-Area along the east shore of the Great Salt Lake.

Conjunctive use of ground and surface water is a longstanding policy option that is used in places such as California and Nebraska and is likely to increase elsewhere in the future. Conjunctive use allows the most efficient use of surface flows and groundwater supplies. The stored water both recharges the aquifer and can be withdrawn in years when surface flows are below normal. For example, the Arvin-Edison Storage District in the southern San Joaquin valley solved a water supply problem through conjunctive management. The district had a service contract for Central Valley Project Water, but the supply was interruptible. The district embarked on a plan to percolate surface water into

an aquifer during wet years. As a result, between 1966-94, 4 maf were imported into the district, of which 1 maf was percolated into the aquifer. Even after drought-year withdrawals, there was a net recharge of 372,000 acre-feet. In addition, water table levels have stabilized.

In Nevada, Sierra Pacific Power Company (Reno area) and Carson City rely on surface waters in times of sufficient runoff but shift to increased groundwater withdrawals at times when surface water supplies are insufficient to meet demand or when quality is impaired. In essence, this coordinated operation is a mechanism to allow wet-period beneficial use of surface water, permitting the groundwater aquifer to "rest."

Groundwater storage is clearly a significant supply augmentation strategy. The legal and administrative problems often are more complex than surface reservoir construction and management, but the existing constraints on new reservoir construction increase the financial and administrative feasibility of subsurface storage of excess surface water. Further, well-managed recharge projects tend to be lower in cost than surface storage alternatives and often avoid negative environmental impacts. Also, recharge projects can be designed to enhance the environment by including artificial wetland components.

Arizona has begun to place a great deal of emphasis on storing excess surface water underground through artificial groundwater recharge projects. Arizona's underground storage laws afford two opportunities to bank water in aquifers. (See the sidebar "Arizona Groundwater Law," later in this chapter). Direct recharge is facilitated through constructed or managed underground facilities such as (1) constructed spreading basins or injection wells, designed and operated to add water directly to the aquifer, and (2) managed systems that require less construction and add water to the aquifers by infiltration and percolation of surface water slowly

released to natural streambeds. Indirect recharge is accomplished through groundwater conservation programs. By this strategy, farms and irrigation districts can develop a plan to reduce their use of groundwater and, by exchange, receive surface water supplies, such as Colorado River water, to meet their needs. The district accrues a long-term storage credit (that can be held for an indefinite period of time) through the incidental recharge of excess applied irrigation water.

In Nevada, Las Vegas Valley Water District and the city of North Las Vegas each artificially recharge the aquifer by injecting treated Colorado River water. The purpose of these projects is to have enough water available to meet summer peak demands and to bank excess surface water reserves for future use (Western States Water Council, 1997).

In California, the Kern Water Bank was planned to take advantage of available opportunities to store and extract State Water Project (SWP) water in the Kern County groundwater basin. The project was not implemented as originally planned for a number of reasons, including the delays while awaiting resolution of Sacramento-San Joaquin Delta issues. However, the Department of Water Resources (DWR) and local water service districts have successfully implemented several demonstration programs. In 1990, about 150,000 acre-feet of SWP water was stored in groundwater basins in the area; in 1992 and 1997, the districts exchanged about 57,000 and 27,000 acre-feet, respectively, by pumping groundwater for local use and allowing a like amount to be delivered to SWP users. In addition, two of the larger elements of the originally planned Kern Water Bank project, the Kern Fan Element and the Semitropic Element, are being implemented, but by local water districts instead of by the DWR as originally planned. The Semitropic Water Storage District has developed and implemented a groundwater storage program where it will store in the basin underlying the district up to a million acre-feet of water for other water districts.

To date, three SWP contractors are storing water under this program. The Kern Water Bank Authority is in the process of implementing a long-term project using the Kern Fan Element property and has already stored water for participating water users.

New Engineering Options: Desalinization and Weather Modification

There are several experimental and proven technological options for supply augmentation that have not been widely used because of legal and physical uncertainties, cost, and public resistance. These include desalinization, weather modification, and reuse of existing supplies. Although use of these techniques has been limited to date, they are becoming a part of a comprehensive water supply augmentation strategy as we look to the future.

Desalinization and treatment of seawater or other brackish water (e.g., agricultural return flows and poor quality groundwater) to remove the salts and make the water usable for agricultural and urban purposes is technically feasible and is receiving increased attention. There is extensive experience in the Middle East with this technology, but application in the United States has been limited and short term, mainly to provide emergency water supplies. In California, desalting is currently limited to small-scale development because of high operational costs associated with existing treatment technologies (DWR, 1992). There are at least nine existing plants with a combined total capacity of about 11,400 acre-feet per year and at least 12 seawater desalination plants in various stages of development. In Texas, desalting processes of reverse osmosis and electro dialysis have reduced the cost of converting brackish and saline water to fresh water so that these processes are now being used commercially at approximately 80 sites (WSWC, 1997). Texas and Oklahoma have constructed facilities to control chloride in existing water supplies and increase the

usable freshwater supply. The Red River Basin Chloride Control Project, when fully operational, will consist of storage and conveyance structures to regulate and divert fresh and usable water around identified salt flats and natural brine springs and control an anticipated 65 percent of the chlorides in the basin that would otherwise contaminate the water supply (WSWC, 1997).

Weather and snowpack modification have been tried for many decades, but legal and physical uncertainties have dampened enthusiasm for these strategies in many states. In most states, basic questions about liability and the right to use the augmented supply remain unanswered by legislatures and courts. However, in Oklahoma, California, Texas, and several other states, weather modification is considered to be an effective and promising water resource management option to increase water supply. Increased interest in enhancing rainfall by artificial means prompted the Oklahoma legislature to pass the Oklahoma Weather Modification Act, while the Southwest Cooperative Program is a joint effort of several agencies to demonstrate cloud seeding technology to increase summertime rainfall in the Southern Plains region (WSWC, 1997). This strategy has been widely practiced in California, where historically 12 to 20 winter cloud seeding projects have been operated each year.

Weather modification has relatively large potential and small cost; however, yield is difficult to measure. A 1993 Reclamation report states that, for the Trinity Watershed in California, the potentially achievable increases range from 64,000 to 113,000 acre-feet for low and high precipitation years—an increase of about 5 percent in seasonal snowpack runoff. The cost of the seeding program is estimated to be about \$8.40 per acre-foot. In Utah, a cloud seeding program was operated in portions of 25 counties at an annual cost of more than \$400,000 during the 1990-94 period.

A technique used in conjunction with weather modification or by itself, snowpack management is an option that involves controlling vegetation to develop shadows over snowfields that delay snowmelts and water runoff. However, because this option requires participation by an increasingly regulated and declining timber industry, locations for implementation may be limited.

Water Importation

The doctrine of prior appropriation recognizes that the place of need for water may be at some distance from the source of supply. Federal, state, and local interests have initiated small and large water importation projects, and states such as California and Nevada have cast a wide net looking for potential sources of imported supply. Engineers continue to study large import potentials. The political reality, however, is that opportunities for new, large importations of water and transbasin diversions are limited for a combination of fiscal, environmental, legal, and political reasons. Area of origin protections, state and federal environmental requirements, and the increasing concern for instream flow values, in addition to substantial construction costs to build new transbasin diversion and conveyance features, suggest that it is unlikely that additional imported water supplies will be a widespread solution for meeting new demand.

Using Supplies More Efficiently

Reclamation and Reuse

Western water has always worked hard. Return flows are a major source of supply in basins throughout the West. Other forms of reuse take advantage of the increasing technical ability to treat water for a variety of second uses. The growing acceptance of reuse is illustrated by the increase in

the use of reclaimed wastewater. In 1990, approximately 553,000 acre-feet of wastewater were used, a 25-percent increase from 1985.

The potential of water recycling, or reclaiming and reusing municipal and industrial wastewater, is also a strategy for increasing freshwater supplies. Recycling creates "new" supplies only in areas where wastewater is not being put to further use. The particular advantages of recycling are apparent in Pacific and Gulf Coast states where wastewater is otherwise discharged to the ocean or in states where wastewater is being irretrievably lost to saline sinks. In California, a *Survey for Future Water Reclamation Potential* report indicates that there is potential for accelerating the pace of water recycling in the future, raising the ultimate statewide water recycling to about 850,000 acre-feet per year.

California's reclaimed water quality standards are a model for other states and countries. Basically, the level of stringency varies with the end use. Virtually all disease-causing organisms must be removed before reclaimed water can be used on agricultural food crops and parks, but the standards are progressively less stringent for pasture, golf courses, fiber, forage, and orchard and vineyard crops (Postel, 1997). A recent NRC study has endorsed greater use of reclaimed wastewater (NRC, 1994).

The Reclamation Wastewater and Groundwater Study and Facilities Act of 1992, commonly referred to as Title XVI of Public Law 102-575, directs Reclamation, through the Secretary of the Interior, to conduct a water reclamation and reuse program. The act authorized Reclamation to participate in the construction of five recycling projects in California and Arizona, four of which have been receiving federal funding. In 1996 an amendment to Title XVI, the Reclamation Recycling and Water Conservation Act, added another 18 projects, including 2 research and development projects.

Gray water use is another possible strategy to increase water supplies. Reuse can be simple or sophisticated. Gray water can be captured from sinks, tubs, and laundry facilities and reused for landscape irrigation. Rainwater can be collected from roof runoff and used for landscape irrigation. Gray water use could help reduce the local demand for potable fresh water over the long term. Many population centers in the arid Southwest are located in areas where the climate requires landscape irrigation at least 7 months of the year, so gray water could replace potable water during that time period. In certain places in California, there is the potential to utilize 24 to 36 gallons of gray water per person per day (State of California, 1994).

Conservation

The trend toward greater conservation and reuse of water will increase. Most western states realize that conservation is a way to "stretch" and augment existing water supplies. Conservation is no longer a strategy used in drought emergencies, but a permanent supply augmentation tool for many water users. Water conservation offices, policies, requirements, and guidelines exist in most western states. In the late 1980s, the state of Washington passed legislation establishing policies favoring water conservation as a source of water supply, if cost effective, as compared to new supply development (WSWC, 1997).

Water conservation includes both installing urban and onfarm technologies and landscape practices that use less water and implementing demand management, which includes pricing water to reflect its opportunity cost. Demand management seeks to reduce consumptive uses by providing economic incentives to use new technologies and to adopt new use practices. The National Energy Policy Act of 1992 requires that all new toilets, faucets, and showerheads manufactured for residential use meet national efficiency standards. Many arid western

cities, such as Las Vegas and Tucson, require xeriscaping—the use of native plants adapted to the climate.

Conservation plans and programs have been developed in urban and rural settings based on retrofitting existing fixtures and conveyance, leak detection, and fee structures. Oklahoma has designed the Oklahoma Leak Detection Program to identify causes of energy and water losses that diminish the efficiency and revenues of many rural water suppliers throughout the state (WSWC, 1997).

Agricultural water conservation focuses on improving delivery and application of water in agricultural use. Improved agricultural water practices include irrigation management, irrigation system selection, onfarm ditch lining and piping to minimize seepage and evaporation losses, irrigation delivery, farm delivery measurement, and reporting systems. Canal lining is an activity that focuses on lining earthen canals and regulating reservoirs with impermeable material and/or replacing open canal facilities with piping. Wyoming's city of Casper, the Casper-Alcova Irrigation District, and Reclamation entered into a water conservation agreement in the mid-1980s. Under the agreement, the city invested in water conservation improvements in the irrigation district's conveyance system with the resulting saved water stored in two North Platte River reservoirs for the city's use. The Coachella Valley Water District in southern California is also a model of efficiency with its recently lined canal, underground pipeline laterals, telemetry flow control, and water metering.

Most states recognize the limitations of water conservation, however. Colorado notes that

...conservation has limited impacts to overall water supply unless the consumptive use is reduced. Conservation can have significant impacts on the timing of when

water supplies are available and may result in a reduction of costs to municipal facilities (WSWC, 1997).

Montana cautions that water conservation may be important in meeting future demands in localized areas, but it is not expected to be a major source of supply. The impacts of water conservation, at least from agricultural uses, need to be carefully examined. In the arid West, many wetlands and wildlife habitat areas, as well as late-season base streamflows, have developed due to the use of irrigation water. Most western states realize that water conservation is likely to play a significant role in providing additional water supplies, but care must be exercised, especially in those areas where conservation would result in diminished return flows.

More Accurate Reflection of the Value of Water

There is a growing argument for a more accurate valuation of water resources as part of any sustainable water policy. Although water is an increasingly scarce resource with a high opportunity cost, it is often undervalued. Sustainable development requires that water be used more efficiently or that the value of new uses, such as *in situ* use, be incorporated into water use decisions (Postel, 1997). As a general matter, proponents of sustainable development advocate eliminating many resource extraction and use subsidies, so that full production costs would be borne by the producer. More sustainable resource use choices would then be encouraged because the incentives for unsustainable practices would be reduced or eliminated. The 1973 National Water Commission broke new ground when it applied basic principles of modern welfare economics to urge that water be more accurately valued because:

Those whose use of water yields utility or value in excess of the cost to them of additional water will use more; those whose

use of the water costs them more than the utility or value that they obtain will use less. Thus, water will be shifted to where it is most productive in terms of aggregate utility or value to society.

When water is undervalued, either because the price is partially subsidized or because the opportunity cost is not taken into account in use decisions, careful use of the water is discouraged. This undervaluing contributes to unsustainable uses.

Sustainable development requires new standards to value water and the use of longer time horizons to make the valuation calculations. As a recent NRC committee concluded, the total economic value of water "is a summation of its values across all of its uses" (NRC, 1997b). A recent study of water use in the Lower Colorado River basin concluded that sustainable water use in the basin requires "pricing policies that reflect the true costs of water to particular uses at particular times" (Morrison et al., 1996).

We rely largely on prices to allocate resources because a properly functioning market is an accurate and decentralized indicator of a resource's economic value. Properly priced resources promote sustainable use decisions. In general, the higher the value of a resource, the more careful the use decisions. The problem with water is that water prices have not always been a reliable measure of the value of water. Often the price is subsidized or the price does not include the external costs of using the resource. Polluted irrigation runoff—such as the selenium found in the Kesterson National Wildlife Refuge in the San Joaquin valley of California in the 1980s (NRC, 1989)—is an example of a cost associated with traditional water use that is not fully paid by the water user. Water is also undervalued because we do not generally calculate the full range of services, especially environmental considerations, produced by the resource over time. Environmental values not reflected in market prices have long been rejected as intangible.

In recent years, many economists have come to accept that resources such as water have nonuse values and that these values should be considered along with traditional commodity values. These are values that people attribute to *in situ* functions, and these are values just like commodity production values. The legitimacy of nonuse values has been endorsed by NRC studies (NRC, 1996a, 1997b) and blue ribbon panels of distinguished economists (National Oceanic and Atmospheric Administration, 1995). However, there is still considerable debate about how they are quantified and whether they should be considered in parity with values reflected in existing markets.²

Subsidies

The continued subsidization of the cost of supplying water can undermine the adoption of sustainable development and use strategies. Subsidies distort the value of water by concealing the true cost of providing water to alternative uses and have historically favored consumptive over nonconsumptive uses of water. The failure of water prices to display the true costs of supplying the water, not to

² There are many direct and indirect valuation techniques. Those, such as the contingent valuation method (CVM), that ask people what they would be willing to pay to preserve a resource instead of trying to measure consumer spending preferences, are controversial. The methodological problems are formidable. CVM is, however, increasingly used by decisionmakers as a way of getting ballpark figures for nonmarket resource values. CVM calculations of the opportunity cost of alternative uses of water can be dramatic. For example, studies done for Reclamation and the Western Area Power Administration to calculate the foregone values of an altered flow regime from Glen Canyon Dam found that "the national nonuse values . . . are about 30 times larger than the foregone power revenues for seasonably adjusted steady flows" (NRC, 1996b). Sustainable development requires (1) the recognition of *in situ* or "off balance sheet" values and (2) the continued effort to calculate these values so that these values can be factored into water use decisions.

mention the social costs of diverting and transporting the water, often encourages consumption and discourages conservation. The President's Council on Sustainable Development proposed that all subsidies should either meet a national need standard or be eliminated.

The 1973 National Water Commission recommended that subsidization of all new irrigation projects should be ended and that acreage limitation should be abolished for all new projects. The Congress increased the limitation from 160 to 960 acres in 1982 but has not addressed the issue of subsidy reduction in future project water deliveries. The 1973 Commission made no recommendations for the transition from subsidized to less subsidized water deliveries. Reclamation faces this future issue since there will be very few, if any, new reclamation projects of the traditional type. Water users have long relied on the expectation that these subsidies will be continued in the future, although the legal obligation of the federal government to continue them is less clear. There is a need to evaluate carefully existing subsidies to determine whether they contribute to or impede sustainable management. Subsidy recapture would be unfair and disruptive at this late date, but there is a case for the gradual withdrawal of future subsidies.³

³As discussed by Mecham and Simon (1995), the terms of repayment and water service contracts can be modified by the government under certain circumstances. The best opportunity is upon contract renewal. While congressional action is required to recalculate the overall repayment obligation and to enact sweeping reforms, the Secretary of the Interior typically has the discretion to independently modify some terms—most importantly, the length of the repayment period. While the repayment of most projects is scheduled over a 40-year period, shorter repayment periods can be required. For example, most components of the Central Arizona Project are to be repaid over 15 to 24 years, even though the authorizing legislation called for repayment schedules as long as 50 years. Changing the repayment period can dramatically modify the irrigation subsidy: for example, reducing the repayment period from 40 years to 20 years reduces the interest subsidy from 65 percent to 45 percent, given current interest rates. Several opportunities also exist to (continued...)

These conclusions also reflect the global assessments of the relationship between irrigation and world food demands. The 1996 World Food Summit in Rome concluded that

...agricultural growth in the future must come primarily from rising biological yields rather than from area expansion or intensification of irrigation . . . because most fertile lands are already under cultivation, and most areas suitable for irrigation have already been exploited.

No national case for expanding irrigated agriculture was articulated to the Commission, although eloquent arguments were advanced for continuing the status quo. Market forces have produced a decline in irrigated agriculture in the West and an increase in the Midwest and Southeast. A recent National Academy of Sciences report states the marginal position of irrigation concisely:

...the value of water in agriculture is generally less than in industrial and municipal uses . . . and because it is so expensive to develop additional water supplies, only the higher-value water uses are likely to be justified economically (NRC, 1996a).

³(...continued)
periodically adjust operation and maintenance rates, which, according to the Reclamation Reform Act of 1982 (P.L. 97-239; 96 Stat. 1261) must be sufficient to cover actual operation and maintenance expenses. Several other provisions in that legislation seek to confine federal water subsidies to small farms, the original focus of the reclamation program. Districts choosing not to comply with the Reclamation Reform Act are to be assessed "full cost" pricing, which includes interest charges for project construction. Many other notable provisions can be found in the recent legislative history of the Central Valley Project, the site of many contract renewal actions in the past decade. Of particular note is the Central Valley Project Improvement Act, which requires federal water users to make payments to cover fish and wildlife restoration efforts (106 Stat. 4706).

The increasing emphasis on the efficient use of water is a major challenge for water management agencies. They must strike a balance among the continued support of the existing agricultural economy, the transition from agricultural to urban and environmental uses, the satisfaction of Indian water entitlements, and the restoration of rivers stressed by the allocation of water to consumptive use. All projections of future irrigation water use show a decline or small national growth rate. The 1989 U.S. Forest Service study, for example, projected a national irrigation growth rate in irrigation water of 0.5 percent from 2000 to 2040 (Guldin, 1989).

Agricultural producers are facing many pressures for change as the food and fiber they produce are marketed in a global economy. International trends affecting demand include the continued rise in world population, increases in per capita gross world product, free trade, and scarcity of water supplies (U.S. Department of Agriculture [USDA], 1997). Grain exports from the United States are projected to increase as a result of world food demands (including growing per capita meat consumption) and the effects of the North American Free Trade Agreement (USDA, 1997). Some contend that conditions unfavorable to agriculture could affect the ability of agricultural producers to fulfill either domestic or foreign needs.

The policy issue raised by this trend is whether federal water policy should be to support the ongoing market-driven transition from agricultural to municipal and industrial and environmental uses, or whether it should insulate some or all irrigated agriculture from the discipline of the market. Two studies released in 1996, the National Research Council's *A New Era for Reclamation* and the Council for Agriculture Science and Technology's *Future of Irrigated Agriculture*, addressed several policy issues. The reports concluded that irrigated agriculture will face increased competition for new supplies, less federal and state support for supply

augmentation, fewer subsidies for crops grown by irrigated agriculture, continued groundwater overdrafts, continued public concern for protection of the aquatic environment, global economic competition, and unresolved Native American claims.

Confronting the Issues of Pricing

A major challenge facing western water managers and policymakers is to promote the more efficient use of the limited water supply. In order to pursue the conceptually popular goal of "doing more with less," however, it is necessary to address one of the most controversial and poorly understood issues in the realm of western water: subsidies. The term "subsidy" is generally utilized to describe a type of payment or other valuable benefit conferred upon a specific individual or group by governmental action without expectation of repayment, designed to encourage or perpetuate a specific behavior. The term often carries a negative connotation, applying to those situations in which the benefit received is considered excessive or inappropriate in comparison to the associated cost, and often resulting in distorted price signals, disrupted market processes, and inefficient patterns of resource allocation and use. The policies pertaining to western water allocation and use are frequently labeled as being fraught with subsidies.⁴ Reducing or eliminating these subsidies, it is argued, is an essential element of a strategy of improved efficiency. In the context of western water resources, this typically involves modifying charges paid by users for their supply of water, especially from federal facilities. This is a highly controversial and deceptively complicated issue.

⁴ For example, Reisner and Bates (1990:7) observe: "The whole system [of western water] encourages inefficient use. Federal water subsidies, hydropower subsidies, crop subsidies, the doctrine of appropriative rights, constraints on water transfers, fixed or declining block rates—a whole gamut of conservation disincentives has given the American West the most prodigious thirst of any desert civilization on earth."

Arizona House Bill 2494

Starting in 1986 and continuing through 1996, Arizona has adopted a series of laws dealing with artificial groundwater recharge. Initial legislation dealt with the regulatory structure for recharge. Arizona Department of Water Resources oversees the permitting of recharge projects and keeps track of the amount of water stored for permit holders. In order to differentiate and protect the stored water for later use, the statutes provide a special accounting system. Credits are tracked by the AMA or groundwater basin where the recharge occurred. The legal character of the water remains what it was when the water was stored. For example, if a party stores excess Central Arizona Project water in 1996 and recovers that water in 2006, the water will still be considered to legally be Central Arizona Project water and not groundwater. The legal distinction is very important in tracking progress toward the safe yield goals and assured water supply requirements. Recharge statutes allow the groundwater aquifers to be used in a manner analogous to a large reservoir by providing for the issuance of long-term storage credits if the stored water can be demonstrated to be surplus to direct use needs. The statutes also allow the aquifer to be used in place of a treatment plant by allowing water to be recharged in one location and then recovered in another location in the same year. This technique, called annual storage and recovery, allows a water user to use a recharge project as an alternative to treating surface water and piping it long distances to the place of use. For accounting purposes, the water recovered from a well again retains its legal character as if the water were used directly. Both annual storage and long-term storage are innovative techniques which integrate the opportunity to store surface water supplies or excess effluent within the groundwater management system created by the Groundwater Code. Over the past few years, nearly 1 million acre-feet have been stored in Arizona aquifers taking advantage of these statutes.

More recent statutes have focused on the creation of institutions for the purpose of recharging water. The Central Arizona Groundwater Replenishment District was created as a mechanism to help meet the assured water supply requirements. If a subdivision or a municipal provider lacks access to adequate amounts of renewable water resources, but did have available an adequate supply of groundwater, then it might want

to use the service of the Replenishment District. The District, which is a suborganization within the Central Arizona Water Conservation District, is responsible to purchase and recharge an amount of water equivalent to the amount of water mined by the subdivision. This mechanism allows the District to act as a broker in finding municipal water supplies, which saves both time and money for individual water users. A second water recharging entity was created in 1996 with the formation of the Arizona Water Banking Authority. The focus of the Authority's mission is to purchase excess Central Arizona Project water while it is currently available and store that water in Arizona's aquifers for recovery in times of shortage. Funding for the Authority comes from property taxes, groundwater withdrawal fees, and general tax funds. The Authority is also authorized to enter into interstate agreements with entities in California or Nevada to bank water on their behalf when extra water is available.

In 1994 the legislature enacted a bill which created the Arizona Water Protection Fund. The Water Protection Fund is a multimillion-dollar-per-year grant program to be used primarily for protection and restoration of Arizona's critical riparian area resources. Grants may also be issued for research and water conservation programs throughout the state. The Water Protection Fund is administered by the Arizona Department of Water Resources, but the Fund is overseen by a 15-member commission whose members are appointed by the Governor, Speaker of the House, and the President of the Senate. In 1995, \$6.8 million was awarded for projects in 11 counties. Projects were funded to restore high mountain meadows, purchase Central Arizona Project water to maintain riparian and wetland habitat, and recharge effluent to protect perennial streamflow. Grants are awarded through a competitive proposal process with "on the ground" projects emphasized. The funding for the program comes from an annual legislative appropriation and an in lieu tax contribution if water is produced through the water bank for out-of-state beneficiaries. The Water Protection Fund program has been widely cited as an effective nonregulatory approach to natural resources management. #

Water in the West is, quite literally, priceless. Whether appropriated directly from a stream or delivered by a federal, state, regional, or local service provider, water is delivered for a fee that primarily reflects the costs of capture and conveyance; the water itself is normally free. This is known as cost-based pricing, an accounting system designed to ensure the financial self-sufficiency of water systems. This philosophy was a foundation upon which the federal reclamation program was established in the Reclamation Act of 1902, which called upon the project beneficiaries—initially just irrigators—to fully reimburse the federal government for construction and operation and maintenance (O&M) costs.⁵ This same philosophy can be found in most other public water systems, as well as many other types of public utilities.

Almost immediately, the cost-based philosophy of the federal reclamation program proved to be financially untenable—irrigators simply could not repay these costs. In the 1920s, the Congress began "forgiving" portions of these repayment obligations. Repayment began to be based upon "ability to pay," a principle adopted in the Reclamation Projects Act of 1939 (53 Stat. 1187). The 1939 act also reflected the fact that federal reclamation projects were increasingly being designed to provide more than irrigation water, also featuring components devoted to flood control, hydroelectric power generation, municipal and industrial (M&I) water supply, and recreation. Under section 9 of the statute, the Secretary of the Interior is required to determine which percentage of total project costs should be allocated to each class of beneficiaries and to then

⁵ The 1902 act was somewhat unclear about the recovery of O&M costs, only stating that these expenses were to be covered, at least in part, from public land sale revenues collecting in the Reclamation Fund. Legislation in 1914 made the recovery of O&M costs an explicit obligation of project water recipients. Contractors are also typically assessed "replacement costs," which are funds collected to finance the periodic replacement of particularly expensive project equipment (Mecham and Simon, 1995).

establish appropriate repayment contracts.⁶ Reimbursable costs include those associated with irrigation, M&I water supply, and hydropower; while nonreimbursable costs include those for flood control, navigation, recreation, and fish and wildlife enhancement.

Several provisions ensure that users of federal irrigation water pay less than would be required under a cost-based scheme (General Accounting Office, 1996). One of the largest subsidies derives from the practice of not assessing irrigators any interest charges on the capital used in construction. The interest subsidy is substantial; for example, the General Accounting Office calculates this subsidy for Oregon's Tualatin Project in Oregon as covering 97 percent of the construction costs allocated to irrigation. Despite the interest subsidy, irrigators have been assessed \$7.1 billion in reimbursable costs out of a total of almost \$17 billion in total reimbursable costs and \$21.8 billion in total construction costs from 133 federal projects with an irrigation component. As of 1994, less than \$1 billion had been recovered from irrigators, and in only 14 of 133 projects have irrigators paid, or are scheduled to pay, the full costs allocated to irrigation.

⁶ Two types of contracts are typically utilized to recoup project costs associated with irrigation: repayment contracts and water service contracts (Mecham and Simon, 1995). A repayment contract, much like a mortgage, assesses a fixed annual charge designed to recover the investment of federal capital over a given time period, normally 40 years. In these arrangements, an additional annual fee is assessed to contractors based on actual O&M costs, which can fluctuate based on water deliveries and other factors. Water service contracts, on the other hand, are delivery contracts extending up to 40 years that charge contractors a per-acre-foot fee based on a calculation combining capital expenses and O&M charges. These contracts also generally specify delivery quantity obligations and terms of contract renewal. Contracts are typically between the Secretary of the Interior (acting through the Bureau of Reclamation) and irrigation districts organized under state law. As of 1995, the Bureau of Reclamation is a party to 865 repayment contracts and 1,980 water service contracts.

One reason that irrigation repayments rarely are sufficient to cover the interest-free construction obligations is a policy known as irrigation assistance, which derives from the practice of setting contract rates based on an ability-to-pay calculation that considers trends in farm income. Approximately three-fourths of all Reclamation projects feature irrigation assistance. Increased charges are assessed against other project purposes, primarily hydropower generation to recover the difference. Ability to pay pricing has been utilized since 1906, reducing reimbursable costs to irrigation by 48 percent (General Accounting Office, 1996). Another significant subsidy can come from congressional chargeoffs (i.e., statutes relieving specific irrigation districts of financial commitments).

Calculations showing significant federal irrigation water subsidies are typically based on a comparison of contract payments versus actual delivery costs. Even greater disparities are revealed if contract payments are compared to two other values closely associated with the economic efficiency concept: market prices and opportunity costs. As a reflection of the marginal value of water in a particular use, market prices are increasingly being advocated as a desirable tool for guiding water allocation and pricing decisions (e.g., Wahl, 1989). While comparisons between cost-based and market-based rates for federal water can be produced, this type of comparison is most typically reserved for discussions of federal hydropower subsidies, as power generated at federal facilities is often sold at levels far below market prices. For example, Driver (1997) estimates that the rates charged by the Western Area Power Administration (Western) over the next 20 years in most regions will, in the absence of fundamental reforms, be roughly half of market rates, potentially resulting in lost public revenues of over \$5.7 billion.

The second economic concept is opportunity costs. A consideration of opportunity costs can raise the value of federal water and power prices even higher,

as this concept suggests that these resources are best valued by considering the economic return they could generate if allocated to other types of uses. To accurately determine and implement opportunity cost pricing would require removing existing barriers and transaction costs associated with water and power reallocations and would require an elimination of all subsidies distorting price signals. Recent experimentation with increased water and power marketing in the West suggests that additional reforms in this direction will likely discourage irrigation, while favoring M&I water supply uses and many instream uses, including power production, recreation, and environmental restoration. This would not only increase economic efficiency, but would provide a strong incentive for reduced water usage in the irrigation sector. Achieving these efficiency benefits through the reduction or elimination of irrigation subsidies, however, would fundamentally undermine the historic justification of the western reclamation program and would negatively impact many farming communities, suggesting that the true value of water in the West can only partially be understood by the concept of pricing. It is this issue of social value, rather than the narrower concern of economic subsidies, that must ultimately guide public policy decisions.

Reclamation contractors and farmers are not the only beneficiaries of subsidies. Urban consumers have also benefited from utility pricing mechanisms that often deliver water at average rather than marginal costs, so many users are not faced with the full cost of their water use. Some utility managers have long assumed that increases in price will not result in lower use. Water was uniformly priced by block rates rather than by marginal or incremental cost pricing, which reflected the value of supplying the last unit of the resource. Further, as is the case with electric power, water rates for use at peak demands should reflect the value of supplying that amount of the resource at peak demand time.

Improving Water Use Efficiency and Fish Passage

In 1997, the Bonneville Power Administration will fund \$88 million in projects in the Columbia River basin to improve conditions for anadromous fish. The following project, implemented a few years ago with other funding sources, illustrates how agencies can collaborate with landowners to improve conditions for fish, while also enhancing their own water operations and reducing costs.

At two farms along Oregon's John Day River, farmers were diverting water into privately owned ditches via three gravel "pushup" dams to irrigate 85 acres of alfalfa. Each diversion had a fish screen maintained by the Oregon Department of Fish and Wildlife. Several times each year, a bulldozer was used to rebuild the diversion dams, a process which destabilized the channel and added sediment to the river. Ditches and fishscreens had to be cleaned of sediment regularly with a backhoe. Salmon had difficulty passing the diversion dams, and the landowners had difficulty staying within their water rate and duty because of ditch losses and application inefficiency.

A cooperative project between the landowners, the Grant County Soil and Water Conservation District, the Oregon Water Resources Department, the U.S. Department of Agriculture Natural Resources Conservation Service, and Reclamation was undertaken to replace the diversion structures with three diesel pumps with modern fish screens, pumping water into a closed pipe distribution system. The agencies provided approximately \$90,000 in materials and services, with the landowners contributing \$2,400 for installation and agreeing to provide maintenance for 20 years.

The project appears to have been quite successful. Crop gains have been dramatic, up 1 ton per acre, as water is now applied more efficiently. Ditch maintenance costs have decreased by about \$5,000 per year. Costs of operation are about \$3,500 per year, with cost savings to all parties of about \$16,500 per year. Salmon passage is improved, and water turbidity has been reduced. #

Water Marketing

Water may be transferred from an existing to a new use, and this longstanding feature of prior appropriation law, now often called "water marketing," is emerging as a major supply augmentation strategy for both urban and environmental uses. The challenge will be to encourage transfers consistent with sustainable development. That is, transfers make sense when they meet new demands and do not impair either the hydrologic baselines necessary to restore and sustain aquatic ecosystems or the rural communities historically dependent on adequate water supplies. Water rights are alienable property rights, although water rights are different than rights in land and other resources. In recent years, the separation of water from land has been seen as a way to reallocate water.⁷

There are constitutional limits, as yet undefined, to using federal and state regulation to reallocate water from new uses, but there are no federal or state constitutional barriers to voluntary transfers. Water marketing has emerged as a major reallocation strategy in response to the new demands in certain states.

Water marketing often responds to the challenges presented by the potentially zero-sum nature of water reallocations and the growing number of parties at the decisionmaking table. Markets promise greater economic efficiency, while avoiding the environmental and economic controversies associated with new water development. Marketing is becoming an invaluable new tool in how the West manages its limited resources.

Water markets also have costs, and markets can hide social and political inequalities. By allowing the market solely to decide the winners and losers of water reallocations, exchanges may result in no

added public value once third-party impacts are considered (National Research Council, 1992b). While water markets may be a practical response to the governance problem of gridlock, if improperly structured or inadequately balanced with other interests, they may actually exacerbate problems by allowing water to flow exclusively toward money, by damaging rural and other less influential communities, and by undermining productive agriculture.

Water marketing may take many forms besides outright sales of water. For example, it may be tied to conservation programs. Washington state has legislation which seeks to encourage investment in water conservation. Washington state first enacted an experimental program for the Yakima River basin to produce new water for environmental use and irrigation through increased use efficiency. The state is authorized to finance conservation projects for water user organizations in the basin; in return, the users must convey the conserved water to the state (RCW 90.38.005). This program was extended statewide in 1993. Trust rights (instream rights held by the state) may be created for water saved by state and federal conservation contracts. The right enjoys the same priority as the original water right but is inferior to the original water right unless the parties agree otherwise (RCW 90.42.040(3)).

Transfers also may be temporary. Several states use water banks to allocate water in times of drought as another route to tapping existing water rights. While in any given year a water rightholder may have excess water, the rule that an unused right may be abandoned or forfeited creates incentives to wastewater. Water banking seeks to counter the "use it or lose it" rule by allowing temporary transfers, which do not impair the underlying right, to a "bank." Water banking was pioneered in Idaho on the Snake River and adopted by California during the drought of the late 1980s and early 1990s. In early 1991, California was facing the fifth consecutive year of drought, and major reservoir

⁷ Many states permit water rights to be transferred separately from land .

Water Transfers: The Large and the Small

Most observers of western water problems have endorsed, to a greater or lesser degree, the use of water transfers to address the growing water needs of western cities, Native Americans, and the environment. Water transfers, or marketing, allow current holders of water rights (usually farmers or irrigation districts) to sell or lease their water rights to others, who usually put the water to use in a different location for a different purpose. The water "market" allows individuals to profit from these transactions and allows water to move to more valued economic uses (e.g., drinking water for cities) or to needed environmental purposes. Often, public interest groups or state agencies will acquire water rights for instream flows, wildlife refuges, or other environmental needs. Voluntary transfers are both fair and efficient; existing water rightholders receive the current monetary value of their water, and the water is put to a higher valued use.

However, water is both a private and public resource, and the impact of transfers on the stream system and related lands and communities should be evaluated in transfers. Western water laws do not fully reflect the public or community value of water, and debates continue about the wisdom of transferring water from one location or purpose to another. Questions arise about who should approve such transfers, what types of consequences should be considered, who should be allowed to protest a transfer, who should profit, and other issues.

Water transfers vary widely in their size, purpose, and consequences. A small sampling of cases cannot capture the complexity of the various issues involved. However, the two cases sketched here illustrate the range of effects and the challenge of fashioning rules that can govern every size and shape of transfer.

Buying Imperial Irrigation District Water For Speculative Profit.—A few years ago, Ed and Lee Bass, Texas oil and real estate billionaires, bought large tracts of farmland in the Imperial Irrigation District in Southern California. As reported by the Wall Street Journal (1997a),

They were going to raise cattle. But it became clear, soon enough, that the Basses' real interest was in the perpetual federal water rights conferred with the 40,000 acres they acquired.

Seen as a long-term arbitrage play, the strategy goes something like this: Eventually, water supplies for this area of vast urban sprawl and water-hogging agriculture will grow tight; those with the water and the right to sell any surplus, stand to make megabucks.

According to the *Journal*, the Basses encouraged the irrigation district to pool its surplus water, including theirs, and sell it to the city of San Diego for prices as much as 40 percent less than San Diego currently pays the Metropolitan Water District. Under the plan, the Imperial Irrigation District farmers would switch to less water intensive crops or implement other conservation measures and sell the water that they now receive for approximately \$12.50 an acre-foot to San Diego for prices that start at \$200 an acre-foot and climb over time.

After receiving a great deal of media attention and criticism for the potential "windfall" profits they might receive, Lee and Ed Bass sold their land to U.S. Filter Corporation for approximately \$250 million in corporation stock. U.S. Filter is the world's largest maker of water recycling and treatment equipment. U.S. Filter Chairman, Richard J. Heckmann, said, "Every place we look, there is rising demand for clean water, but the supply is not getting bigger. We see tremendous opportunities to make some money and do some good" (*Wall Street Journal*, 1997b).

Acquiring Water for Stream Restoration. The Oregon Water Trust is a nonprofit corporation founded in 1993 to acquire consumptive water rights from existing users and convert them to instream flows. The Trust made its first acquisition of a permanent water right for Sucker Creek, a tributary of the Illinois River in the Rogue River basin in southern Oregon. Sucker Creek provides important spawning habitat for coho and chinook salmon but can run dry for several miles during the summer due to irrigation diversions. A property owner sold his right to divert 0.16 cubic foot per second of Sucker Creek flow to the Trust for \$8,800. Although this water right is small, it has a priority date of 1857 and can represent the difference between some flow versus no flow in Sucker Creek during dry months of the year. #

storage was at 54 percent of average. To meet the gap between available supplies and demand, the state created a drought water bank. Emergency legislation was enacted to allow water suppliers the authority to enter into contracts with the bank and to provide that any temporary transfer would not affect the supplier's water rights. The bank played a major role in shifting water from agricultural to urban uses and from seasonal crops to permanent crops during the last years of the drought. (A recent evaluation of the program concludes that it met the objective of providing emergency supplies, but that established procedures for the protection of third-party interests were bypassed (Gray, 1994).)

Land fallowing, a temporary transfer policy for increasing water supplies, is implemented by contract or agreement with growers or water purveyors to purchase a quantity of water currently used for irrigation; in exchange, the seller agrees to reduce consumptive use by an equal amount. Land fallowing may be temporary, idling land only when needed, or permanent; the latter type of land retirement would be necessary to provide a more reliable supply of water regardless of water-year conditions. Modified cropping is a third option for increasing water supplies under the land fallowing strategy. Under modified cropping, a crop with a high water requirement is replaced with a crop using less water, and the freed-up water use is available for other uses. Land fallowing is an option being examined as a means of satisfying the requirements of Central Valley Project Improvement Act in California (Reclamation, 1995).

Managing Shortages

The West is vulnerable to both short and long periods of drought, which has been defined as a "creeping phenomenon" which has no fixed definition (Wilhite, 1997). Tree ring analysis reveals that the West has experienced prolonged droughts throughout its history, the most recent of

which, from 1986-92, severely affected California, Nevada, and other parts of the West. A significant challenge facing western water managers is the increasing vulnerability of society to prolonged droughts. There are three reasons for this. First, as the demand for relatively fixed water supplies increases, future droughts can be expected to produce greater impacts. Second, the projected effects of global climate change may exacerbate drought cycles because runoff may occur earlier in the water year and evaporation rates may increase. Third, we continue to treat drought as an emergency rather than a systemic risk in arid areas.

Sustainable drought management requires that our traditional response to drought—supply augmentation—has to be supplemented by a variety of risk-based strategies. We must realize that drought is a recurrent feature of the climate of the West. A sustainable drought policy should seek to minimize the damages associated with prolonged, severe droughts by inducing all sectors of water use to take the responsibility to mitigate damages rather than to rely on postdrought compensation.

Drought mitigation can take the form of both short- and long-term responses. Urban water rationing and modest cuts in irrigation deliveries (within the law of prior appropriation and Reclamation's legal duties to deliver project water to contractual beneficiaries) may be sufficient for short-term droughts, but long-term responses require users to decrease their vulnerability to drought. Water users can be induced to reduce their consumption by the installation of cost-saving technologies, by incentives which allow agricultural users to capture and resell all or a portion of any water saved, and by water prices that better reflect the marginal cost of providing the water. More drought-resistant cropping patterns can be adopted, and improved climate monitoring and risk communication employed to allow users to take mitigation steps in anticipation of a drought.

Modifying Operation of Federal Water Projects

In addition to increasing water supplies by conservation, reuse, and other measures, new supplies also may be made available by changes in the operating patterns of reservoirs. Where consistent with existing project purposes and entitlements, changes in flow release and retention patterns may make more water available when it is needed. The environmental and, to a lesser extent, social impacts of dams are a growing concern in the West. As a recent U.S. Geological Survey paper observes:

. . . downstream effects of dams were of little concern during the design and construction of most dams in the United States. Engineers knew that water releases would erode the channel immediately downstream from spillways and power plants; they attempted to calculate the amount of scour to protect the integrity of the dam and its structures. Changes in fish populations were often unanticipated or were not taken seriously. . . (Collier et al., 1996).

There are several proposals to restore aquatic ecosystems by the removal of dams. A few small dams may be removed in the future, but, in general, ecosystem restoration will generally take place within the framework of the existing infrastructure. Dams have great potential to contribute to ecosystem restoration because they are a source of altered flows and, where power is generated, restoration funds.

Several states see reoperation or management modification of existing storage facilities as a strategy for augmenting supplies. Modifying operations to increase yield involves changes in operating criteria, policies, and agreements that allow greater amounts of water to be delivered to water users, while at the same time meeting the

management objectives of protecting fish, wildlife, and habitat and providing flood control. Most states see reoperation activities as a means to increase the efficiency of regulation and distribution of water supplies. Examples include increasing a reservoir's yield at somewhat greater risk to carryover storage from year to year and converting a single-purpose flood control reservoir to a multipurpose facility, including storage. The Amistad-Falcon Reservoir system in Texas has increased water yield by coordinating operations of system reservoirs to reduce evaporation, capturing floodflows normally lost as spills, and reducing streambank losses (WSWC, 1997). In Colorado, the Front Range Metropolitan Water Forum is formulating cooperative approaches to coordinate and integrate the operations of many existing but separate water systems in the Denver metropolitan area. In Oklahoma, allocation of storage and control of reservoir operations to achieve the full potential of river and reservoir regulation will be an increasingly attractive water management option. At Broken Bow Reservoir, the Oklahoma Water Resources Board, Oklahoma State Department of Wildlife Conservation, Southwest Power Administration, and the Corps of Engineers entered into an interagency memorandum of understanding that set temporary conservation pool releases to enhance the downstream trout fishery (WSWC, 1997). In Oregon, the Willamette Basin Reservoir Study will address whether operational changes or modifications in storage allocation are solutions to meeting present and future water resource needs in this basin.

Changes in wet weather reservoir spill management (inflow forecasting) and operational spill management (end-of-season storage levels) for flood control purposes are options that could offer increased water supply (Reclamation, 1995). A change in spring target reservoir storage for Glen Canyon Dam and Reservoir on the Colorado River from full capacity to about 500,000 acre-feet below capacity was a change in operation policy that

resulted in improved operations, reduced the likelihood of reservoir spills, and allowed for more beneficial use of the water supply.

Dams can contribute to ecosystem restoration through reoperation. Reoperation can provide more environmentally sustainable patterns that mimic features of the natural hydrograph. The recent reoperation of Glen Canyon Dam is an example of the potential to revise operating procedures to produce more environmentally sustainable flow patterns. When Glen Canyon Dam was constructed, it eliminated the natural variation in flow that had sustained the canyon ecosystem (generally, annual floods are an integral part of the natural equilibrium of all river systems because flood cycles "are necessary for maintaining channels and replenishing bankside sediments and nutrients") (NRC, 1987). Following completion of Glen Canyon Dam, Grand Canyon beaches eroded, endemic fish were jeopardized by the substitution of colder, clear water for the warm, more turbid natural flow regime, and rafting trips were subjected to pulsating flows from the daily power release cycle. In 1982, Reclamation and Western Area Power Administration began to collect information about these changes (NRC, 1987; 1991) and agreed to conduct an environmental impact statement (EIS) study of the dam's operations (Interior, 1995).⁸

The Grand Canyon Protection Act requires that the Secretary of the Interior operate the dam in a manner consistent with the "Law of the River" and the Endangered Species Act, and "mitigate adverse impacts to, and improve the values for which the Grand Canyon National Park and the Glen Canyon National Recreation Area were established, including, but not limited to natural and cultural resources and visitor use." The act also directed that a new cost allocation be performed for the project if significant changes in dam operations were

implemented, under the principle that, while new environmental and recreation needs might require some reduction in project hydropower benefits, those who were financially dependent upon hydropower revenues should not bear the full economic burden of reoperation. The *Operation of Glen Canyon Dam Final Environmental Impact Statement* was filed in 1995, and a new operating regime was subsequently adopted for the dam. The new plan included limits on fluctuations in daily flow, maximum and minimum flows, and an adaptive management framework.

As part of the adaptive management approach, in 1996 Reclamation released high flows from the dam for a period of 7 days (at the cost of some peaking power revenues). Thirty-four scientific studies were performed before, during, and after these test flows to determine the ability of a managed high flow to rebuild critical sediment deposits for beaches and backwater habitat for endangered fish. The experimental flows illustrated that system management does not necessarily require a fundamental change in reservoir operations, and thus reoperation may not be inconsistent with entitlements.

Decision-Relevant Science

The Glen Canyon Dam flow experiment illustrates the need for science-based resource management decisions. Adaptive management must be supported by science, but we need more focused and integrated research. Water resources management has generally been supported by good science, but the research missions of government agencies are not well adapted to produce the science needed to make informed aquatic restoration decisions. Too often, we spend millions of dollars on science that cannot be applied to make the necessary regulatory decisions. The Sacramento-San Joaquin River basin study reported a familiar problem: millions of dollars have been spent on numerous projects that study elements of the ecosystem, but the research

⁸ The triggering event was the decision to upwind the dam's generators.

AgriMet—An Automated Weather Monitoring System for Irrigation Water Management

In an effort to improve irrigation water management in the Pacific Northwest, the Bureau of Reclamation operates a network of automated agricultural weather data collection stations called AgriMet that provides information for modeling crop water use during the growing season.

AgriMet's more than 45 automated stations collect meteorological data required to model crop water use, including solar radiation, air temperature, relative humidity, and windspeed. These parameters are sent by satellite to a ground receiving station in Boise, Idaho, where automated crop water use models are run daily to translate local climate data into daily evapotranspiration information for crops grown at each station.

The crop water use information is published daily in newspapers throughout the region and is integrated into various onfarm technical assistance programs throughout the Pacific Northwest by local agricultural consultants, the Cooperative Extension Service, and the USDA Natural Resources Conservation Service. Reclamation also maintains a dial-up computer system accessed by more than 200 registered users for daily crop water use and related agricultural information. AgriMet information is available over the Internet at: <http://www.pn.usbr.gov/agrimet> and was accessed nearly 1,000 times per week during the 1997 growing season. Use of AgriMet information is resulting in irrigation water application savings. Various agricultural consultants have reported water and power savings ranging from 15 to 50 percent from client bases ranging from 4,000 to 150,000 acres. In some locations, this reduction resulted in real savings of \$9 per acre in pumping costs. #

—Peter L. Palmer, AgriMet Program Coordinator

has not been integrated. Thus, scientists cannot answer questions that are basic to making sustainable use decisions.

Modern resource management requires the increased production of "regulatory science." Regulatory science is scientific research directed to providing useful information for regulators facing specific choices, rather than to pursuing knowledge for its own sake. The Department of the Interior's proposal to create a National Biological Survey illustrated the focused and law-driven nature of regulatory science. A National Research Council report endorsing the proposed National Biological Survey concluded that "one of the most important uses of the scientific information gathered by the National Partnership [for the Biological Survey] will be to assist decisionmakers in addressing existing biological resource issues and anticipating future ones" (NRC, 1993). We need integrated, long-term research projects to answer specific regulatory questions. Management strategies should change and adapt in response to new scientific information. A recent National Research Council National Academy of Sciences study captures the essence of adaptive management:

Adaptive planning and management involve a decisionmaking process based on trial, monitoring, and feedback. Rather than developing a fixed goal and an inflexible plan to achieve the goal, adaptive management recognizes the imperfect knowledge of interdependencies existing within and among natural and social systems, which requires plans to be modified as technical knowledge improves . . . (NRC, 1992a).

A new applied science, conservation biology, is being developed to provide the information to protect ecosystems from human impacts and to manage them adaptively (Soule and Wilcox, 1980). Conservation biology seeks to develop scientific standards that can be applied to regulatory criteria and then to develop on-the-ground management

strategies to meet the standard (Noss and Copperrider, 1994). For example, endangered species protection first requires the determination of an "effective population size" for species viability. After this population is calculated, a habitat reserve system must be designed (that preserves the species), taking into account existing land use patterns and uses. Existing laws and the politics of endangered species protection require only that *minimum* necessary habitats be preserved. Not surprisingly, conservation biology is concerned with the relationship between species extinction and habitat fragmentation (Wilcox and Murphy, 1985).⁹ The basic objective is to manage nature to mimic natural systems (Soule and Wilcox, 1980).

Hydropower

The Glen Canyon Dam studies illustrate the way that hydropower generation shapes the operation of dams. The many conflicts on the Columbia River between hydropower production and recovery of salmon populations are also well known. Hydropower, especially the future of hydropower in the federal system, is an important issue because of the substantial benefits produced, the impact of hydropower on system operations, and the key role that hydropower revenues play, helping to fund project investment as well as funding for restoration of the aquatic habitat. For example, power revenues from Glen Canyon Dam provided tens of millions of dollars for the Glen Canyon environmental studies. Similarly, the Bonneville Power Administration (BPA) contributes over \$400 million annually from its revenues toward salmon restoration in the Columbia basin.

In its 1973 report, the National Water Commission did not analyze hydropower issues. Nearly a quarter of a century ago, hydropower was viewed as a relatively benign source of inexpensive power.

⁹ Provides a good short review of the early literature.

The Artificial Glen Canyon Flood of 1996

Reclamation built and operates Glen Canyon Dam. Since its completion, questions concerning its effects upon the Grand Canyon and Colorado River have been raised. Reclamation, in cooperation with a number of other agencies, states, and tribes, examined operations in an environmental impact statement (EIS) and concluded that dam operations should change to support a number of objectives, including canyon habitat, fisheries, and endangered species management. To support these goals, adaptive management would be applied to the operations and the results monitored.

Creating an artificial flood to mimic natural spring floodflows was proposed to meet operations objectives. Reclamation—working with other agencies such as the National Park Service, the Fish and Wildlife Service, and various states and Indian tribes—scheduled and released such an artificial flood in April 1996. A monitoring program was established to determine if the flood supported the EIS objectives.

The flood tested various hypotheses concerning effects of high flows upon the Grand Canyon ecosystem. Flood effects were closely monitored to test the results against the EIS objectives including increasing sand deposition above the "normal" waterline, flushing non-native fishes, rejuvenating backwater habitats, and protecting existing endangered species, cultural resources, and the existing trout fishery.

Monitoring indicated that considerable numbers and areas of new sandbars were developed by the high flows, and, despite some erosion, a significant number remained at the end of the summer.

The test flows appeared to flush non-native species from parts of the system. However, this seemed to be a short-term effect, and the numbers of non-native species generally rebounded quickly. Some species (the fathead minnow, for example) even appeared to increase in some areas.

Backwater areas also showed mixed results. In several reaches, the backwater areas that remained after the flood were generally larger than before the flood, but fewer in number. Other important existing resources, including cultural resources, endangered species, and trout, were not significantly adversely impacted.

Overall, the test flood demonstrated the effectiveness of testing management options in the real world. The test did not support all of the objectives of the EIS, which is to be expected when attempting to manage any natural system. It did, however, demonstrate the utility of adaptive management and the need to continue to experiment and test management theories. #

Use of Adaptive Management by Federal Resource Agencies

Adaptive management is a process of managing toward defined goals in the face of uncertainty. In many ways, this is the essence of managing natural systems. Adaptive management acknowledges that we do not understand all the consequences of our actions and that any attempt to manage a natural system will produce some unexpected results. Adaptive management depends upon carefully monitoring the effects of management actions on the environment, and then using that information to both refine our understanding of the system and to adjust our management plan. The careful setting of long-term goals separates adaptive resources management from management that simply reacts to changing situations. Adaptive management requires a long-term commitment to assess the effects of a management strategy before modifying it to move closer to the goals.

Adaptive management is currently a popular idea in natural resources management. Various texts have described how the process of adaptive assessment and management can help resolve controversial issues and conflicting management directives (Holling, 1978).

Despite widespread enthusiasm for adaptive management within the federal government, it is hard to find examples in western water resources management where adaptive management has been utilized over several management cycles. Many federal agencies are initiating adaptive management programs, but none has applied formal adaptive management long enough to test the concept in the real world of interest groups, politics, changing budgets, and changing environmental conditions.

Some starts are being made. The Northwest Forest Management Agreement is putting logging and forest management plans in place and monitoring their effect on the population of spotted owls, along with other indicators of watershed health. As discussed earlier, Reclamation is initiating a formal adaptive management approach at Glen Canyon Dam.

Some of the longest running examples of adaptive management of natural resources are the big game management programs in the various states. For example, in Colorado, the Wildlife Commission has for years undertaken experimental management programs and monitored their effects on game species. To increase the number of mature bull elk and buck mule deer, the Wildlife Commission instituted an experimental antler point restriction for all hunting seasons. Monitoring herd composition for several years indicated that restrictions for elk increased the number of mature bulls, but that the number of mature buck mule deer actually seemed to decline. As a result, the antler point restrictions on buck mule deer were removed.

(See "Adaptive Management," next page)

Adaptive Management (continued)

John Volkman, in his report to the Western Water Policy Review Advisory Commission, has highlighted some of the difficulties of applying adaptive management to rivers in the West (Volkman, 1997). First, trying to experiment in such a complex managed system is fundamentally difficult, if not impossible, because few controls are available and because the impacts of management actions are likely to be less than naturally occurring fluctuations. Correlating observed changes in the system with management actions will be difficult.

Second, it is difficult to support real world funding for an effort where the results are unknown and where long-term monitoring is required to determine a program's efficacy. While this uncertainty exists for management of all natural systems, historically, federal agencies have preferred to make predictions of a project's effects in a planning report, assume the predictions are correct, and then implement the project. Rarely are any significant resources spent on testing the predictions, partly because there are other uses for the funds and partly because agencies may not want predictions proven false. As conditions and political priorities change, it is difficult to maintain budgets for long-term monitoring.

Despite these challenges, adaptive management has potential to help meet the needs of the real world, where our knowledge is limited but action must be taken. Perhaps the best that can be said about adaptive management is that (to paraphrase Winston Churchill), "Adaptive management is the worst way to manage, except for all the others." #

Compared to other water and power issues, hydropower was not perceived as a problem.

Perceptions have changed since 1973. Managers of dams have to balance the competing multiple uses of the projects—a task which is becoming increasingly complex. Although most existing Federal Energy Regulatory Commission (FERC) licensed projects were permitted in an earlier era without regard for environmental mitigation, FERC is now expressly required to give equal consideration to other uses of the water.

FERC regulates construction and operation of most of the nonfederal hydropower capacity—roughly 20,000 megawatts (MW). In 1986, the Congress enacted legislation expressly requiring FERC to give "equal consideration" to the purposes of energy conservation and the protection and enhancement of fish and wildlife, among others, when it issues licenses for new dams or relicenses existing facilities. FERC is also required to include other federal agency requirements in licenses and to consider requirements of environmental laws enacted or amended since 1973. Approximately two-thirds of the licenses for nonfederal hydropower capacity in the West expire between 1997 and 2010, thereby creating the obligation to place environmental conditions on the operations of these facilities. It is likely that the owners and operators of the nonfederal facilities will strongly oppose additional conditions on their licenses and will argue that such requirements will impair their ability to operate in a more competitive, deregulated market.

Balancing competing demands for water, increased knowledge about aquatic ecosystems, legal requirements to protect natural resources, changing public values, and the potential restructuring of the utility industry all pose daunting new challenges for water, power, and natural resource managers. A report to the Commission identifies some of the policy questions that hydropower managers face today (Driver, 1997):

As the electric utility industry is restructured, what are the impacts on the federal hydropower facilities if they are exposed to a competitive environment? To the extent that aquatic ecosystem protection and restoration activities are currently financed, in part, by revenues generated at federal dams, what are the likely consequences for these activities if those facilities have to become competitive in the marketplace?

How will the ability of the federal agencies to manage rivers to meet changing public demands (such as for recreation) and to restore aquatic ecosystems be affected?

If federal hydropower facilities are privatized, in whole or in part, how can the multiple purposes—irrigation, municipal and industrial water, recreation, fish recovery, and so forth—of these projects be protected? How will ongoing or future mitigation be met, if at all? Who will make the "trade-offs" among the competing demands for water and power, under what conditions and constraints?

These questions and many others are currently being debated in the Congress and in state legislatures. It is unclear how these issues will be resolved or even how deregulation or privatization will affect the federal projects. Unless great care is taken, the consequences, intended or unintended, could be significant for aquatic ecosystems specifically and for the management of western water resources generally.

Power Marketing Administrations (PMAs)

Federal hydropower facilities in the western United States are constructed and operated by Reclamation, the Corps, and BPA. The 10 largest dams in the United States are in the West. Seven of the 10 dams

were constructed by Reclamation and the Corps. Fifty-five percent of the total hydropower capacity in the West comes from federal dams.

Power is marketed and transmitted mostly by the BPA and Western Area Power Administration. BPA markets power from 29 federal hydropower dams with a capacity of about 20,000 MW, providing about 40 percent of the firm power in the Pacific Northwest. Western markets power from 55 federal hydropower plants with about 10,000 MW of capacity.

Some observers believe that PMAs are attractive and vulnerable targets for defederalization. For example, BPA is under financial stress at this time—in large part due to its obligation to retire its nuclear powerplant debt. Its rates, once a bargain, are somewhat above the cost of alternative power supplies. The salmon recovery efforts cost BPA about \$400 million a year. An additional concern for BPA is that many of its power contracts expire in 2001; if these contracts are not renewed, BPA's financial situation will become more acute. The region's governors, following a major review of the system, suggested breaking BPA into two entities—one for transmission and one for hydropower generation and marketing. The governors' review was, in effect, an effort to head off the efforts to privatize BPA.

Western's situation is different. It is less financially precarious, and its contracts begin to expire, on a staggered basis, in 2000. But, as with BPA, some investor-owned utilities and others see the value of the hydropower generated at the large dams as enticing targets for privatization.

The Congress has considered privatizing the PMAs (particularly in the past 3 years) (see next section for more on the privatization as it applies to all federal water facilities). A variety of reasons are given by proponents of privatization, ranging from the

argument that private industry can do the job better to deficit reduction, but initiatives for privatization have failed so far.

In the report to the Commission mentioned earlier in this section, Driver reaches the following conclusions and questions about the federal and federally licensed hydropower system:

- A. *Hydropower makes a significant contribution to power supplies in the West, especially in the Pacific Northwest where it provides about two-thirds of that region's generation capacity. Policies adopted for hydropower can have far-ranging effects on the region's economy and environment.*
- B. *Restructuring does not really threaten the viability of western hydropower, even if hydropower pays its share of environmental costs, except where hydropower sales have been asked to recover costs unrelated to hydropower, in particular, nuclear power plant costs.*
- C. *The sales of hydropower by Western are worth billions of dollars when measured against the alternatives available in the western grid. This value now flows almost exclusively to preference power users. Should some of this value flow to achieve other goals, say deficit reduction or environmental mitigation?*
- D. *A distant federal agency, the FERC, will be making many of the trade-offs between energy and environmental policies on western rivers in the next ten to fifteen years, especially in the Pacific Northwest. Is this appropriate?*
- E. *Interest in privatization of the power marketing agencies (a.k.a. defederalization) has cooled some since 1995, but it will not*

The Shasta Dam Temperature Control Device: A New Method for Improving River Conditions for Salmon

Shasta Reservoir, located at the north end of California's Central Valley, is the largest reservoir in California, storing 4.5 maf of water for agricultural and urban uses. Reclamation's Shasta Dam, along with other dams in northern California, has restricted the range of native salmon which use the upper reaches of the rivers to spawn. This makes the 55 miles of prime salmon spawning habitat below Shasta Dam even more critical to survival of the species. In 1969, nearly 117,000 salmon made the journey to the upper Sacramento River. However, salmon tolerate only a narrow range of water temperature, especially when young. If water temperatures rise above 57.6 °F, they begin to die. The temperature of the water released from the dam rises during the summer and fall when the reservoir warms. In the 1976 and 1977 drought, thousands of salmon died when water levels reached 62 °F. The winter-run chinook was declared a federal endangered species in 1989 ;and in the last 3 years, only 2,000 returning adults were counted (*New York Times*, 1996).

Water from the dam is normally released through the hydroelectric plant, whose intakes are not deep enough in the lake to reach the coldest waters. In 1987, Reclamation began releasing water in summer and fall from deeper in the reservoir, which improved downstream conditions for the salmon but required bypassing the powerplant and foregoing electricity production.

In 1989, Reclamation began researching and designing a multilevel intake structure that could take water from many levels in the lake, allowing the temperature of the releases to be closely controlled without bypassing the powerplant. In 1992, the Congress passed the Central Valley Project Improvement Act, which authorized funds for the temperature control device. Twenty-five percent will be paid by the state of California and 37 percent by water and power customers. Construction began in January 1995, and the 250-foot-tall, \$80-million device was completed in February 1997 (Reclamation, 1997a).

The temperature control device is an example of the potential flexibility that exists to improve the operations of dams and reservoirs to more closely mimic natural conditions. In this case, the technological fix is quite expensive but was made politically feasible by the legally protected status of the salmon and the desire to maintain the dam's financially important powerplant operations. #

likely disappear. The two main issues raised by defederalization are: Who gets the value of the hydropower systems, as measured by the difference between their cost and the price of power on the open market? And what is the impact on the environment?

- F. *Federal hydropower's debt to the U.S. Treasury is substantial and increasing. And it appears that neither Western nor BPA is making the taxpayer whole. In particular, the American taxpayer is subsidizing power users because neither Western nor BPA is yet repaying irrigation debt in any substantial amounts, contrary to popular perception. Will this arrangement be altered by Congress? Should it be?*¹⁰

In sum, there are large decisions to make about western hydropower in the years to come, involving difficult tradeoffs and large impacts on the region. In our view, this requires that the public, politicians, and others beyond the inside players learn the issues and stay involved and that appropriate forums remain available for this involvement.

¹⁰ With respect to the conclusion that taxpayers subsidize the Bonneville Power Administration, BPA contends there is a larger context that must be kept in mind. BPA repays some \$850 million to U.S. taxpayers each year. In 1997, the agency had refinanced over \$7 billion in debt to the U.S. Treasury at existing market interest rates. It has provided, in addition, a \$100 million one-time payment to the taxpayer and over \$300 million in additional credits to the U.S. Treasury. The ratepayers of the Pacific Northwest have now paid off entirely the government's original investment in Bonneville and Grand Coulee Dams. The federal government retains ownership of the dams, which will continue to produce value well into the next century. Despite the fact that some old loans prepaid by Bonneville were below market interest rates at the direction of Congress, the arrangement whereby ratepayers paid the federal government's capital investments, including interest, has significant benefit to the federal taxpayer.

Privatization of Federal Water Facilities

In 1993, Vice President Al Gore initiated the National Performance Review (NPR) with the overall objective of making government work better at less cost. As part of the second phase of the NPR (REGO II), Reclamation implemented a program to voluntarily "transfer title of facilities that could be efficiently and effectively managed by nonfederal entities and that are not identified as having national importance (Reclamation, 1997a)." To carry out this program, Reclamation developed policy guidance, *Framework for the Transfer of Title* for the transfer of title to "uncomplicated projects." The framework applies to transfer situations in which outstanding issues and the concerns of the various stakeholders can be readily resolved. It is not Reclamation's intention to transfer large, multipurpose projects, or power generating facilities at this time.

The framework sets forth six criteria which must be met before any project is transferred, as well as additional guidance which applies to the transfer and establishes the valuation of the assets to be transferred. The six criteria are:

- (1) The federal Treasury, and thereby the taxpayer's financial interest, must be protected.
- (2) There must be compliance with all applicable state and federal laws.
- (3) Interstate compacts and agreements must be protected.
- (4) The Secretary of the Interior's Native American trust responsibilities must be met.
- (5) Treaty obligations and international agreements must be fulfilled.
- (6) The public aspects of the project must be protected.

Since the policy was announced in August 1995, Reclamation estimates that approximately 60 districts, out of 592 water districts (involving 191 operating projects), have expressed varying degrees of interest in taking title. In August 1997, Reclamation estimated that serious discussions were taking place with approximately a dozen districts, but no transfers under the Framework policy have taken place for a variety of reasons, including the concerns of potential transferees about assuming liability for facilities and complying with National Environmental Policy Act and other environmental laws, involvement of the public in the title transfer process, and disputes over the valuation of projects.

Moreover, potential transferees have attempted to bypass the Framework process by requesting the Congress to either authorize or direct the sale of a particular project. The Administration, environmental organizations, and in some instances, other affected stakeholders have opposed these attempts to legislatively mandate transfers, in part because many of the bills have waived environmental laws.

The sale of federal facilities to nonfederal owners presents significant challenges to federal agencies, water and power users, other interested parties, and managers of natural resources. The key challenge is to establish priorities among the competing interests. Who are the winners and who are the losers? Ultimately, who will make the decisions concerning management of the water resources and under what conditions?

Improving the Mechanisms of Governance

For many decades, scholars have been arguing that completely and efficiently addressing water and other natural resource areas requires focusing greater attention on institutional arrangements. The processes by which humans manage their interactions with each other and with the natural

world have a profound impact on how water problems originate. Water problems are ultimately human problems, resulting from the interaction of the physical environment with the demands and rules imposed by human institutions (Lord, 1984; Mann, 1993). Only recently has this reality become widely understood and embraced. As a result, nonstructural institutional remedies such as demand management (for addressing water and power shortages) and flood plain zoning are increasingly accepted as practical complements to—and often alternatives to—a continued reliance on problem-solving efforts based on further manipulating the physical landscape.

The main challenge to improving decisionmaking and reducing conflict is to find new basin and watershed governance structures that avoid many of the past pitfalls in institutional design. This will not be easy, because the history of past efforts to achieve comprehensive, multiple-objective river basin and watershed management is not encouraging. Nonetheless, the lesson that basins should be managed along hydrologic units remains clear. As a 1992 National Academy of Sciences study concluded:

The focus during the early years of this century on the river basin as a unit of planning needs to be reinvented with new goals and new approaches to make it work more effectively than it did in the past (NRC, 1992b).

While myriad institutional problems exist, two main questions were addressed by the Commission:

1. What is the most useful federal-state relationship to address water management problems, especially at the regional and river basin level? (This is sometimes referred to as the question of natural resources federalism.)

More Efficient Funding of Federal Powerplant Repairs

Reclamation operates several hydroelectric powerplants in the Pacific Northwest, and BPA markets the electricity generated these projects. Repair and maintenance costs for the facilities have been funded through the federal budget process and then repaid a year later by BPA.

Because federal appropriations are uncertain from year to year, the agencies were concerned that there was potential to compromise the long-term reliability of the power system. Employees from both agencies explored creative alternatives to the federal budget process with the objectives of securing the longer-term budget certainty, reducing red tape, increasing management flexibility, and providing costs savings for the ratepayers. The result was the direct funding agreement, executed December 11, 1996, which enables BPA to fund directly those annual operation and maintenance costs of Reclamation power facilities from its power marketing revenues.

The agreement removes approximately \$36 million from the federal budget process annually and allows BPA and Reclamation to determine the amount and timing of funds that will ensure the facilities are efficiently operated, repaired, and maintained. In essence, this agreement allows Reclamation to operate "corporately," with budgets driven by the business needs of the two agencies, rather than by the budget process and schedule of Congress. The agreement covers a 10-year period beginning October 1, 1996, and can be renewed indefinitely.

A joint operating committee, composed of representatives from both agencies, will review budgets and program expenditures, measure performance, and determine the level of performance incentives to be provided if Reclamation successfully achieves the performance objectives of each annual power budget.

Unfortunately, this funding mechanism is limited to the Pacific Northwest because the budget authority used is exclusive to BPA. Western, which markets Reclamation and Corps power in other regions, lacks similar authority to enter into direct maintenance funding arrangements. #

2. What institutional arrangements can promote effective, inclusive decisionmaking at the local level?

The Changing Federal-State Relationship

The allocation of governance responsibilities in western water resources between the federal and state governments has always been somewhat problematic, frustrating, and fractious. Strong federal roles in multipurpose water development, management, and, more recently, environmental regulation have evolved in a policy environment which simultaneously stresses state administration of water allocations under a system of privately held water rights. The western states began to determine their own approach to water allocation before the federal government began financing reclamation projects and constructing multiple purpose reservoirs. A new round of tensions has been created by the overlay of federal environmental protection mandates.

We have seen three models of federal-state relations: (1) federal supremacy, (2) federal preemption, and (3) a presumption of shared authority. The federal supremacy model displaces state law with the exercise of federal constitutional authority. Federal Indian reserved rights are an example of this model. Federal preemption occurs when the Congress implicitly or expressly exercises its constitutional authority and decides to displace state law. With some exceptions, FERC's authority to license dams has been interpreted by the Supreme Court to preempt inconsistent state laws.

Traditionally, the western states have resisted assertions of federal authority because state allocation primacy was displaced. The basic constitutional argument is that the federal government separated all water from public lands and thus ceded to the states the complete power to

allocate and manage water. In the famous *California Oregon Power v. Beaver Portland Cement Co.* decision in 1935, the Supreme Court gave constitutional stature to a history of deference to state water law and policy and provided the constitutional foundation of the primacy of state water law because the decision protects the rights of the states to choose their own allocation systems and to define property rights presumptively eligible for constitutional protection. However, the decision does not immunize the states from the exercise of all federal power relating to water. Prior and subsequent decisions excepted tribal and non-Indian federal reserved water rights from the severance, and states now generally recognize the federal government's power to manage water resources for federal objectives. As the Colorado Supreme Court said in 1983:

Federal statutes, as interpreted by the United States Supreme Court, recognize Colorado's authority to adopt its own system for the use of all waters within the state in accordance with the needs of its citizens, subject to the prohibitions against interference with federal reserved rights, with interstate commerce, and with the navigability of any navigable waters (Colorado Department of Natural Resources v. South-western Colorado Water Conservation District).

In summary, while *California Oregon Power* continues to be the constitutional foundation of western water law, it does not require that the federal government always defer to state law. *California Oregon Power* requires federal protection of vested rights, but it does not limit the federal government's supreme power to manage resources in ways that conflict with allocations established under state law.

The deference policy worked reasonably well for reclamation programs. The federal government was limited to the assertion of major policies, such as acreage limitation laws, and otherwise the states

could control the allocation of water for Reclamation projects. The deference policy does not work as well for the management challenges that today's western water managers face because many of the major management challenges involve environmental protection. The Clean Water Act, the Endangered Species Act, and the 1986 Federal Power Act Amendments impose national environmental protection mandates on both federal and state water managers. They do not reflect the tradition of deference to state law, and the Congress gave little thought to the impact of these programs on water management in their enactment.

Deference does not excuse the states from compliance with these federal regulatory programs, and thus there is a need to understand the reach and limits of the Supreme Court's presumption of deference to state water law to accurately understand the evolving federal role. This is both the legal and political reality of western water management. While the federal environmental laws do not seek to displace directly state law (as the federal government occasionally did under the Reclamation Act of 1902 and the Federal Power Act), they overlay water rights regimes. In other words, these laws leave state allocation primacy in place but impose additional duties on state water rightholders. Sustainable water resource management would perhaps be better served if both the federal government and the states recognized that each has major, but nonexclusive, management roles, and that the issue is how this mutual authority can be directed through new governance institutions to ensure the sustainability of our river basins and watersheds. Thus, with the notable exception of environmental regulation, federal primacy in many areas of water development and management is giving way to a greater state and nongovernmental role. Contemporary resource management requires multijurisdictional cooperation because no one political jurisdiction can implement the necessary plans and policies, and the growing interest in federal budget deficit reduction is likely to accelerate these trends.

Agency Jurisdictions

The changing allocation of roles among the branches of government has been as significant as the state/federal shift. Most of the federal agencies with significant water and land management responsibilities in the West emerged in an age in which agencies (in all subject matters) were looked to as impartial, scientific decisionmakers, a concept underlying much of the progressive conservation era (circa 1890-1920) (Hays, 1989). Over time, this idea has lost popular support as agencies have increasingly become characterized—sometimes unfairly—as interest groups pursuing agendas of bureaucratic status and growth, responsive only to narrow constituencies seeking federal support for their interest. In a national context, this governance phenomenon is regarded as part of the larger trend of "interest group liberalism" (Lowi, 1979). In the water resources realm, this changing perception of agencies primarily grew out of our national experience with water development "iron triangles"—policy subsystems of federal agencies, key congressional committees, and local interest groups organized to promote particular water projects (McCool, 1994). As the environmental and economic costs of this mode of decisionmaking became more widely understood, and as growing populations placed new and diverse demands on limited natural resources, an era of environmental activism was born, the iron triangles began to weaken, and natural resource agencies increasingly found their actions subject to judicial review. The water resources subject area featuring the greatest growth in judicial involvement has been the intersection of water quality and quantity management, which has historically been viewed as distinct activities (Dinar and Loehman, 1995). As water management issues become increasingly multifaceted, this fragmentation of modern governance arrangements is becoming more problematic.

The enhanced role of the judiciary in issues of water development and management has been accompanied by an enhanced role for environmental activists, Indian tribes, and other parties previously excluded from water decisionmaking systems. After decades of crafting policy in relatively closed and narrowly focused policy arenas, major issues in the water resources realm are now considered in processes that are increasingly open to diverse interests and viewpoints (Ingram, 1990). While certainly desirable from a normative standpoint, this change in our processes of governance has made it increasingly difficult to make decisions, as more and more parties come to the decisionmaking table seeking an increasingly diverse set of benefits from limited western water resources.

Collectively, the inclusion of diverse interests has made the politics of water much more complex. Federal subsidies and the exclusion of divergent interests during the water development era made it relatively easy to craft positive-sum solutions while, in contrast, open processes and the increasingly reallocative nature of modern water issues frequently gives these conflicts a zero-sum quality (Lord, 1979; Ingram, 1990).¹¹ At least two significant trends have emerged from greater inclusion in water development. First, the incentive for congressional involvement in water disputes is lessened. Disputes that are not clearly resolved by congressional policy choices end up in the courts, further shifting power in the intergovernmental system toward the judicial arena (even though it is

often difficult for courts to consider scientifically complex proposals that influence, and are influenced by, other projects and resource management concerns) (Goldfarb, 1993). Second, a growing number of parties involved in decisionmaking have the legal and political resources to influence policymaking efforts, resulting in an increasingly large number of interests with the power to veto, or at least impede, proposed actions. The simultaneous growth in the number of parties with veto power, considered along with the growing difficulty in crafting positive-sum solutions and the largely unmet need to address the interrelationships among resource issues, means that the act of making essential decisions—the primary purpose of all mechanisms for governance—is more difficult than ever. The result is gridlock.

Collaborative Decisionmaking to Help Break the Gridlock

The gridlock, fragmentation, and related deficiencies in the mechanisms of resource governance have spawned interest in institutional reform. The use of collaborative groups, such as watershed initiatives, is becoming more popular, often out of necessity. As Rieke and Kenney (1997) observe:

The 1990s have seen a proliferation of "watershed initiatives," in which stakeholders from a variety of governmental levels and jurisdictions have joined with nongovernmental stakeholders to seek innovative and pragmatic solutions to the problems associated with resource degradation and overuse. Although these initiatives share many common qualities, they are also notable for their variety of structures and functions, a predictable feature given that each watershed initiative is an ad hoc effort tailored to the unique institutional qualities and physical qualities of the particular region.

¹¹ In a zero-sum solution, benefits to one party come at the expense of another. Technically, a positive-sum solution is one in which the benefits to all parties exceed the costs to all parties. In such a situation, some individual parties may actually incur more costs than benefits, although the net result for all parties viewed collectively is to benefit. From a political standpoint, the primary concern is normally to ensure that all participating parties receive either net benefits or no change in their condition, a special subset of positive-sum solutions known as Pareto optimal solutions.

Like water markets, watershed initiatives provide a tool for concerned parties to interact and to make decisions (i.e., to govern) regarding issues and resources of mutual concern. Unlike water markets, however, the basic philosophy of watershed initiatives is to involve as many parties as possible in consensus-based decisionmaking processes, with the rationale that any party deliberately excluded from consideration will likely try to exercise its legal and political authorities through other channels to block proposals emerging from the initiative.

This fundamental difference between watershed initiatives and water markets is perhaps best explained by observing the different subjects each typically addresses. Water reallocations, the typical subject matter of water markets, involve redistributing a fixed quantity of water and, as such, have the potential to be zero-sum in nature when all interests are considered. In contrast, watershed initiatives typically do not focus on issues of water supply, but instead focus on broader issues. These efforts typically promise to provide collective benefits to all participating (and even nonparticipating) parties. By bringing a type of pragmatic democracy to hydrologically relevant management units, watershed initiatives appear to be a worthwhile innovation in resource management and governance.

Despite their positive qualities, watershed initiatives have a limited scope of effectiveness because they cannot operate at the scale necessary to solve some broad problems or mobilize the necessary resources to do so. Ironically, it is again the issue of participation that is most commonly raised by the critics of these efforts, such as Michael McCloskey, chairman of the Sierra Club:

Few of the proposals for stakeholder collaboration provide any way for distant stakeholders to be effectively represented. While we may have activists in some nearby

communities, we don't have them in all of the small towns involved. It is curious that these ideas would have the effect of transferring influence to the very communities where we are least organized and potent. They would maximize the influence of those who are least attracted to the environmental cause and most alienated from it. (High Country News, 1996)

Also, collaborative groups, as part of their need for consensus in decisionmaking, may encourage "lowest common denominator" decisions, and the focus of most groups is not sufficiently broad because these efforts are rarely linked to river basin management programs (Rieke and Kenney, 1997). These concerns about adequacy of representation, the locus of decisionmaking authority, the processes of decisionmaking, and the adequacy of focus are all ultimately questions of governance. Whether or not they are factually accurate in the case of watershed initiatives, they do provide further evidence of the difficulty in crafting efficient, equitable, and universally acceptable mechanisms of governance.

Other emerging decisionmaking tools are currently at work in the West, changing the way resource management decisions are made and responding to and raising additional issues in resource governance. Prominent examples include the proliferation of alternative dispute resolution (ADR) devices in environmental conflicts and the use of adaptive management, mentioned in foregoing sections, to deal with complex problems. Both of these tools bring much needed pragmatism and action to management efforts, responding to and indirectly modifying deficient arrangements for resource governance. Specifically, ADR is a tool for addressing the high transaction costs (e.g., delays), narrow focus, and frequently zero-sum nature of many decisionmaking processes, especially in the judicial arena, although it has been occasionally criticized as improperly shifting the responsibility for decisionmaking (Bacow and Wheeler, 1984).

The CALFED Process: A Model for Resolving Complex Water Disputes

The Bay-Delta region of California, the largest estuary in the West, is an intricate web of waterways created by the blending of the San Francisco Bay with the confluence of the Sacramento and San Joaquin Rivers (CALFED Bay-Delta Program, 19xx). The significance of this resource can hardly be overstated. "The Delta provides forty percent of the state's drinking-water supplies, serving over twenty million people in northern and southern California. The Delta also provides irrigation for 200 crops, including forty-five percent of the nation's fruits and vegetables" (Rieke, 1996). This 738,000-acre area of channels, sloughs, and islands is critical habitat for more than 120 fish and wildlife species and provides irrigation water for more than 4 million acres of farmland (CALFED Bay-Delta Program, 1997a).

Water quality standards in the Bay-Delta are established by the State Water Resources Control Board pursuant to the Clean Water Act. The Board had failed in several separate efforts over more than a decade to adopt a water quality plan to stem declining fish populations in the Bay-Delta and its tributaries which could be approved by the EPA (Rieke, 1996). In 1992, California Governor Pete Wilson brought together several state agencies with regulatory responsibility for the Bay-Delta to form the Water Policy Council (CALFED Bay-Delta Program 1997a). In September 1993, the Federal Ecosystem Directorate was created to coordinate related federal activities in the region. In June 1994, the Water Policy Council and the Federal Ecosystem Directorate joined to become CALFED.

CALFED was created as a means of bringing together representatives of agricultural, business,

environmental, and urban concerns—all in an effort to guarantee more reliable water supplies and improved water quality for the environment, cities, and farms. By the end of that year, CALFED, in cooperation with these diverse interest groups, had drafted interim Bay-Delta water quality standards and created a state/federal work group to coordinate operations of the State Water Project and the federal Central Valley Project (CALFED Bay-Delta Program, 1997a).

In December 1994, Governor Pete Wilson, Secretary of the Interior Bruce Babbitt, and EPA Administrator Carol Browner announced that CALFED had reached a final agreement. This agreement called for increased fresh water flows for the Bay-Delta—an additional 400,000 acre-feet per year in normal years and 1.1 million acre-feet per year in critically dry years (Rieke, 1996). To provide greater certainty for agricultural and municipal supplies, any additional water needed due to additional endangered species listings must be met by water purchases financed with federal funds and undertaken on a willing seller basis.

Essentially, agricultural and municipal users are assured that additional water needs for endangered species purposes will not be through regulatory reallocations of water (Rieke, 1996).

In June 1995, CALFED launched the CALFED Bay-Delta Program to develop a long-term, comprehensive solution to Bay-Delta problems (CALFED Bay-Delta Program, 1997a). Whereas CALFED established the goals to be

(See "CALFED," next page)

CALFED (continued)

to San Diego, and frequent public technical workshops in Sacramento, have been a cornerstone of the process (CALFED Bay-Delta Program, 1997b).

Phase I of the CALFED Bay-Delta Program's three-phase process was completed in fall 1996. Three alternatives designed to comprehensively address Bay-Delta problems were developed with the benefit of significant public input. Each alternative addresses water use efficiency measures, ecosystem restoration, water quality protection, and levee improvements. Each also includes a range of storage options but differs in how it conveys water. During Phase I, 14 community meetings and 7 technical workshops were held to gather public input and additional scientific peer review (CALFED Bay-Delta Program, 1997b).

Phase II, which is underway, involves a six-step process leading to selection of a final preferred alternative in fall 1998. Extensive public participation will extend throughout this environmental impact statement/ environmental impact report process. Formal public hearings will follow the release of the Draft Programmatic environmental impact statement/ environmental impact report during Phase II (CALFED Bay-Delta Program, 1997b).

Phase III, site specific project analysis and implementation, will begin in late 1998 and last for decades.

It is estimated that \$8 to \$10 billion over 20 years is necessary for completion of the Bay-Delta recovery—\$2 billion for ecological restoration, \$1 billion for water quality improvements, \$1.5 billion to improve system integrity, and the balance to establish a reliable water supply. Approximately \$1 billion has been committed with \$600 million from a

California bond measure, \$340 million from the federal government, and \$60 million from private sources, including urban water districts.

CALFED and its successes to date are very impressive in light of the complexity and diversity of issues to be resolved. Most noteworthy is the extensive public participation that has occurred throughout the process.

Betsy Rieke, who, as Assistant Secretary of the Interior for Water and Science, managed the negotiations leading to the Bay-Delta Accord, summarizes some of the lessons learned.

(O)pen, inclusive, and collaborative processes are critical to decisions that will have a reasonable shelf life. Such processes do not mean that the decisions entrusted by law to federal officials are to be delegated to a group decisionmaking process. Rather, such processes assure there will be a genuine search for alternative solutions that provide mutual gains whenever possible. . . . The Bay-Delta experience also demonstrates that collaborative processes alone—regardless of how inclusive and well managed they are—often will not guarantee that long-term, national values receive adequate protection. Water users frequently need external incentives to put water on the table for environmental protection—whether those incentives are federal mandates, federal dollars, or something else. Absent the mandates, of the Clean Water Act and the ESA, there would be no Bay-Delta agreement and, therefore, no enhanced protection for the natural resources in that system (Rieke, 1996). #

Adaptive management potentially accommodates a need for more immediate, broadly focused, and science-based management in many policy areas characterized by technical uncertainty (Lee, 1993). On the other hand, adaptive management may not be easily integrated with existing budgetary practices and may place undue faith and responsibility in the hands of scientific decisionmakers.

Navigating the Road Ahead

Recent experience with water markets and watershed initiatives, among many other efforts, provides evidence that new institutional problemsolving tools are carving a niche in the traditional governance arrangements for western water resources. In general, both strategies have proven themselves to be useful tools that should be utilized further; however, they also are clearly not panaceas for all problems of resource governance. The sobering truth is that no panacea exists, and the rapidly growing demands on western water resources continue to pose a formidable challenge to our capacity for institutional change. Solving the water problems of the West, including the twin governance problems of decisionmaking gridlock and the fragmentation of government, will require the skillful development and application of a variety of problemsolving tools. Market-based and collaborative strategies based on voluntary action, positive incentives, and political viability are currently enjoying broad and significant success (though still with some detractors).

These new strategies appear to be strongly conducive to success, where institutional arrangements used in the past to promote river basin management were largely viewed as failures. This is critical, given the largely unmet need in the West and elsewhere for basin level planning process despite more than a century of experimentation (Rieke and Kenney, 1997). Efforts to force or encourage divergent agencies and political jurisdictions together for the purpose of regionally

integrated resource management have often failed, partly because of the lack of support for these efforts. Similarly, strong forces at work promoting, nurturing, and protecting the status quo have not been acknowledged. While fragmentation of authority and accountability for integrated regional resource management clearly hinders problem-solving efforts in the West and elsewhere, fragmentation and specialization are central elements of "interest group governance"—the dominant mechanism for public policymaking in the United States for the last half-century, as noted earlier (Lowi, 1979). Consequently, the resolution of the West's water problems is to some degree, for better or worse, linked to our larger efforts to improve the quality of government in the United States.

Fortunately, there is some reason to believe that we may be moving beyond the self-imposed limitations on our ability to effectively govern the use of natural resources. Research suggests that a general shift in governance approaches is currently under-way in this country, moving away from the interest-group governance mode (featuring a substantively narrow and geographically broad focus) to a "civic governance" mode (featuring a substantively broad and geographically situational focus).¹² In the context of western natural resources management, the phenomenon of "civic environmentalism" is best illustrated by the growing recognition that issues of water supply, water quality, environmental restoration, and community stability must be approached in a more integrated and comprehensive manner and in a manner that respects the unique physical, political,

¹² In their terminology, the continuum of substantive focuses ranges from narrow to broad, while the continuum of geographic focuses ranges from universal (i.e., uniform policies in all regions) to more situational approaches (i.e., region-specific problemsolving approaches). This leads to a four-part scheme of governance modes, including "interest group governance" and "civic governance" (as explained above), as well as "rationalist governance" (substantively broad and geographically universal) and "populist governance" (substantively narrow and geographically situational).

and socioeconomic qualities of a given region. This provides an excellent basis for addressing the full spectrum of western water issues and improving the mechanisms of governance.

Meeting Obligations to Indian Nations and Tribes

Indians and Indian tribes possess vested rights to water sufficient to provide a homeland. The Supreme Court's opinion in the 1908 case, *Winters v. United States* (207 U.S. 564 (1908)), remains the foundation of Indian water rights. At issue was the claim to use of water from the Milk River in Montana by the Gros Ventre and Assiniboine Indians on the Fort Belknap Indian Reservation as against upstream non-Indian appropriators. The court recognized the "command of the lands and the waters" previously held by the tribes and the concession they had made to stay within the limits of the reservation, exchanging their nomadic life for a pastoral one. Water sufficient to support this pastoral life must have been reserved by this agreement between the U.S. and the tribes, determined the court.

In 1963, the U.S. Supreme Court strongly reaffirmed the existence of tribal reserved water rights, this time in the context of the lower Colorado River.¹³ The existence of these rights

¹³ In *United States v. Adair*, 723 F. 2d 1394 (9th Cir.), cert. denied, 467 U.S. 1252 (1985), the Ninth Circuit held that the Klamath Tribe's treaty intended to reserve water necessary to support the hunting and fishing activities relied on by the tribe. The Ninth Circuit also upheld the existence of a reserved right to support the fishery on the Colville Reservation (*Colville Confederated Tribes v. Walton*, 752 F.2d 397 (9th Cir. 1985)). And the Washington Supreme Court upheld a decision in the Yakima River adjudication, finding a reserved water right for "the minimum instream flow necessary to maintain anadromous fish in the [Yakima] river, according to annual prevailing conditions" (*State Dep't of Ecology v. (continued...) (continued...) (continued...)*)

dates at least from the creation of the reservation, stated the Court. It then established a standard upon which tribal water rights reserved for agricultural purposes could be quantified: the amount of water needed to irrigate all "practicably irrigable acreage" on the reservation.

A major challenge for the federal government is to develop a strategy that results in Native Americans being able to benefit from the *Winters* doctrine¹⁴ and other water rights. Many claims remain unquantified, and quantified and unquantified claims in some instances have not been put to beneficial use because of lack of funding for water projects. In many cases, the sources of water available to satisfy tribal rights are already fully appropriated and used. Particularly when senior tribal rights have not been adjudicated or otherwise quantified, states are reluctant to reduce uses by junior appropriators in favor of senior tribal uses. While the 1973 National Water Commission recommended that all *Winters* rights be adjudicated, we are much more cognizant of costs and limitations of large-scale water adjudications than we were at that time. This policy was actively pursued in the 1970s; and while some *Winters* rights have been quantified, adjudication has not delivered the anticipated "wet" or usable water to the tribes.

In addition, for many tribes the issue is not simply the quantification of their rights. As a matter of politics, new sources of water must often be identified to satisfy tribal rights and to allow junior non-Indian uses to continue. Increasingly, water issues involve complex environmental issues such as

¹³ (...continued)
Yakima Reservation Irrigation District, 850 P.2d 1306 (Wash. 1993)). The Wyoming adjudication, on the other hand, found that the Wind River Tribes could not claim reserved rights on the basis of fisheries maintenance.
¹⁴ The *Winters* doctrine provides that the establishment of an Indian reservation impliedly reserves the amount of water necessary for the purposes of the reservation (*Winters v. United States*).

the preservation of endangered fish, so that tribal issues are interrelated with larger basinwide issues and must be addressed in this context. The long, bitter, and ongoing history of efforts to build the Animas-La Plata Project in Colorado illustrates the complications encountered in redressing past injustices to Native American tribes.

Water Rights Settlements

In the late 1970s, tribes began to seek alternative ways to assert their rights. As of the end of 1996, 15 tribes have negotiated water rights settlements which have been ratified by the Congress, and 1 tribe has negotiated a settlement not requiring congressional action. Another 19 were in settlement negotiations. Negotiations offer the tribes several potential advantages over adjudication:

- Negotiated settlements may be faster and cheaper compared to adjudications.
- Tribes can tailor the application of the *Winters* doctrine to specific requirements of reservations and surrounding areas, eliminating some of the major legal uncertainties about the use of the water and providing means to benefit from the now quantified water. For example, settlements may specify the array of purposes for which water may be used and may allow some form of off-reservation use. The settlement may include provisions enabling tribes to directly secure supplies of water or to provide for water delivery and use systems.

Settlements increase the chances that the tribes will see wet water because the agreements can link rights (and their forbearance) to financial packages which enable tribes to develop their water. However, settlements also present formidable problems because they are ad hoc agreements that generally require congressional approval and financial support from federal and state governments, and they likely will

require judicial recognition to be effective against all water users on or in a given stream or basin.

Despite the demonstrated benefits of settlements, the settlement process has slowed dramatically since the early 1990s, due in part to the way in which the Congress has chosen to account for settlement funds under its budget balancing efforts. The money to implement the federal share of Indian water rights settlements has traditionally come from the Bureau of Indian Affairs (BIA) budget, competing within a limited budget with other priority programs, and, in the view of many individuals and interests, including Secretary Babbitt, this is unacceptable. BIA's budget is not large enough to accommodate the large cost of settlements without severely affecting Indian education and health programs. Interior is currently exploring other avenues of funding, such as Reclamation appropriations and federal hydropower revenues.

Water Marketing

Water marketing may provide an opportunity for tribes to utilize their resources until infrastructures can be built within the growing tribal communities and to provide water during the interim to off-reservation water-short communities. Discussions of Indian water marketing maintain a firm distinction between permanent sales and leases of Indian water rights. The Secretary of the Interior must consent to any title transfer of trust property; however, except for the statutory leasing authorizations contained in specific Indian water rights settlements, the Secretary of the Interior's authority to approve such leases is a subject of substantial debate. Many western states oppose tribal water marketing, however, as inconsistent with *Winters* and assert the authority to approve any changes of use occurring within their boundaries. Basic notions of fairness, as well as economic efficiency, demand that tribes be given the same opportunities to benefit from the use of their water resources as are available to other water rightholders. If legal and policy issues are

addressed, tribal water rights could be marketed at least within the state within which the reservation is located and even interstate. Most tribal water rights settlements have allowed restricted off-reservation marketing.

Tribal Self-Management

Tribes contend that efforts to become more self-sufficient have been eroded by recent Supreme Court precedents and by Congress. The Endangered Species Act (ESA) is an example of such erosion, although the issue is complex. The ESA has been upheld by some courts as an exercise of Congress' plenary power over Native American tribes by making actions on reservations impacting protected species subject to control under the ESA. At least one tribe has used the ESA effectively to increase flows to preserve fish central to the tribe's existence. The Pyramid Lake Paiute Tribe, Nevada, relied on the ESA in response to a 1983 Supreme Court decision which refused to reopen a decree on the Truckee River, which feeds Pyramid Lake. The decision thus precluded the tribe from asserting reserved rights to flows to sustain the cui-ui, a federally listed endangered species. A federal court subsequently held that the ESA required Reclamation to operate an upstream reservoir to protect the species. This precedent enabled the tribe to play a major role in the congressional settlement of many of the disputes in the Truckee-Carson basin and in the implementation of the legislation. Conversely, in the Colorado River basin, some tribes have objected to the application of the ESA to tribes because compliance may be inconsistent with the construction of new and expanded tribal irrigation projects. For example, on the San Juan River in New Mexico, the completion of the Navajo Indian Irrigation Project has been delayed, pending years of studies of the effects of depletions on endangered fish downstream. In 1997, the Secretaries of the Interior and Commerce signed an order directing their agencies to apply the ESA in a manner least intrusive to the rights of tribes to use their natural resources.

Sustainable development requires that tribes play a major role in water use decisions affecting their lands. Many Native American tribes are actively engaged in charting their own future, and water allocation and management play a large role in this. Tribes seek the resources and technical assistance they need to improve management capabilities and to exercise the authority they already have through tribally developed programs or through implementation of federally developed programs.

Indian Irrigation Projects

There are 77 federally authorized and funded Indian irrigation projects in the West, with a total potential for irrigation of almost 4 million acres. However, as reported by BIA (1997):

Because Indian irrigation projects did not receive a large outpouring of political and, therefore, fiscal support, many of the projects were never finished or fell into disrepair. The BIA's shift in funding in the mid-1970s, in combination with a number of other factors, all but eliminated operation and maintenance funds; the consequent disrepair of the facilities has been a source of increasing conflict in recent years as both Indians and non-Indians find it difficult to irrigate their crops with systems that 'leak like a sieve.'

The BIA further states that,

It is critical that a review of these systems and selective rehabilitation and betterment be undertaken soon for a number of reasons. First, as Congressionally authorized projects, federal agencies have a duty to complete them so as to fulfill the intent of Congress with respect to tribes. Moreover, the protection of tribal water resources and the development of tribal economies is central to the trust responsibility. Further, it is essential from the standpoint of certainty that western water users be apprised

Tribal Water Rights Settlements

Water is perhaps the most valuable tribal resource remaining and is one of the most significant potential forces of change. The potential size of tribal water rights should not be underestimated.

For example, water rights claims of the Missouri River basin tribes could total more than 19 million acre-feet, or approximately 40 percent of the average annual flow of the Missouri. As of 1995, there are more than 60 cases in courts involving the resolution of Indian water rights claims. The total amount of water potentially involved in these claims ranges from 45 million to over 65 million acre-feet . . . [i]n Arizona, for instance, 19 Indian reservations account for 20 million acres (28 percent) of the state's land base. Experts have estimated that the water entitlements of Arizona tribes, many of which remain to be quantified, may surpass the state's water supplies.

Since 1982, at least 15 water rights settlements have been ratified by the Congress. These settlements are summarized in table A.

Table A
(Source: National Research Council, 1996)

Tribe	Location	Acre-feet per year
Ak-Chin Indian Water Rights Settlement Act	Arizona	85,000
Colorado Ute Indian Water Rights Settlement Act of 1988 (Ute Mountain Ute and Southern Ute Tribes)	Colorado	92,000 39,900
Confederated Tribes of the Warm Springs Reservation	Oregon	
Fallon Paiute Shoshone Indian Tribes Water Rights Settlement Act of 1990	Nevada	10,588
Fort Hall Indian Water Rights Act of 1990	Idaho	581,031
Fort McDowell Indian Community Water Rights Settlement Act of 1990	Arizona	36,350
Jicarilla Apache Tribe Water Settlement Act of 1992	New Mexico	40,000
Northern Cheyenne Indian Reserved Water Rights Settlement Act of 1992	Montana	91,330
Salt River Pima-Maricopa Indian Community Water Rights Settlement Act of 1988	Arizona	122,400
San Carlos Apache Tribe Water Rights Settlement Act	Arizona	77,435

(See "Tribal Rights," next page)

Tribal Rights (continued)

Tribe	Location	Acre-feet per year
San Luis Rey Indian Water Rights Settlement Act of 1988	California	16,000
Seminole Indian Land Claims Settlement Act of 1987	Florida	—
Southern Arizona Water Rights Settlement Act	Arizona	66,000
Truckee-Carson/Pyramid Lake Water Rights Act	Nevada (California)	520,000
Ute Indian Rights Settlement Act of 1992	Utah	481,000
Yavapai-Prescott Indian Tribe Water Rights Settlement Act of 1994	Arizona	1,550

Negotiated settlement of tribal water claims, as opposed to adjudication through the courts, has some advantages. Through settlement, states can protect water users who have been previously granted water rights through state appropriation systems, the federal government can fulfill its trust obligation to tribes, and the tribes can turn "paper" water rights into wet water rights which can often be marketed to enhance economic development and self-sufficiency. Most importantly, all parties involved can avoid costly litigation.

However, negotiated settlements are not an easy solution. They rely on the willingness of parties to negotiate. Delays and political maneuvering are often considerable. Settlements generally must be ratified by the Congress and, in most instances, need judicial recognition to be effective. Most importantly, settlements generally rely on large infusions of federal funds to provide additional water for tribes without damaging the rights of other water users. Federal budgetary concerns will probably restrict funding of new water settlements and project-based solutions. Accordingly, future negotiators will have to be even more creative.

There are at least 20 pending Indian water rights settlements being negotiated, many of which have been prompted by the specter of litigation or general stream adjudications.

As of 1997, Indian water rights negotiations are shown below.

Tribe	Location
Pueblos of Nambe, Pojoaque, San Ildefonso, and Tesuque	New Mexico
Pueblos of Zia, Jemez, and Santa Ana	New Mexico
Blackfeet	Montana
Crow	Montana

(See "Tribal Rights," next page)

Tribal Rights (continued)

Tribe	Location
Shoshone-Paiute Tribes of the Duck Valley Reservation	Nevada, Idaho, and Oregon
Fort Belknap	Montana
Gila River Pima-Maricopa Indians	Arizona
Pueblos of Acoma and Laguna	New Mexico
Las Vegas Paiute	Nevada
Navajo, Hopi, San Juan Southern Paiute, and Zuni	Arizona, New Mexico (Utah)
Lummi	Washington
Nez Perce	Idaho
Big Pine Bend of Owens Valley Paiute Shoshone Indians	California
Chippewa-Cree	Montana
Shivwits Band of the Paiute Indians	Utah
Soboba Band of Luiseno Mission Indians	California
Taos	New Mexico
Confederated Salish and Kootenai Tribes, Flathead Reservation	Montana
Turtle Mountain Chippewa Tribe	Montana
Zuni	New Mexico
Klamath	Oregon

of the potential volumes of tribal water involved as their projects resume functioning. For those tribes who choose to discontinue to irrigate on a large scale, the mechanism of tribal water marketing could free up large supplies and become a valuable source for environmental, agricultural, hydropower, municipal, and industrial uses (BIA, 1997).

Basic Water Supply and Sanitation Facilities

The provision of basic domestic water supply and sanitation facilities for Indian reservations is a significant challenge. Tribal lands have historically lagged far behind the rest of the nation in basic water supply and sanitation facilities. In 1988, the Environmental Protection Agency (EPA) surveyed water supply for tribal lands and reported that

. . . summer water shortages and limited storage capacity are common problems on many Indian reservations. Except for the Arizona tribes on the Colorado River and in the mountains, most of the tribes experience seasonal water shortages.

EPA also reported that tribal drinking water systems show higher rates of violation for microbial standards than do nontribal systems nationwide. However, these data are collected only for water systems serving 25 or more persons. It is estimated that 650,000 Native Americans are served by water systems serving fewer than 25 persons. Little systematic information is available, therefore, concerning the quality of domestic water used by the vast majority of Native Americans living on reservations (EPA, 1988).

From 1960 to 1995, the Indian Health Service provided water and sewer systems for more than 200,000 Indian homes. However, in 1997, the Indian Health Service estimated that more than 20,000 Indian homes still do not have basic water

and sewer systems and that many times more than this require significant upgrades to meet modern standards. Currently, the Indian Health Service estimates that more than \$600 million would be required to address these deficiencies in sanitation facilities (Indian Health Service, 1996).

Environmental Protection and Restoration

Restoring Aquatic Ecosystems

The protection of fish and wildlife habitats, one of the most difficult problems in water management, is often the driving force in efforts to develop new basin and watershed protection strategies. Fish and waterfowl protection mandates are at the heart of four of six river basin studies prepared for the use of the Commission—the Sacramento-San Joaquin, Columbia, Platte, and Truckee Carson—and are playing an increasing role in the Colorado River and the Rio Grande.

The emphasis on the protection of fish and migratory waterfowl is one of the most dramatic changes in federal water policy since 1973 and is leading to a more holistic focus on the restoration and maintenance of healthy aquatic ecosystems. The 1973 Commission emphasized the incorporation of fish protection measures and flow release schedules into new projects, rather than the restoration of existing degraded systems. However, the events of the past 20 years have rendered this focus outdated—a key issue today is the potential reoperation of existing projects to help restore aquatic ecosystems, as was noted in foregoing sections.¹⁵ The evolution of Reclamation's budget illustrates this shift in priority. Reclamation's fiscal year total budget for 1998 is \$948.3 million. The

¹⁵ The importance of ecosystem integrity has been a central focus of recent water policy reviews and recommendations.

Water and Power Resources account gets the largest share—\$666.4 million—but this represents a 12-percent decrease from the previous year. Facility operation and maintenance is budgeted at \$275 million, with about \$96.1 million for dam safety. The new Water and Energy, Fish and Wildlife, and Land Management account is budgeted at \$422.3 million. Only about \$120 million is allocated to project completion; the rest is for ecosystem restoration, especially in the Bay-Delta and Central Valley of California, and for fish recovery and pollution reduction projects.

The construction of dams and the diversion of water from river systems or basins have contributed to the decline of historic natural fish populations in many river basins throughout the West. Dams and water diversion patterns have also increased predation, reduced wildlife habitat, and increased pollution. The lowered Mono Lake levels caused by transbasin diversions in California, the loss of whooping crane habitat along the Platte River in Nebraska, and the low and toxic volumes of water entering the Stillwater Wildlife Refuge in Nevada are examples of nationally prominent conflicts between consumptive use and wildlife habitat maintenance. Impoundments and diversions are not the sole source of declining fish runs; land use and forestry practices in riparian corridors, point and nonpoint source discharges, and natural weather cycles also contribute to the problem.

The immediate dilemmas facing modern water managers concern the preservation of existing native fish species and wildlife habitats, as well as the restoration of degraded habitats to increase their productivity. But there is also a growing recognition that the development of ecological baselines and the maintenance and restoration of healthy aquatic ecosystems are the best ways to avoid the bitter fish-versus-diversion conflicts that now pervade the West. There are three primary reasons for this. First, the ESA makes protection of listed fish and wildlife an absolute priority. The ESA directs the Fish and Wildlife Service (Service)

or the National Marine Fisheries Service of the Department of Commerce to list species, subspecies, or distinct populations of fish and wildlife as threatened or endangered; the difference reflects the degree of extirpation risk. Once a species is listed, federal agencies or permittees may not take any action likely to jeopardize the continued existence of the species, including habitat destruction or modification. Second, the ESA applies to existing activities as well as to future ones. Third, there is increasing recognition that there are few "natural" aquatic environments to preserve. More and more, the emphasis is on the restoration of degraded systems.

Protecting Water Quality

Sustainable development and management requires that we maintain streams and aquifers capable of supporting a broad range of human and ecosystem functions. In general, the quality of the West's waters is good, measured by the ability to support fish populations, human contact, and a wide variety of human and commodity production uses. EPA's *Water Quality in the West* report describes the majority of the West's waters as having "generally good" water quality, adding that, however, "in many instances it suffers from varying degrees of degradation" (EPA, 1998). This conclusion is encouraging but is based on a summary of the indices used to measure water quality. We rely on indirect measurements—temperature, dissolved oxygen, fecal coliform bacteria, dissolved solids, nitrates, phosphorus, and suspended sediment—to evaluate water quality. However, these indices do not fully reflect the status of the West's rivers or riparian areas. Measurement is further complicated because natural and anthropogenic factors interact in complex ways to affect surface water quality, and the indices do not reflect the problem of inadequate data. We do not have a comprehensive inventory of the extent of pollution in rivers; we have fragmentary information that can only provide a snapshot of water quality issues.

Dam Removal: A New Option

Removal of existing dams for environmental purposes is an idea that is being actively investigated in a number of locations in the United States. In Michigan and Wisconsin, a basinwide study of the Menominee River associated with FERC license renewal has resulted in an agreement to modify operations at some dams and to remove three dams—Sturgeon Hydro in Michigan and Pine Hydro and Woods Creek in Wisconsin. Issues identified to date include sediments, fisheries, wetlands, waterfowl, and contaminants. The agreement calls for the removal of the three dams in steps, with the first being removed 5 years after the agreement is approved, the second 7 years after, and the last 29 years after FERC approves the agreement.

On the Olympic Peninsula in Washington state, a cooperative study by the National Park Service, Reclamation, the Corps, and the Service has led to a proposal to remove the two dams on the Elwah River. These dams (Glines Canyon and Elwah) currently are used for hydropower generation and were privately constructed in the early part of this century. Removal should help restore a number of anadromous fisheries in the river. Additionally, the anadromous fish resource is of cultural significance to the Lower Elwah S'Klallam Tribe, and its restoration would uphold the federal trust responsibility. The environmental impacts analysis identified silt and the control of the silt deposits behind the dams as significant issues to be addressed in removal of the dams.

Finally, and most speculatively, a study is underway to evaluate removal of four dams on the Lower Snake River to help restore Snake River salmon stocks. The four dams (Ice Harbor, Lower Monumental, Little Goose, and Lower Granite) were constructed by the Corps in the 1960s and 1970s. The Corps is now examining if it is reasonable to remove the dams and what other actions may be necessary to restore the salmon. A significant question is whether the river, even with dam removal, can be restored to a fish friendly condition.

While removing dams has potential to significantly restore ecosystems, little experience exists anywhere with the consequences of removing an existing dam. Definitive answers to persistent questions of stream rehabilitation within the reservoir pool and silt impacts to the downstream reaches are not available and are not likely to be available until a removal is completed and impacts studied.

For the first time in history, FERC has denied a relicensing request for an operating hydroelectric dam and made the unprecedented recommendation that the 160-year-old Edward Dam on the Kennebec River near Augusta, Maine, be completely removed to help restore spawning habitat for nine migratory fish. The state of Maine, as well as the Departments of Commerce and Interior, has endorsed the recommendation. FERC conducted an independent analysis of three options—the status quo, keeping the dam but spending \$10 million to build fish passage facilities, and dam removal—and found the latter to be the best and least expensive option as part of a comprehensive plan for developing and improving the Kennebec River basin.

Interior Secretary Babbitt has supported the recommendation, stating:

The Commission made a difficult but brave decision: that a river is more than the sum of its kilowatthours, that its potential energy goes far beyond any electricity it may generate. The Kennebec can once again stand as a model for the nation. Its true power will become self-evident in the many species of teeming anadromous fish that will soon swim and spawn there again, in the anglers who will inevitably seek them, and in the local sustainable sportfishing economy which will steadily grow up around those anglers and recreationists. #

An important challenge for federal and state decisionmakers is to find ways to collect and synthesize the information that will enable them to formulate baselines against which adaptive management can be measured. The Sacramento-San Joaquin study found that, after years of research on the Bay Delta, a model of an undisturbed ecosystem the size of the Bay Delta did not exist, and the CALFED process has not established "the ecosystem baseline."

The primary regulatory focus of the Clean Water Act has been elimination of point source municipal and industrial discharges and toxic wastes. The assumption was that this would improve the quality of receiving waters. Today, the emphasis on biodiversity conservation has placed increased emphasis on defining the conditions for a healthy aquatic ecosystem. As states and the federal government struggle to decide how to protect endangered fish populations, river parameters are being set that make preservation of endangered and threatened native species the driving factor in all present and future water use decisions.

An eastern regional perspective is also reflected in the greater attention to point rather than nonpoint source reduction. Agricultural drainage water is exempt from the requirement to obtain a discharge permit when discharged through a point source. Additionally, farm runoff that is nonpoint source pollution is not subject to national technology-forcing standards, and states have considerable discretion in how they approach managing these nonpoint sources. Regulation of nonpoint sources is not required by the Federal Clean Water Act. A major future challenge will be to reduce nonpoint source pollution from irrigation, livestock production, and mining and timber production, as well from urban runoff, in an effective and affordable manner.

Ultimately, water quality cannot be separated from the general problem of the restoration and maintenance of healthy and productive aquatic ecosystems. We need to provide the incentives and regulations that prevent pollution at the source. However,

controlling discharges must be coordinated with maintaining adequate streamflows and managing exotic species. We can no longer maintain the artificial separation between water quality and quantity. This requires maintaining national pollution standards, but also the recognition that basin and watershed entities must have some flexibility to apply and adapt them to local conditions.

Flood Plain Management

Floods are an endemic part of the hydrologic cycle, but we have been unable to develop management policies that effectively reduce flood damage. Sustainable flood management is ultimately an important component of aquatic ecosystem maintenance and restoration. It requires the greater use of ecosystem functions, such as wetland and upstream retention, and greater efforts to prevent flood damages by discouraging high-risk uses of flood plains (Interagency Flood Plain Management Review Committee, 1994). Unlike ancient civilizations such as Egypt, which built their agriculture and social systems around periodic flooding, we treat floods as natural disasters to be prevented or mitigated to the maximum extent possible. The 1997 cycle of floods repeated a familiar pattern and elicited the traditional call for federal assistance to property owners damaged by flooding. Our characterization of floods as preventable natural disasters has led to unsustainable land use practices that need to be reversed in upstream watersheds and on flood plains.

Characterizing floods as natural disasters has made it difficult to recognize the need for periodic inundations on some river systems to maintain their historic natural productivity and their riparian zones. In the West, we have altered the natural flow cycles of most large rivers by impounding them for multiple uses. One major cost of reservoir construction, as the Commission was informed, is that river "productivity has . . . shifted riverine to lentic productivity associated with large reservoirs,

and the historic balance between retention and transport has been altered" (Grimm, 1997). Not only do we fail to recognize the ecosystem and economic benefits of seasonable flow regimes, but we engage in land use practices that exacerbate the magnitude and scale of flooding. Both urban development and rural land use practices have contributed to this problem (Minckley, 1997).

Since the 1930s, our approach to flood control has been to prevent floods by building large reservoirs to retain flows and subsequently release them at nonflood levels, and by investing in levees, dikes, and channelization to increase channel capacity in flood-prone river segments. For example, during the 1996-97 floods in California, outflows from the Folsom Dam on the American River were 252,000 cubic feet per second (cfs), compared to the normal outflow of 10,000 cfs. The dam prevented floodwaters from rising 10 feet above the levees in Sacramento (Western States Water No. 1183, January 17, 1997).

However, there is a growing dissatisfaction with our exclusive reliance on upstream storage and channel modification. The common theme in the modern flood control debate is the recognition that water and land management policies have increased the magnitude of floods and settlement of flood plains, and thus the amount of flood damages. In addition, flood plain management programs have not succeeded in mitigating flood losses in most situations. Multiple purpose dams have often increased downstream flooding by diminishing the channel's capacity to pass floods. They have also eliminated flood cycles that replenished stream systems and ecosystems. For example, the Elephant Butte Dam on the Rio Grande in New Mexico has increased flooding in El Paso by reducing flushing of the stream channel downstream. Sediment from bank scouring has combined with sediment loads from undammed tributaries to raise the bed level downstream. The net result is that, even though Elephant Butte Dam has reduced predam flows at El Paso by as much as 75 percent, small floods can

do a great deal of damage (Collier et al., 1996). One of the lessons that the Commission learned from the Aquatic Ecosystem Symposium is summed up in a 1996 U.S. Geological Survey paper:

Floods are a key element in the future management of dams. Without periodic high flows, some channels downstream from dams will aggrade with sediment or narrow with overgrown vegetation. Two or three flood free decades may have been traded for more devastating floods in the future (Collier, et al., 1996).

There are basically four ways by which humans adjust to floods. Unlike many other water programs, these approaches require the cooperation of all levels of government to implement.

1. We can bear the loss.
2. We can modify the loss burden by (1) emergency measures that remove humans from the path of a flood, or (2) redistribution of the loss through insurance or government-financed relief.
3. We can limit our susceptibility to damage by limiting land uses in the flood plain to those that are the least vulnerable to floods, by preserving the major flood channels, by designing structures to withstand floods, or by floodproofing buildings to the maximum extent possible.
4. We can confine water to the channel through levees and floodwalls, and we can minimize the scope of the flood by preserving wetlands and floodways.

Land use regulation is a relatively efficient way to minimize flood damage, but it is still easy to build in flood plains because few state or local governments pursue flood plain management aggressively.

"We'd Like to Make One Thing Perfectly Clear"

Arthur C. Clarke's "third law" states that sufficiently developed technology is indistinguishable from magic. We seldom deal with technologies as dramatic as that in natural resource management. However, the Agriculture Research Service's (ARS) lab in Idaho has developed a simple technology with truly dramatic effects. The team has found that a dash of Polyacrylamide (PAM, a white powder) in furrow irrigation water virtually halts furrow irrigation-induced erosion. Contrasting untreated and PAM-treated runoff is like comparing a milkshake with bottled drinking water. In 3 years of ARS tests, erosion was reduced 80 to 99 percent (an average of 94 percent) using the application method adopted by Natural Resources Conservation Service as an interim standard (10 parts per million in advancing furrow streams, about 1 pound per acre). Drastic reductions in runoff P, N, BOD, and pesticides have also been documented. This research was initiated in 1991 to address the many problems associated with irrigation induced erosion, including:

- Sediment in irrigation return flows may cause water use impairment from sediment pollution and agrichemical transported by sediment, resulting in major water-quality degradation of several rivers in the western United States, harming fish and other aquatic life.
- Erosion reduces the agricultural productivity of the fields and causes off-farm damages. In southern Idaho, crop yield potential has been reduced by 25 percent due to 80 years of irrigation-induced erosion.
- Some irrigation districts spend more than \$50,000 annually to remove sediment from drains.

ARS's initial research led to demonstration projects throughout the West sponsored by the Natural Resources Conservation Service, the University Cooperative Extension Service in several states, and major distributors of PAM. Some users believe continued use could cut down on the size of sediment basins needed—resulting in less maintenance and more productive land.

A by-product of PAM's use may be water conservation and increased yields. Because farmers can irrigate without the usual risk of erosion, PAM use also opens the door to new surface irrigation management. Longer furrows, higher flows, and shorter sets can be used without erosion and potentially still provide improved irrigation uniformity and less leaching of soluble chemicals and fertilizer to groundwater. PAM's ease of use has led to ready acceptance by farmers who were reluctant to adopt more difficult conservation measures. PAM (at \$3.50-\$5 per pound) is economical, requiring 3-7 pounds per acre to protect most crops all season.

Because of successes and its ease of use, growth of PAM use has been phenomenal. PAM's use grew from an estimated 50,000 acres during its 1995 debut to near 500,00 acres in 1996. Based on sales inquiries, the 1996 acreage of use could double or triple in 1997. An environmentally safe product, the industrial/governmental use in the U.S., including in municipal water treatment systems, is nearly 200 times the current use in agriculture. Most of that use is via water treatment processes that deliver effluent directly to riparian waters as contrasted with agriculture use where studies to date have not detected measurable losses to riparian resources. Research across the West is now looking at PAM application in sprinklers and dozens of other new ways to use PAM's remarkable properties to benefit agriculture and the environment.

As Bob Sojka and Rick Lentz, ARS soil scientists in Kimberly, Idaho, who initiated the PAM research, continue to say in regards to runoff from irrigated fields, "We'd like to make one thing perfectly clear." Farmers across the West are now doing just that. #

—Ron Marlow, Natural Resources and Conservation Service, Department of Agriculture.

Federal programs can also undercut those state and local efforts which do encourage more responsible use of flood plains. For example, in response to recent hurricanes, earthquakes, and floods such as the Mississippi valley floods of 1993, the federal-state cost sharing of Federal Emergency Management Agency disaster assistance programs for these events was raised from 75/25 to 90/10. As the Galloway Report (published by an executive task force following the 1993 Mississippi floods) observed, such a program establishes:

... an expectation of similar treatment in subsequent disasters and increases political pressure to provide a lower nonfederal share. This perpetuates the dominant federal role in recovery and increases federal costs.

It also defeats "the fundamental purpose behind cost sharing, which is to increase the amount of local involvement, responsibility, and accountability" (Interagency Flood Plain Management Committee, 1994).

Federal water resource planners within and outside the Corps have long been aware of the limitations of over-reliance on structural flood control measures. Recent severe floods have prompted renewed interest in nonstructural flood control measures as an integral part of river basin flood management. The Galloway Report articulated a new vision of flood plain management that included two strategic goals: (1) reducing the vulnerability of the nation to the dangers and damages that result from floods, and (2) preserving and enhancing the functions of flood plains (Interagency Flood Plain Management Review Committee, 1994). The flood plain of the future includes much human activity, but the most vulnerable activities would be relocated to higher ground, and those who choose to reside and use flood plains without taking mitigation steps would assume more of the risks of flooding. Greater use would be made of natural retention areas, such as

sloughs and wetlands, and other upstream runoff retention strategies to complement dams and levees.

Protecting Productive Agricultural Communities

The changing West produces winners and losers, as population growth affects the nature of communities and increases the nonagricultural uses of water. Many communities are facing intense pressures to abandon long-established patterns of economic livelihood and culture. Urbanization and the division of large rural holdings into smaller, often second-home parcels, are changing the landscape and life of many western small towns. To aggravate matters, agricultural subsidies are being withdrawn, and market pressures are reallocating land and water to new uses.

Many of these western communities may, in fact, be practicing (or could practice) sustainable resource use with the appropriate encouragement. Farming and ranching practices can be, and in many instances are, maintained in an environmentally sound manner. When this is done, the landscape is maintained out in a manner more consistent with aquatic and terrestrial ecosystem conservation, as compared to piecemeal urbanization and suburbanization.

Water Policy

It is difficult, however, for local leaders and water managers to preserve the historic nature and culture of local communities in the face of development pressure.

Water policies only indirectly affect growth patterns; and where they do have an effect, water policies have historically supported development. The limited role that water law and policy play in stabilizing rural communities is illustrated by the National Academy of Science's study of western

water transfers. *Water Transfers in the West: Efficiency, Equity, and the Environment* (NRC, 1992b) recognized that impacts on rural communities—such as "changes in the quality of community life, feelings of connectedness to the land, and a sense of control over an area's destiny"—are legitimate third-party effects of water transfers. However, the report did not indicate the process that would lead to community stability when water is reallocated, reflecting the long-standing social policy that government has no special responsibility to protect communities from the discipline of the market.

Western water law is based on the understanding that human needs often require water to be removed from streams and transported over long distances, often out of the basin of origin. This idea is expressed as a "policy of capture," which allows water to be removed completely out of its natural watershed, sometimes leaving little or none for those who may have need for it later (Bates et al., 1993). Various measures have been proposed to alleviate these impacts. The National Water Commission suggested that a transfer of water from one basin to another should be permitted only when it has been proven to be the lowest economic cost source of water supply and to have benefits that exceed all costs (National Water Commission, 1973). Others have suggested that areas of origin should be adequately compensated for their economic losses (MacDonnell et al., 1985), but such compensation would do little to address the social and cultural impacts that may result. Public utility law complemented prior appropriation because most water suppliers have assumed that they have a legal duty, as public utilities, to provide adequate supplies for all anticipated growth and in seasons of drought.

The insistence by many westerners that land and water are exclusive individual property rights with no community dimension means that the control of land and water is decentralized. Land and water are alienable property rights, and individual right-

holders are generally free to respond to market pressures without regard to the impact of a decision to break up a parcel of land or transfer a water right on the surrounding community.

The historic acceptance of a duty—noted above—to provide the necessary water for unlimited growth has further acted to separate water from land use issues. The problem is exacerbated because land use controls have largely been delegated to the county and municipal level, except in a few states such as Oregon. Water allocation, however, remains primarily a state function. This historic separation of land and water law and policy is now changing. States are beginning to link more closely water supply and land use planning objectives, and these initiatives give local governments some ability, if they take advantage of it, to control the use of local water resources. In 1965, California enacted legislation—primarily in response to the rapid growth and conversion of prime agricultural land in the San Joaquin valley—that requires cities to have a firm water supply plan in place before large, new developments are approved. This limits the power of cities to approve new growth and defer the issue of the provision of an adequate water supply until a later date. An intermediate appellate court has also interpreted the California Environmental Quality Act to reinforce the duty to match growth to availability of water supplies. Further, California historically has refused to regulate groundwater use at a state level; but in recent years, the legislature has given individual counties the right to control exports.

Community Influence

Communities typically do not control the allocation or reallocation of water—but state laws often provide local communities some leverage to influence water transfers. Most states have liberalized standing rules to allow nonwater rightholders to

New Approaches to Flood Management

The 1994 report, *Sharing the Challenge: Floodplain Management Into the 21st Century*, was produced by an interagency task force created to deal with the 1993 Midwest flooding and recovery. One of the main recommendations of the report was to place a new emphasis on using nonstructural solutions for flood damage prevention; to look for opportunities to move people and structures out of frequently flooded areas or to reduce their vulnerability to flood damage, rather than using dams and levees to prevent the area from flooding.

Historically, nonstructural solutions to flood mitigation have been one of the tools employed in federal flood management programs. Below are listed some recent nonstructural projects undertaken by the Corps.

Location	State	Description	Year
Allenville	AZ	Acquired 54 houses, replaced outside of long term	1981
Prairie du Chien	WI	Acquired 122 houses, 2 commercial structures	1984
Wilson Bridge	SC	Relocated six homes	1984
Sope and Proctor Creek	GA	Acquired and relocated 45 homes	1986/ 1990
Ardsley	NY	Floodproofed four commercial structures	1989
Malhuer Lake	OR	Raised 6.3 miles of railway	1990
East Brewton	AL	Acquired 19 commercial properties	1993
Williamson	WV	Floodproofed 54 homes	1994

(Source: Corps, 1997)

These new approaches were emphasized immediately following the Midwest floods. More than 12,000 structures have been acquired or relocated, and more than 250,000 acres of flood-prone land have been acquired by state and federal agencies.

This new emphasis in flood mitigation has been formalized in law and federal programs through subsequent legislation:

Flood Insurance Reform Act of 1994
1996 Farm Bill

Water Resources Development Act of 1996
Crop Insurance Reform Act of 1996

(See "Floods," next page)

Floods (continued)

Recently, the White House issued guidance (Memorandum Executive Office of the President (dated February 18, 1997) that reflects the main principles of *Sharing the Challenge*. Its stated purpose is "to ensure the agencies fully consider relevant options, including nonstructural alternatives, during the evaluation and review of levee repair and reconstruction projects and associated restoration necessitated by the 1996 and 1997 floods." Its goal is "to achieve a rapid and effective response to life and property, while ensuring a cost-effective approach to flood damage mitigation and flood plain management and the protection of important environmental and natural resource values that are inherent to the long term and adjacent land."

The California Governor's Flood Emergency Action Team Report (May 1997) was prepared after the January 1997 floods, in part to guide improved flood response and recovery. It also reflected interest in and support for less traditional responses to flood recovery, in particular, the need to develop integrated planning to aid future flood response and recovery efforts consistent with joint state/federal long-term water resource management and environmental restoration goals. #

participate in water rights proceedings, but there is little substantive protection for community stability. Most states have the power to subject new appropriations to a public interest review, and this standard is now being extended to transfers. Statutes in California, Idaho, Montana, Nebraska, Texas, and Wyoming give state water administrators the power to take public interest considerations into account in transfers (Grant, 1987). A Utah court interpreted Utah's transfer statute to include public interest review (*Boham v. Morgan*, Utah, 1989). The Idaho Supreme Court has ruled that state law allows the Department of Water Resources to invite protests in change of place of diversion proceedings from third parties beyond those in the immediate area of the diversion, and this ruling was upheld on appeal.¹⁶ A New Mexico trial court opinion held that a proposed change of water use from livestock and early season flood irrigation to a ski resort was invalid, even though there was no proof of any injury to vested rights. The court held that the transfer was contrary to the public interest because

... the Northern New Mexico region possesses significant history, tradition and culture of recognized value, not measurable in dollars and cents; the relationship between the people and their land and water is central to the maintenance of that culture and traditions and the imposition of a resort-oriented economy in the Ensenada area would erode and likely destroy a distinct local culture that is several hundred years old.

The case was reversed on appeal because the New Mexico transfer statute at the time did not allow public interest considerations in transfers, and

¹⁶ *Hardy v. Higginson*, Case No. 92599 (District Court of the Fourth Judicial District of the state of Idaho, July 25, 1990), affirmed in part, rev'd in part 123 Idaho 485, 849 P.2d 946 (1993), upheld the power of the state engineer to impose conditions on diversions from the critical habitat of a candidate fish for listing under the Endangered Species Act.

the New Mexico Supreme Court refused to hear an appeal (*Sleeper v. Ensenada Land and Water Association*, New Mexico, 1988). (New Mexico law now allows the public interest to be considered in transfers.) This case has led some to suggest that communities be given a veto over major water rights transfers (DuMars and Minnis, 1989). Public interest review can be supplemented by the public trust doctrine. Some states hold that vested water rights are subject to the public trust (*National Audubon Society v. Superior Court of Alpine County*, 1983). This judicially controlled doctrine permits a court to balance the environmental and consumptive values of a water use and, in some states, to require that consumptive uses of navigable waters be subordinated to ecosystem maintenance. Thus, transfers could be judicially invalidated because they are inconsistent with the public trust use of the water. However, the trust doctrine has not been extended beyond the protection of fragile ecosystems.

Communities can benefit from statutes that either revive the original idea that water rights were appurtenant to the land where the water was initially applied to beneficial use or that protect the area of origin of the water. The 1992 Central Valley Project Improvement Act is an example of a modern appurtenancy statute:

- Transfers in excess of 20 percent of a contracting agency's long-term space entitlement are subject to agency approval (§ 3405(1)).
- The amount of transferable water cannot exceed the average annual quantity delivered during the last 3 years of normal water delivery before 1992.
- All transfers of water out of the Central Valley Project service area are subject to a right of first refusal by the agencies within the project service area (§ 3405(1)(F)).

High Stakes! Preserving Colorado's Great Outdoors

When it comes to innovative funding mechanisms, Colorado voters showed great foresight when they chose to use the proceeds from the Colorado Lottery to fund a program to preserve Colorado's "Great Outdoors." The Great Outdoors Colorado (GOCO) program was approved by the voters in 1992 to protect wildlife and habitat and recreational resources, and to provide grants to state agencies, counties, and local and other entities to acquire and manage open space and parks.

To date, GOCO has invested \$94 million in 791 projects throughout the state. The projects range from large, multiyear projects—such as the South Platte River Project to restore the river corridor, trails, and wildlife habitat—to smaller grants such as those to help the town of San Luis create its first park. The popularity of the GOCO programs is clear: it receives three times as many project requests as it can fund. To spread its resources as far as possible, GOCO encourages its grant recipients to leverage their money with partnerships and other sources of revenue.

As Colorado's population rapidly grows, creating suburban sprawl and filling the farm and ranchlands with ranchettes and second homes, communities throughout the state are seeking ways to preserve the quality of life in their areas, protect agricultural communities, provide wildlife habitat and corridors, and provide recreational opportunities. GOCO has provided planning assistance to these communities.

One recent example illustrates the remarkable changes taking place in Colorado. In the Gunnison valley, ranchers, environmentalists, and other local citizens watched with growing concern as the valley ranchlands and scarce riparian areas were divided, sold, and developed for second homes. They decided to put aside old animosities and take collective action before their valley turned into another Aspen. Over a period of years, they met, got to know each other better, determined their common goals, and worked out a plan to save their valley and keep the local ranchers in business.

Their plan is relatively simple: raise funds to purchase conservation easements on ranch and riparian properties and put those lands into permanent trusts so that they cannot be developed. The ranchers, already financially stressed, will get some cash as the conservation easements are purchased, and their taxes will go down because their land will no longer be developable. The coalition approached GOCO to help with funding. GOCO liked the fact that the plan was well thought out and had the support of the broad community (*Time*, 1997) and awarded a \$2 million grant to fund the Gunnison Legacy project. It is now up to the local sponsors to raise the rest of what they need and make their plan work. #

¹ For more information about Great Colorado Outdoors, contact its offices at 303 East 17th Street, Suite 900, Denver, Colorado 80203. Telephone 303-863-7522.

Public Trust Doctrine—Its Role in Protecting Water Resources

In the past 25 years, the legal concept of "public trust" has played a significant role in western water management. The public trust concept has some of the oldest roots of any legal doctrine, tracing its origin to the ancient Romans. Public trust rights were set forth almost 1,500 years ago as a part of the Corpus Juris Civilis, promulgated between 529 and 534 A.D. by Roman Emperor Justinian. Roman public rights in water and the seashore were generally unrestricted and common to all. Generally speaking, the public trust doctrine involves:

. . . that aspect of the public domain below the low water marks on the margins of the sea and the great lakes, the waters over those lands, and the waters within rivers and streams of any consequence. . . . Traditional public trust law also embraces parklands, especially if they have been donated to the public for specific purposes; and, as a minimum, it operates to require that such lands not be used for nonpark purposes (Sax, 1970).

In the United States, the public trust doctrine has been closely associated with the state sovereign ownership doctrine, which asserted that when a British Colony or U.S. territory achieved statehood, the state received immediate ownership of certain lands and waters previously owned by the Crown or the U.S. government. "These natural resources are viewed as being held by the state in a fiduciary capacity, for the benefit of the members of the general public" (Beck, 1991). In other words, the significance of these public resources creates a public interest in how these resources are used, and this public interest rises to the level of a trust responsibility. It is uncertain at what point private use of a public resource violates this trust responsibility.

The first application of the public trust doctrine in the United States came in *Illinois Central Railroad v. Illinois* (1892). The Illinois Central Railroad fought the repeal of a statute that granted the railroad ownership of submerged lands in Lake Michigan. Ownership was given in consideration for providing a percentage of profits to the state on monies made from docks and wharfs on these lands. The U.S. Supreme Court ruled that these lands were held in trust for Illinois citizens and therefore the state could not convey these lands in a manner inconsistent with this trust responsibility.

How this doctrine is applied today is highly controversial.

Three types of restrictions on government authority are often thought to be imposed by the public trust: first, the property subject to the trust must not only be used for public purposes, but it must be held available for use by the general public; second, the property may not be sold, even for a fair cash equivalent; and third, the property must be maintained for particular types of uses. The last claim is expressed in two ways. Either it is urged that the resource must be held available for certain traditional uses, such as navigation, recreation, or fishery, or it is said that the uses which are made of the property must be in some sense related to the natural uses particular to that resource. As an example of the latter view, San Francisco Bay might be said to have a trust imposed upon it so that it may be used for only water-related commercial or amenity uses . . . but it would be inappropriate to fill the bay for trash disposal (Beck, 1991).

Modern expansion of the public trust doctrine came in *National Audubon Society v. Superior Court* (1983), more commonly known as the "Mono Lake" case, where the court applied the doctrine to water appropriation. For years,

(See "Public Trust," next page)

Public Trust (continued)

Los Angeles had diverted water from Mono Lake tributaries, significantly affecting water quality and water quantity in the lake. The appropriations were challenged on the basis that they violated the public trust, and the California Supreme Court held that Los Angeles water rights are subject to limitation in order to protect the public right to water in Mono Lake itself.

Prior to National Audubon Society, however, courts had not applied the doctrine to limit diversions of water from navigable water courses. . . . [This] decision potentially allowed the state to reallocate water from private consumptive use to public instream uses. . . . Moreover, the court's decision did not suggest that these involuntary reallocations for public uses triggered compensation for a 'taking' under the state of federal constitution (Weber, 1995).

In most states, hints of public trust considerations can be found in legislative or judicial requirements imposed upon state engineers, or their equivalent, when they are reviewing applications for water appropriations. Public trust ideals are reflected in mandating consideration of the effect of water allocation decisions on fish and game resources and on public recreational opportunities associated with streams, rivers, and lakes (Alaska Stat. 46.15.080 (1987) and North Dakota Cent. Code 61-04-06 (1993)). In other states, public trust doctrine ideals emerge from beneficial use definitions.

Beneficial use definitions have included appropriations of water for wildlife (*McClellan v. Jantzen*, 26 Ariz. App. 223, 547 P.2d 494 (1976), recreation, and fish and wildlife (American Bar Association, 1988)). Beneficial use consideration at the administrative level has essentially created instream flows for fish. In South Dakota, an appropriation application was denied because the waters in question were some of the most productive spawning grounds for fish, especially brook trout. The administrative denial was based on public interest in maintaining the present flow and temperature of the water for the fishery and outweighed the proposed use by the applicant (American Bar Association, 1989).

Still, the public trust doctrine is not firmly entrenched in American law for

[d]espite the plausibility of treating the statements in Illinois Central on the fiduciary obligation of a state as an expression of federal law, they have not been treated subsequently as binding on the states. Years later, the Supreme Court itself characterized Illinois Central as an application of Illinois law, and generally the state court decisions do not treat Illinois Central as binding upon them (Beck, 1991).

Realizing this, some state legislatures have sought to limit their own public trust responsibilities. The Idaho legislature has specifically excluded the public trust doctrine from applying to management or disposition of state constitutional lands; appropriation or use of water; or the granting, transfer, administration, or adjudication of water or water rights as provided for under the constitution and water code, or under other procedure or law applicable to water rights in the states; and protection or exercise of private property rights within the state (*Water Strategist*, 1996).

Just how, or if, the public trust doctrine fits within the spectrum of state sovereign ownership is unclear. States apparently have broad discretion in interpreting their public trust obligations, and the extent to which they can limit these obligations is unsettled. #

Area-of-origin protection legislation developed in California prohibits the state from transferring appropriations when the transfer will deprive the county in which the water originates of water necessary for its development (California Water Code § 10505). A broader statute protects watersheds of origin and adjacent areas from the export of water to supply projects such as the Central Valley Project (California Water Code § 11460). Area-of-origin protection principle can be expanded to encompass river basin protection in appropriate circumstances. The California Delta Water Rights decision (*United States v. State Water Resources Control Board*, 1986) used the state public trust doctrine and state water quality law to extend area of origin protection law to both upstream and downstream diversions to protect water quality and fish and wildlife.

In recent years, rural communities have asserted their interests more aggressively, and these experiences provide some examples for communities who want to develop sustainable water use and growth plans. Control over their water resources is an important symbol of community. As water scholar Helen Ingram has written:

Strong communities are able to hold on to their water and put it to work. Communities that lose control over their water probably will fail in trying to control much else of importance (Ingram, 1990).

In the early 1990s, for example, a diverse mix of residents of Colorado's San Luis valley successfully opposed a private company's proposal to pump and

transport groundwater from their basin to faraway urban areas. Funded by a self-imposed tax, the locals were able to participate in water court proceedings that ultimately led to the defeat of the proposed water export (Bates et al., 1993). Water managers in Colorado's Arapahoe County ran into similar local opposition when they proposed a network of diversions, reservoirs, and pipelines to transport water from the Gunnison River basin on the western slope to the rapidly growing Front Range. In other western river basins, rural residents are finding the means to resolve water disputes outside the traditional channels. For example, irrigators and environmentalists hammered out an innovative instream flow protection scheme for the Clark Fork River in Montana as an alternative to costly and time-consuming litigation. The coalition's plan was later adopted by the state legislature and now guides water management in the upper basin (Snow, 1996).

These and many other stories of rural communities organizing around water offer support for the statement that,

... [b]ecause water is a highly emotional issue closely bound up with ideas of community, self-determination, and survival, it prompts a committed, group response that is a necessary ingredient to successful economic development (Brown and Ingram, 1987).



History of the Federal Water Programs

This chapter briefly reviews the historical evolution of the water resources missions of the federal agencies.¹ Two major themes emerge in this chapter. First, the objectives of the federal water resources programs have evolved from regional project development to resource management. The federal government's transition from regional developer to resource manager is still incomplete. Second, this evolution has not been accompanied by the development of hydrologically rational governance units to resolve the intense conflicts that have arisen from increasingly more diverse demands for water.

The following topics are discussed:

1. The federal constitutional authority to manage water.
2. An overview of the history and evolution of federal involvement in water policy, development, and management. This section discusses the major areas of navigation, flood control, irrigation, Native American water issues, hydropower, pollution control, and fish and wildlife. In the context of watershed management, the responsibilities of the land

management agencies and the interrelationships among those activities, water resources, and watershed management are also discussed.

3. A summary of previous major national water commissions, including a description of recurring themes among the Western Water Policy Review Advisory Commission's findings.

Federal Constitutional Authority to Manage Water

The federal power to regulate the use of water stems from the power under the constitution to regulate commerce "with foreign nations, and among the several states, and with the Indian tribes." This federal authority was built on international law, adapted to the need to develop inland arteries of commerce. Freedom of navigation is a customary right under international law, and this right has been recognized in treaties since the Paris Treaty of 1783. Initially, there was doubt about the federal government's constitutional power to undertake internal improvements to promote navigation. However, in 1824, *Gibbons v. Ogden*, the Supreme Court confirmed the federal government's power both to protect and promote navigation under the Commerce Clause. The navigation authority became the constitutional foundation (though not the limit) for all federal regulation of water use.

¹ There are many excellent histories of the expansion of the federal government's role in developing and managing the nation's water resources (e.g., Holmes, 1972 and 1979 and Report of the President's Water Resources Policy Commission, 1950).

Doubt about the scope of the federal government's power to regulate water for uses other than navigation continued to be raised through the 1800s and early 1900s. Because *Gibbons v. Ogden* had linked federal authority under the Commerce Clause with interstate navigation, the Congress explicitly listed navigation protection as an objective of many multiple purpose federal projects, even when navigation control was a minor project purpose. In 1899, the Supreme Court held that the federal government could prohibit a privately constructed dam on the non-navigable portion of the Rio Grande River at Elephant Butte, New Mexico (*United States v. Rio Grande Dam and Irrigation Company*, 1899). The stated reason was the need to protect the navigable portions of the lower reach of the river in Texas, but the real reason was to preserve the Elephant Butte site for a federal dam which would store water for irrigation in New Mexico and guarantee minimum flows to Mexico below El Paso.

Through the middle of the 19th century, both the Congress and the Supreme Court interpreted the federal commerce clause power broadly. The commerce clause has thus been relied on for federal authority to develop water sources for irrigation, hydropower, flood control (*Jackson v. United States*, 1913), and municipal and industrial use, as well as to regulate the use of the nation's waters to prevent environmental degradation and to restore past environmental damage. The spending and war powers have been relied upon as well as the Commerce Clause, but the latter remains the primary source of federal authority to regulate water resources development.

In the past two decades, the Supreme Court has defined the scope of federal powers more narrowly than it did in the 1940s through the 1960s (*United States v. Lopez*), but federal power to manage water resources has not been directly curtailed. The economic use and protection of interstate rivers from environmental degradation continue to fall

within the federal government's historic constitutional power to manage interstate rivers and their tributaries for multiple uses.

Legislative History: The Evolution of Federal Functions and Agencies

Water institutions reflect three widely accepted policy choices. First, the law should recognize private rights to use water. Second, the need to sustain human life and development means that water must be shared among wide groups of users. Third, there is a public as well as private dimension to water use, and there is an increasing recognition that the resource must be managed for public as well as private objectives. While individuals may have recognized private entitlements to use water, private choices historically have been subjected to public scrutiny to protect other users and the broader interstate and national public interests.

Within this general framework, this chapter discusses the evolution of the federal role in water development and management.

In the late 19th century, the West was a sparsely populated region whose harsh climate was a major barrier to permanent large-scale settlement. It was therefore subject to boom and bust cycles and dependent on development capital from outside the region. About this time, a vision of the region as an egalitarian, irrigated agricultural society captured some public attention. State water law, after considerable trial and error, provided the incentive for investment in irrigation infrastructure, but this was not enough to generate sufficient capital to build and sustain the desired irrigation projects. Such an undertaking created the demand for the resources of the federal government. Accordingly, with the Reclamation Act of 1902, the Congress assumed primary responsibility for developing an irrigation society in the West.

The 1902 legislation initially made the federal government a short-term lender, but the irrigation economy was more fragile than originally anticipated. Federal support gradually increased, and the government evolved into a major financier of regional infrastructure. Project purposes expanded to include flood control, navigation, and hydro-power generation. In the 20th century, the federal government has financed much of the infrastructure to supply the West with water for irrigation and municipal and industrial uses, and to minimize flood damage and improve navigation. The federal financial contribution to water resources development in this century, especially since the late 1930s, has been substantial. The Bureau of Reclamation (Reclamation) alone has been responsible for the construction of 133 water projects in the western United States, at a cost of \$21.8 billion (General Accounting Office, 1996).

In addition, early in the 20th century, during the progressive conservation era, the Congress began establishing multiple federal agencies with distinct missions. The Corps of Engineers' (Corps) flood control mission expanded, and the passage of the Reclamation Act underscored the federal commitment to help settle and develop the West through federally financed projects. The Congress eventually created more than a dozen agencies with management and regulatory authority over water.

The federal government assumed other responsibilities, in part because the geography of river basins (most of which are interstate or international in scope) has encouraged it to play a large, but not exclusive, role in water management. In addition, the federal government protects claims and uses that are not well defended by the states, such as Native American and environmental claims. The federal court also provides a forum, such as the Supreme Court's original jurisdiction, for the adjudication of interstate claims. Supreme Court adjudication favors prior uses, and states have used interstate compacts to allocate river basins to protect

both existing and future uses. By and large, water has been allocated for specific uses rather than managed according to comprehensive or multiobjective plans.

To provide secure rights adapted to an arid climate, the western states largely either abandoned the common law of riparian rights in favor of an exclusive system of prior appropriation or created dual appropriative-riparian systems. In the West today, riparian rights remain important primarily in California, Nebraska, and Oklahoma (tribal rights were not traditionally considered by states in their allocation schemes). Western water law creates relatively certain private rights to use water. Prior appropriation allows water to be used where it is needed; creates quantifiable, enforceable rights; and limits the right to water to the amount actually applied to beneficial use.

The federal government has left it to the states to develop comprehensive plans to guide the choice and timing of water development projects or the allocation and distribution of water in federal projects. It has made attempts to better coordinate water policy decisionmaking, such as it did with the Water Resources Council. However, the decisions about the construction of water projects were often left to the political process.

The federal role continues to be fragmented, with multiple agencies, each with specific and narrow legal mandates and constituencies, managing or controlling certain aspects of water uses. For example, Reclamation built and manages specific projects primarily for the benefit of agricultural water users, although this mission has broadened considerably in recent decades. The Corps manages projects, maintains navigation channels, and operates and maintains reservoirs and levees to control floods and for such incidental uses such as hydroelectric power generation. The Fish and Wildlife Service (Service) and the National Marine Fisheries Service administer the Endangered

Major Federal Laws and Actions Affecting Western Water Resources

1. Navigation

1824 - *Gibbons v. Ogden* (holding that constitutional authority over interstate commerce gave the United States the power to regulate commerce-related navigation within states)

1824 - General Survey Act (authorizing the President to use the Army Corps of Engineers to develop plans for building roads and canals "of national importance")

1826 et seq. - Rivers and Harbors Acts (authorizing specific projects to make rivers and harbors more usable for navigation)

1890/1899 - Congressional Acts (Regulating construction of bridges, wharves, piers, channels, and harbors; diversions of water; and deposits of refuse and other materials in navigable waters)

2. Flood Control

1874/1879 - Congressional commissions investigating flood control for the Mississippi River

1893 - Congressional commission investigating flood control for the Sacramento/San Joaquin

1917 - Flood Control Act (authorizing Corps' construction of flood control works on the Mississippi and Sacramento Rivers)

1928 - Flood Control Act of 1928 (establishing the Mississippi River and Tributaries Project)

1936 - Flood Control Act (making flood control a national responsibility)

1944 - Flood Control Act (greatly expanding the Corps' flood control program)

1954 - The Watershed Protection Act (authorizing USDA assistance for flood control projects in small watersheds)

3. Hydropower

1879 et seq. - Congressional approval of individual private dams for hydropower

1890 - Secretary of War review of dams for congressional approval

1906 and 1910 - General Dams Acts (establishing application procedures for nonfederal hydropower development on navigable waters)

1920 - Federal Power Act (establishing a permanent commission to license nonfederal development of water power on navigable waters and public lands)

4. Irrigation Water Supply

1870s/1880s - Powell/Hayden/other surveys

1877 - Desert Land Act (authorizing sale of 640-acre tracts of arid lands in western states to people who would irrigate them within 3 years)

1894 - Carey Act (authorizing grants of federal public lands to states to encourage their settlement and irrigation)

1902 - Reclamation Act (providing for federal construction of water projects for irrigation)

5. Urban Water Supply

1906 - Town Sites Act (authorizing delivery of Reclamation project water to nearby towns)

1920 - Sale of Water for Miscellaneous Purposes (authorizing delivery of Reclamation project water for "purposes other than irrigation" under certain conditions)

1939 - Reclamation Project Act - § 9c (authorizing contracts for municipal water supply or miscellaneous purposes)

1944 - Flood Control Act (authorizing contracts with states, concerns, or individuals for surplus water from Corps' reservoirs)

1958 - Water Supply Act (authorizing storage in either Reclamation or Corps' projects for present or future municipal or industrial water needs)

6. Multiple Purposes

1927 - Rivers and Harbors Act (authorizing the Corps to prepare multipurpose plans to improve navigation, water power, flood control, and irrigation—the so-called 308 plans)

1928 - Boulder Canyon Project Act (project purposes stated as controlling floods, improving navigation, regulating flows, providing storage and delivery of water for beneficial uses, and generation of electrical energy)

(See "Federal Laws and Actions," next page)

Federal Laws and Actions (continued)

6. Multiple Purposes (continued)

1939 - Reclamation Project Act - § 9(a) (project costs to be allocated among different functions; no reimbursement for navigation and flood control features)

7. Fish and Wildlife/Recreation

1934 - Act to Promote Conservation of Wild Life, Fish and Game (directing consideration of opportunities to use federally constructed impoundments for fish-culture stations and for migratory bird resting and nesting areas and to provide passageways for fish migration)

1944 - Flood Control Act - § 4 (authorizing public park and recreation facilities at Corps' water projects)

1946 - Coordination Act (providing consultation requirement for new federal water projects with Fish and Wildlife Service and state wildlife agency)

1948 - Fish and Wildlife Coordination Act (further amending and naming the 1934 and 1946 acts)

1965 - Federal Water Project Recreation Act (promoting planning of federal water projects to include opportunities for recreation and fish and wildlife enhancement)

8. River Preservation

1964 Wilderness Act (setting aside public land areas as wilderness areas, subjecting any future water development therein to Presidential approval)

1968 - Wild and Scenic River Act (setting aside designated river segments from further impoundment)

9. Consider/Mitigate Adverse Environmental Impacts of Federal Actions (especially related to fish and wildlife)

1969 - National Environmental Policy Act (establishing a federal policy of productive harmony between nature and man's activities and requiring federal agencies to assess the environmental impacts of proposed major actions)

1976 - Federal Land Policy and Management Act (subjecting rights-of-ways across federal lands to terms and conditions minimizing damage to scenic and aesthetic values and fish and wildlife habitat and otherwise to protect the environment)

1976 - National Forest Management Act (requiring protection of water bodies and their fisheries from adverse effects of timber harvesting)

1986 - Electric Consumers Protection Act (requiring FERC to give equal consideration to the purposes of energy conservation; the protection, mitigation of, damage to, and the enhancement of fish and wildlife (including related spawning grounds and habitat); the protection of recreational opportunities; and the preservation of other aspects of environmental quality in its hydropower licensing decisions)

1986 - Water Resource Development Act (providing for fish and wildlife mitigation at Corps' projects)

1992 - Reclamation Projects Authorization and Adjustment Act (among other things, establishing a mitigation commission for the Central Utah Project and requiring fish, wildlife, and habitat restoration associated with the Central Valley Project)

10. Water Quality Protection

1972 - Federal Water Pollution Control Act Amendments (prohibiting pollutant or dredge and fill discharges into water without a permit)

1976 - Resource Conservation and Recovery Act (regulating disposal of hazardous wastes)

1976 - Safe Drinking Water Act (establishing standards for publicly provided drinking water)

1980 - Comprehensive Environmental Response, Compensation and Liability Act (requiring cleanup of hazardous wastes)

11. Endangered Species Protection and Recovery

1973 - Endangered Species Act (prohibiting federal actions likely to jeopardize the continued existence of protected species as well as private actions harming or killing such species)

12. Tribal Reserved Water Rights

1908 - *Winters v. United States* (creation of an Indian reservation impliedly reserves sufficient quantities of water to fulfill the purposes of the reservation with a priority date at least as early as the creation of the reservation) #

Species Act (ESA) and the Fish and Wildlife Coordination Act (FWCA) to protect fish and wildlife whose survival may be jeopardized by a federal activity or where private actions, such as a diversion, threaten to harm the species when water is removed from stream channels. More recently, the Clean Water Act allowed a new federal agency, the Environmental Protection Agency (EPA), to set water quality standards for and control discharges into surface waters, but specifically exempted agricultural return flows as nonpoint sources.

The fragmentation of federal responsibilities in this area is illustrated by the following statement:

In essence, the complex federal executive responsibilities for water resources reflect comparably complex congressional legislative responsibilities, which in turn mirror the multiple and complex ways in which water resources affect social and economic activities (Congressional Research Service, 1997).

A more complete discussion of the federal agencies and their respective responsibilities over aspects of water development and management can be found in chapter 5 of this report. The Congressional Research Service of the Library of Congress prepared a memorandum and a table discussing the jurisdiction of congressional committees and executive agencies over western water resources. (See appendix A of this report.)

Navigation Protection and Enhancement

Navigation protection and enhancement constitute a major federal water function because the nation's major rivers are interstate and are under the jurisdiction of the Corps, although the Coast Guard has some responsibility for inland navigation management. Navigation plays two important roles in water management. First, as discussed above, it

is the constitutional foundation of federal power to manage water resources. Second, the Corps' navigation mission provides an example of a limited form of river basin management; the Corps must plan and manage on a basinwide scale to ensure that its flood control and navigation missions achieve their objectives and do not conflict with each other or other agencies' activities, such as ESA compliance, which may be occurring on the same river.

The protection and enhancement of navigation have been an important federal function but have never played a major direct role in the settlement of most of the West. In general, navigation played a minor role in the development of the West because much of the region was settled by overland wagon trains and then by the transcontinental railroads constructed after the Civil War. Navigation plays a limited but diminishing role in the modern West because most crops and other commodities are moved by rail or truck, although the Sacramento, Columbia-Snake, and Missouri Rivers continue to be used for navigation.

As a nonconsumptive use, navigation usually is consistent with other water uses, but navigation projects do have environmental costs. Locks and reservoirs may destroy riverine ecosystems. Sometimes navigation conflicts with other possible uses of a river's supply, forcing the Corps to balance its duty to operate projects to maintain a sufficient navigation channel in the river with the protection of other values that require a different flow release pattern.

Flood Control

The history of United States flood control in this century is, in part, the rise of the public expectation that floods and flood damages are largely preventable. Flood control was initially a local responsibility, although the Corps' navigation channel improvement projects also often had flood

control benefits. The Corps was first authorized to expend federal monies on levee construction to supplement local contributions in 1890, although the Corps had concluded as early as 1875 that state and local levee construction efforts were too uncoordinated to be effective.

The federal role was growing in the 1920s. In 1928, the Congress authorized \$325 million for levee and other construction in the lower Mississippi Valley without local contributions (President's Water Resources Policy Commission, 1950). Until 1936, the federal government followed the traditional strategy of levee construction and maintenance. Then the Depression era combined the need for economic relief through public works with an optimistic faith in large-scale engineering works to foster human progress, culminating in a program of larger flood control projects.

In 1936, flood control responsibility was split between the United States Department of Agriculture (USDA) and the Corps (with most responsibility and projects allocated to the Corps), and federal policy combined levee construction and maintenance with upstream retention reservoirs to hold back winter and spring runoffs. The USDA, through the Soil Conservation Service, was authorized to finance small dams on the upper reaches of watersheds. The Corps was given the authority to construct large multiple-purpose dams on large navigable rivers and their tributaries.

Today, the responsibility to prevent and mitigate flood losses is distributed among several federal agencies and a variety of state and local agencies, and federal policy has, in effect, subsidized development in flood plains as described in chapter 3. This policy has long been questioned, but the federal government did little, either directly or indirectly, to try to divert vulnerable urban development from likely flood paths. Federal flood control programs have provided a high level of protection for those at risk from floods, but they also produced a moral

hazard problem. ("Moral hazard" is a term used by economists to describe the tendency of those insured to "relax his [or her] efforts to prevent the occurrence of the risk that he has insured against because he has shifted all or part of the expected cost of the risk to an insurance company [Posner, 1992]). Flood protection efforts create a moral hazard problem because the use of flood plains increases as the perception of risk—either of physical damage or uncompensated damage—decreases.

The federal flood insurance program of 1968 recognized that structural measures did not prevent flood losses and that there was a need to limit flood plain use to land uses and structures that were best adapted to floods and to share the risks of flooding between the federal government and those who chose to locate in flood-prone areas. The program now basically requires that the Federal Emergency Management Agency develop local community flood risk maps and that communities enact appropriate land use measures. Communities must designate floodways, which are the portions of the 100-year flood plain required to carry the water of a 10-year flood without raising the surface elevation of the flood any more than 1 foot at any point in the flood plain. All fill, construction, and development must be prohibited in this area. This program has led to an expansion of river corridor parklands and to the better integration of flood plain greenbelts into new development decisions. However, many developments and urban redevelopments continue to crowd as close to floodways as possible to capture the amenity value of this resource.

Water for Agriculture

Federal support for reclamation projects has played a major role in the development of the modern West. As was detailed in chapter 2, irrigated agriculture is both a major contributor to the region's productivity and a unique culture. A recent National Research Council report (1996a) observes:

Repayment of Reclamation Water Projects

Historically, construction of Reclamation water projects was funded from the federal treasury. What follows is a brief description of how the costs of building projects get repaid by those receiving project benefits, how water contracts are constructed, and how they are renewed. This is a general description, which does not account for the many details or variations among projects.

Cost Allocation. Reclamation water projects generally have multiple beneficiaries—agricultural water users, municipal water users, hydroelectric power users, and recreation visitors. Project costs are assigned to each beneficiary according to the cost of constructing the associated project features (e.g., hydropower is assigned part of the cost of the dam and all of the cost of the powerplant; irrigation is assigned part of the dam's cost plus all of the cost of canals and other distribution facilities). This allocation is the starting point for determining how much each group of beneficiaries must repay.

Repayment. Several laws have defined how the allocated costs of a water project must be repaid by the various beneficiaries.

Irrigation. The Reclamation Project Act of 1939 provides that the costs assigned to irrigation be repaid only up to that amount which farmers can cover from the increased income received from irrigated (as opposed to dryland) farming. Contracts for the repayment of the irrigation costs are based on the farmer's payment capacity that remains after the project's operation and maintenance costs have been deducted.

Two types of contracts for repayment are allowed under the 1939 Act. "Repayment contracts" which are authorized by Section 9(d), provide for a fixed obligation of the irrigation district. At the end of the repayment period, the debt obligation is fulfilled, but the other contract provisions continue in perpetuity. These contracts usually require approval by the members of a district for adoption or revision. Contracts usually are for 40 years, but this varies from project to project.

Section 9(e) of the 1939 Act provides for "water service contracts" which may be for terms of up to 40 years. Under these contracts, irrigators only pay for water actually delivered to the farm in any given year. Current policy requires review of payment capacity at 5-year intervals in these contracts. There are a number of other rate setting and cost-recovery procedures in use for water service contracts.

It is Reclamation's policy to collect 100 percent of remaining payment capacity after operation, maintenance,

and replacement (OM&R) costs have been deducted. No reduction in the annual payment on the construction obligation for repayment (Section 9(d)) contracts will be made to account for increases in OM&R costs. For water service contracts under Section 9(e), the current OM&R costs will be reflected as a part of the reanalysis of payment capacity at 5-year intervals. Beginning in 1994, Reclamation policy restricted contract length to 25 years.

In most of Reclamation's operating area, assistance is available from federal power revenues to repay the project costs that are beyond the irrigators' ability to pay. Irrigators pay the construction costs up to their ability to pay, and assistance from power revenues pays the balance of the irrigation obligation. All construction costs allocated to irrigation are repaid without interest.

Municipal and Industrial (M&I) Water. Payment of project cost by those receiving M&I water is most often governed by the Water Supply Act of 1958. This Act permits storage capacity to be included in any Reclamation or Corps reservoir for present or anticipated M&I demand. M&I water rates are set to repay the full cost allocated to M&I supply, with interest, generally over a 50-year period. However, up to 30 percent of the cost of the project storage needed to meet future demand can be deferred, subject to repayment within the life of the project or a 50-year repayment period. Interest charges on these deferred costs may be waived for a period up to 10 years, and initiation of construction repayment may be deferred until the block of water allocated to future demand is first used.

Hydropower. Power generation was included in many projects to provide energy to pump project water. Energy in excess of project demands is permitted to be sold to "preference customers"—public entities, such as rural electrification associations and municipalities. Most Reclamation hydropower projects are incorporated into basinwide accounts for power repayment and marketing. The power rate is set at a level to cover, over 50-years' time, the project costs (both capital and O&M) assigned to hydropower, plus the portion of irrigation repayment that is beyond irrigators' ability to pay. Costs allocated to hydropower are reimbursable with interest.

Recreation and Fish and Wildlife Enhancement. The Federal Water Project Recreation Act of 1965 (P.L. 89-72) provided the first general authority for facilities at Reclamation projects to be designed specifically for recreation and fish and wildlife purposes and financed through cost sharing with a nonfederal entity. Prior to this,

(See "Repayment," next page)

Repayment (continued)

specific project legislation addressed recreation and fish and wildlife cost allocation and repayment matters. Under Public Law 89-72, 50 percent of the construction costs allocated to these purposes are repaid with interest by a nonfederal entity over a 50-year period. Most recreation areas are turned over to other federal and nonfederal agencies for management, and those agencies incur the O&M expenses. The Water Resources Development Act of 1974 (P.L. 93-251) amends P.L. 89-72 and provides that only 25 percent of the costs allocated to fish and wildlife enhancement are to be repaid with interest.

Fish and Wildlife Mitigation. Where a project creates impacts on fish and wildlife resources that must be mitigated, the costs of mitigation measures are assigned proportionally to the various project purposes and repaid using the procedures applicable for each respective function.

Flood Control. The Flood Control Act of 1936 established the philosophy that flood control was for the general welfare of the region and the nation and required that the nonfederal interests share in the development costs, such as providing lands and O&M of the project works. The Flood Control Act of 1938 repealed the requirement for such participation. The Water Resources Development Act of 1986 required a 25-percent cost share from local beneficiaries, increased to 35 percent in 1996.

Existing Contracts. To administer project water, Reclamation currently utilizes approximately 9,000 project repayment and water service contracts, including temporary water service contracts and contracts with individual water users. Of these, about 2,700 are considered to be major contracts. These contracts provide water service to 10.9 million acres for agricultural lands and 800,000 acres of urban and suburban lands, thus providing benefits to 30.9 million people. In the next 5 to 7 years, numerous contracts will be due for renewal, including many in the Central Valley Project of California.

Contract Renewals. Water contract renewal has always been a concern of water users and, more recently, is a concern of those who feel that some types of water use should not be continued or should be modified as contracts expire.

One of the purposes of the 1956 Act (Administration of Contracts under Section 9, Reclamation Project Act of 1939, July 2, 1956) was to address the concerns of irrigation districts related to renewal of water service contracts. The objections of the districts were: "(1) that no assurance can be given in the contract itself or any other document binding upon the government that the contract will be renewed upon its expiration; (2) that the water users who have this type of contract are not assured that they will be relieved of payment of construction charges after the government has recovered its entire irrigation investment; and (3) that the water users are not assured of a permanent right to the use of water under this type of contract."

In partial response to these objections, Subsection 1(1) of the 1956 Act allows the inclusion of a provision in water service contracts for the renewal of the contract. Subsection 1(2) allows for the conversion of a 9(e) water service contract to a 9(d) repayment-type contract, provided certain conditions are met. Currently, Reclamation and the Office of the Solicitor are reviewing a number of questions with respect to interpretation of this Act and its effect on the contract renewal process.

Contract Program Review. Given the large number of contracts coming up for renewal in the near future, Reclamation is currently reviewing legal requirements and internal procedures associated with its contracting program. This review is critically important, given the strong interest in contract renewal by the historic beneficiaries as well as environmental and tribal interests. Part of the impetus for the review stems from legal actions concerning contract renewal, the most notable being suits brought by the Natural Resources Defense Council over renewal of the water service contracts for the Friant Unit of the Central Valley Project. This suit raised questions about the need to address ESA issues and conduct NEPA studies before reaching a decision to renew. Reclamation's review of policy will address how the contract renewal process can address both the need for predictability for water users seeking renewal and the flexibility to adjust water use to changing environmental needs and social values in the West. #

... if society accepts that irrigation is more a culture—the way people live and part of the national identity—it's logical for the public to absorb a significant share of the responsibility for the activity in the name of the national interest. Thus society shares the costs and uncertainties by providing various subsidies to farmers, which in turn subsidize the costs of food and fiber to consumers.

Reclamation has been the primary federal agency responsible for the promotion of an irrigation economy in the West, but the promotion of this economy has also been a part of the mission of USDA and a secondary benefit from Corps projects. The federal reclamation program created in 1902 (Reclamation Act, 32 Stat. 388) was to be used for:

... the construction and maintenance of irrigation works for the storage, diversion, and development of waters for the reclamation of arid and semiarid lands in the said States and Territories.

The history of the settlement and development of the West is one of constant adaptation to the reality of arid or semi-arid lands through agronomic and institutional experimentation, and the Reclamation Act of 1902 represented a recognition that substantial federal support would be necessary to sustain settlement in the region.

The West initially was dismissed as an uninhabitable desert, but exploration changed this perception by the 1840s. Settlement was initially confined to fertile areas of California and Oregon or to river valleys with an adequate supply of water for small-scale irrigation. The lands immediately west of the lower Missouri and the Red River basins in Minnesota and North Dakota, for example, received from 20-25 inches of rain a year. In 1847, the Mormons migrated from Nauvoo, Illinois, to the

Valley of the Great Salt Lake and began irrigating much more arid lands. The settlement of other arid areas such as Colorado followed.

The federal government initially tried to encourage western settlement through the disposal of public lands, assuming that individual enterprise would adapt itself to the region's climate. Much public land policy from 1862 to 1902 can be seen as an unsuccessful attempt to develop a land disposal scheme that would support non-Indian settlement and stimulate private enterprise in the more arid parts of the West. The Homestead Act of 1862 was designed for humid (or at best semi-arid) areas and failed to attract sufficient settlers to the more arid regions of the West. The Congress increased the incentives by the passage of the Desert Land Act of 1877. The Act allowed settlers to acquire 640-acre tracts of nonmineral, nontimbered land at \$1.25 an acre if they reclaimed the land through irrigation within 2 years after entry; but as a leading public land historian concluded, the Desert Land Act:

... was abused from the outset by cattlemen and other groups anxious to gain ownership of water rights. . . 159,704 entries on 32,803, 914 acres of desert land, and 46,999 final entries for 8,645,749 acres indicate that many tried but few succeeded in fulfilling the requirements of the Desert Land Act (Gates, 1968).

The agricultural settlement of the West proceeded on two tracks—dryland farming and irrigated agriculture. Except for southern California, which developed a fruit and vine culture modeled on the Mediterranean, irrigated agriculture was initially developed to provide winter feed to support the cattle industry. Dryland farming—cultivation with a minimum of water—was adopted to grow wheat in the upper Great Plains and in the dry areas of the Pacific Northwest. The story of the successful introduction of hard wheat to the upper Missouri region and its survival in the 1930s is a classic

example of adaptation to a semi-arid climate without supplementing existing supplies of water. Russian and German Mennonites brought drought-resistant Turkey Red wheat from the Crimea; later, a far-sighted USDA employee imported a better strain from Russia and created new pasta markets for this hard variety.

The United States decided to support the fledgling irrigation economies developing in the West by federally financed water projects. Irrigation had become a national political issue in the 1890s and was touted as the means to create a civilized society of farmers. The success of the Mormons in Utah became the model for similar collectives, such as secular, communal efforts in Colorado, California, and Washington. The Anaheim colony in southern California and Union colony in what became Greeley, Colorado, were the first two major irrigation colonies, and they induced the formation of larger, less idealistic irrigation projects backed by eastern and foreign capital (Dunbar, 1983). These projects were intended to be self-sustaining—and, in many cases, profitmaking—but many were not. Too often, speculation, rather than bona fide occupation by resident farmers, and drought cycles combined to bankrupt many canal companies.

Federal support for irrigation emerged after the federal government was unable to develop a public land policy to induce sufficient settlement of the West, and states' efforts to finance irrigation projects or to induce the creation of irrigation districts were not successful enough to create sustainable irrigation economies. The 1902 Reclamation Act was passed when President Theodore Roosevelt asked opponents, mainly fiscally conservative eastern Republicans, not to oppose the bill. This, along with a "veiled threat to veto the river and harbor bill," cleared the way for its passage (Pisani, 1992). Until the New Deal, the actual impact of the Reclamation Act was small. Initially, federal funding was limited to the construction of storage and distribution facilities to support individual

reclamation projects, many started by private enterprise. Supporters predicted that 60-100 million acres would be irrigated, but the thirty projects created during the first 6 years of the Act totaled about three million acres, and much of this land had been irrigated prior to 1902.

The New Deal fundamentally transformed the Reclamation program from a community-based effort to a regional water development program. Larger carryover storage reservoirs were constructed to support irrigated agriculture as well as urban growth. Hoover Dam was constructed to firm up supplies for both the Imperial Valley and Los Angeles, and it became the model for the construction of large multiple-purpose projects during the Depression and into the 1960s. The competition for scarce resources was solved by supply augmentation and the occasional reallocation of existing supplies.

Historically, the major tension in Reclamation philosophy and practice was between the original social vision of a West peopled with small farms and the reality that, in many places, that vision was not economically feasible. The history of acreage limitation illustrates the tension between original intention and the recognition that a different adaptation had occurred, especially in California. The original reclamation program contemplated that individual project costs would quickly be repaid in 10 years by the beneficiaries: the program limited water deliveries to 160-acre tracts or 320 acres when both a husband and wife held title. Most projects could not meet the repayment obligation, so the repayment period was progressively extended. Other assistance was provided through interest-free repayment charges and use of an "ability to pay" standard for cost recovery. This allowed Reclamation to shift some of the repayment obligations from irrigators to hydroelectric power generation.

Native Americans

Native American tribes and nations face a difficult paradox. The tribes and nations have rights to substantial quantities of water, but they have not been able to enjoy this water. While tribes share the western landscape, unlike the major beneficiaries of federal water resources development, by and large, they have not shared in the federal government's water largesse from 1902 to the present.

Federal support for Native American irrigation dates to 1867. During the allotment era (1888-1932), some 150 reservation projects irrigating 362,000 acres were constructed when federal policy was to turn "nomadic" peoples into "pastoral" peoples (Sly, 1988). An unpublished 1975 Senate Report (Sly, 1988) estimated that \$201 million had been expended to irrigate about 648,000 acres and that only 16 Native American projects could be considered major. The gap between Native and non-Native American water expenditures and the difficulties that tribes face in using water for nonirrigation purposes has been a continuing source of frustration to them. No feasible solution is currently on the federal policy agenda.

The federal government holds a "trust" responsibility for Indian tribes. The trust is a product of Chief Justice John Marshall's creative effort to recognize the indigenous nations' and tribes' inherent sovereignty within the context of a wider national government. In three seminal decisions—*Johnson v. McIntosh* (21 U.S. (8 Wheat.) 543 (1823)), *Cherokee Nation v. Georgia* (30 U.S. (5 Pet.) 1 (1831)), and *Worcester v. Georgia* (31 U.S. (6 Pet.) 515 (1832))—he rationalized the federal government's superior power, now much contested by many Native Americans. Marshall held that the purpose of the exercise of the power was to fulfill the government's duty to protect the tribes' treaty rights. As applied to water, the trust responsibility requires that the

federal government protect the tribes' continued enjoyment of their existing *Winters* rights.

Consequently, the extent of tribal claims to western water resources is substantial. In 1984, the Western States Water Council estimated that tribal reserved water rights might extend to as much as 45 million acre-feet. In most cases, tribal rights are senior to other water rights established under state laws. However, the process of defining particular uses and quantifying the amount of the reserved water rights held by each tribe in the West has moved slowly. In 1983, the Supreme Court determined that tribal water rights are subject to determination in state general stream adjudication processes.

As described in the chapter 3 sidebar, "Tribal Water Rights Settlement," these processes are complex and are proving to take much longer to conclude than expected.

Indian water rights are one of the tribes' most important assets.² The United States holds a trust responsibility to protect tribal water rights from infringement by others. In instances in which a tribe decides to seek quantification of its rights or in which a state seeks to join a tribe in a stream adjudication process, the U.S. must represent and protect tribal interests in its rights. As discussed in

² In *United States v. Adair*, 732 F. 2d 1394 (9th Cir.), cert. denied, 467 U.S. 1252 (1985), the Ninth Circuit held that the Klamath Tribe's treaty intended to reserve water necessary to support the hunting and fishing activities relied on by the tribe. The Ninth Circuit also upheld the existence of a reserved right to support the fishery on the *Colville Reservation (Colville Confederated Tribes v. Walton*, 752 F.2d 397 (9th Cir. 1985)). Also, the Washington Supreme Court upheld a decision in the Yakima River adjudication, finding a reserved water right for "the minimum instream flow necessary to maintain anadromous fish in the [Yakima] river, according to annual prevailing conditions." *State Dep't of Ecology v. Yakima Reservation Irrigation District*, 850 P.2d 1306 (Wash. 1993). The Wyoming adjudication, on the other hand, found that the Wind River Tribes could not claim reserved rights on the basis of fisheries management.

Federal Reserved Water Rights at Zion National Park

Federal reserved water rights for surface water and groundwater at Zion National Park were recognized in a signing ceremony on the banks of the North Fork of the Virgin River in December 1996. Secretary Babbitt, Utah Governor Leavitt, Zion Superintendent Falvey, and representatives from Washington and Kane Counties signed the agreement, recognizing the first federal reserved water right for a national park in Utah. The agreement, following 5 years of negotiation, secures instream flows and groundwater to protect the Virgin River and hanging gardens while providing a dependable water supply for local communities.

The NPS Water Resources Division initiated studies in 1987 to support water rights claims in the Virgin River Adjudication and to address the threat of 37 proposed upstream dams. Fourteen studies were conducted to estimate the amount of water necessary for park purposes and to maintain unimpaired water resources. Investigators studied flow, including water and sediment discharge; age and origin of groundwater; channel forming processes; riparian vegetation; native fisheries; aquatic organisms; hanging gardens; aesthetics; and recreational use.

Between 1987-90, little progress was made in settlement due to traditional state and federal government rivalries and a lack of scientific data. In 1992, negotiations to explore settlement options were reopened. In 1993, study results were presented to the state and Washington County Water Conservancy District (WCWCD). Scientists and historians presented data and information to support water rights for instream flows and groundwater to protect Zion ecosystem values.

Equipped with a new understanding about the dependence of water-related sources on streamflows and groundwater in the park, NPS, the state, and WCWCD formed a technical team to develop and evaluate settlement proposals and reached agreement on settlement concepts in May 1996.

The final agreement recognizes a federal reserved water right to all the unappropriated flows in and above the park and allows valid existing uses to continue. It limits total depletion but allows a small amount of water development above the park. Construction of proposed mainstem dams on the East and North Forks of the Virgin River and a transbasin diversion to Cedar City are prohibited. Future water supply needs for administrative purposes at Zion are defined. The agreement also establishes a 2-mile groundwater protection zone, restricting development of high capacity and high volume wells on Zion's boundaries.

The agreement will be effective upon completion of a land exchange between BLM and WCWCD for public lands at the proposed Sand Hollow Reservoir site downstream of Zion and private property above the park. The exchange removes a longstanding threat that WCWCD would construct Bullock Dam above Zion and allows it to develop a reservoir downstream of the park to provide water for St. George, Utah. The historic agreement will then need to be confirmed by the state adjudication court before water rights are decreed. Should objections arise, Utah and Washington and Kane Counties have agreed to stand "shoulder-to-shoulder" with NPS in support of the settlement.

At the signing ceremony, the Secretary and the Governor praised the work of the negotiation team and encouraged the continued use of "good science" and cooperative efforts to solve complex water rights issues in Utah. This agreement forever protects water resource values at Zion and establishes a process that can be used to complete settlements of this nature at other Utah parks. It is doubtful that NPS could have secured this impressive set of protections through litigation. #

— William R. Hansen and Daniel J. McGlothlin, National Park Service, Water Resources Division

chapter 3, many tribes have chosen to pursue negotiated settlements of their rights rather than adjudication in federal or state court.

Hydropower

Hydroelectric power generation is a major nonconsumptive use of water, and generation of hydroelectric power has become one of the central issues of water management. Hydropower generation is both a source of and solution to environmental problems. Demand for power may be inconsistent with other flow needs of the project, such as for irrigation or for ecosystem restoration; however, the alteration of generation patterns may be a source of restoration flows, and hydropower revenues are a source of restoration and mitigation funds.

As the 1950 Report of the President's Commission on Water Resources Policy observed, "the drive to make economical use of capital investment has placed growing emphasis upon power as the principal and often the only feasible means for recovering project costs." Power revenues are also a potential source of basin funds which can be used to redistribute regional development monies to substitute for lost water project development opportunities.

Three controversies have surrounded hydroelectric power generation: (1) the public versus private debate; (2) the debate over whether to preserve or dam up the canyon; and (3) the modern conflict between hydropower generation and protection of environmental and recreation resources.

Federal power policy was a major political issue from the turn of the century through the 1950s. One key question was: Who would capture the benefits of prime damsites—the federal government or private utilities? The Federal Power Act of 1920 settled a long battle over public versus private

control by allowing private access to hydroelectric sites, subject to a federal license. Between 1920 and the 1950s, additional compromises were reached which have produced a mixed system of privately and publicly generated power.

Toward the end of the major dam-building era, environmentalists began to challenge proposals to dam scenic canyons on aesthetic and, later on, economic and other grounds. Starting in the 1950s, the need for large dams on the nation's rivers came into question. The modern environmental movement grew, in part, out of fights between those favoring dam construction and those opposing dams on the Colorado River system.

Federal Conservation Programs

The passage of the Wild and Scenic Rivers Act in 1968 restricted the construction of large federal and privately licensed dams on the prime undammed rivers (Fairfax et al., 1984). The immediate genesis of the legislation was a 1965 study by the Secretaries of Agriculture and Interior which recommended that several rivers be protected from dam construction. Accordingly, the original legislation was aimed primarily at stopping new dams. Although conservation organizations succeeded in broadening the focus to river and river corridor protection and management between 1965 and 1968 (Tarlock and Tippy, 1970), preventing construction of new dams remained its focus (Hiser, 1988).

The Wild and Scenic Rivers Act recognizes three classes of free-flowing rivers for protection: pristine; relatively undisturbed scenic; and developed recreation. Rivers may be designated by the Congress or by the Secretary of the Interior upon the request of a governor. In addition, many states have enacted similar Wild and Scenic Rivers Acts. The actual impact of the act on United States rivers is small, but the act is the first recognition that the preservation of free-flowing rivers is a federal

policy. Although 600,000 river miles in the U.S. are affected by dams, only 10,000 river miles are protected by the Wild and Scenic Rivers Act.

Pollution Control and Environmental Regulation

The federal interest in water pollution prevention began in 1899 with the passage of the Refuse Act, which charged the Corps with keeping the nation's navigable rivers free of obstructions and discharges that might impair commerce. The Corps, which was the first agency directed to prevent water pollution, was given the subsequent regulatory authority to stop all discharges into the nation's waters under the 1924 Oil Pollution Act. (This mission predates the Corps' flood damage reduction mission.) Between 1948 and 1972, the control of water pollution evolved from a local and state responsibility to a national one, but the focus was on humid industrial regions rather than the arid West. A new agency, the EPA, was created in 1970 to administer the federal pollution programs. Existing agencies such as the Service and the Corps were given expanded environmental mandates—the ESA and Section 404 of the Clean Water Act are the best known. Since the 1970s, EPA has set and enforced uniform environmental quality standards which impact the use of water; the National Environmental Policy Act (NEPA) of 1969 has applied to a wide range of both new and re-engineered existing projects.

The Federal Water Pollution Control Act and subsequent amendments, popularly known as the Clean Water Act, divided pollution sources into point and nonpoint sources and established a zero discharge goal for all surface point source discharges.³ The Congress established a permit

system for point source discharges and delegated to EPA the authority to establish effluent limitations for categories of point sources. The limitations were subject to progressively higher levels of technology resulting in the development and adoption of technologies that would reduce waste discharges and encourage dischargers to adopt production changes to reduce the waste stream.

The regulatory aspect of the Clean Water Act was aimed primarily at the elimination of the major industrial and municipal discharges. Riverflows in the East are usually near average, except during relatively short-lived droughts; thus, most streams have a natural assimilative capacity to handle wastes that can be factored into discharge permits. Because such conditions are less common in the West, there has always been disconnection between the Clean Water Act and western water policy. The most familiar is the tension between the use of technology to reduce discharges and the right of downstream water rightholders to return flows. Municipal discharges and irrigation return flows were not historically viewed as pollution, but as a valuable resource. In a celebrated Colorado case (*A-B Cattle Co. v. United States*, 1978), a ditch company unsuccessfully argued that the government's replacement of silty water with clean water was a taking of its water right because the district could no longer rely on the silt to line its canals. Return flows often make up a substantial portion of a stream during low-flow months, and these flows are valuable because they support irrigation and other stream uses.

On the other hand, western irrigators have also benefited from the eastern focus of the program. As mentioned above, agricultural return flows are

³ The distinction between point and nonpoint sources is not completely clear because courts have the power to define sources absent a congressional classification; basically, it
(continued...)

³(...continued)
reflects the difference between confined and unconfined runoffs. The Congress has exempted agricultural return flows from the point source classification, so most agricultural pollution falls into the nonpoint source category.

exempt from the duty to obtain a discharge permit; generally, most farm runoff is classified as nonpoint source pollution. Nonpoint source pollution is not subject to national technology-forcing standards; instead, nonpoint sources must be addressed through best management practices, and states have considerable discretion to define these practices.

Fish and Wildlife

The protection of fish, other aquatic species, and migratory waterfowl was secondary when most federal reclamation projects were constructed and private hydroelectric dams were licensed. This is no longer the case.

Early responses to the need for such protection included authorizing agencies to construct fish ladders, create wildlife refuges, and operate reservoirs in a manner consistent with fish and wildlife interests. Fish losses, for example, were replaced with hatchery-bred stocks. Yet, in reality, fish and wildlife interests often were subordinated to water development needs. For example, in 1950, then Attorney General Edmund G. "Pat" Brown of California issued an opinion which concluded that the only water stored in Friant Dam that would be available for fish and wildlife protection would be the "surplus" water left after all municipal and agricultural uses were satisfied. Since Reclamation assumed that all water stored in the dam would be used to supply irrigation water to the Central Valley Project, the opinion effectively stripped fish of any legal protection (Dunning, 1993).

Fish and wildlife protection law has passed through various stages. From 1888 to 1958, fish and wildlife protection was generally a permissible but minor use of water. The Service in the Department of the Interior and the National Marine Fisheries Service in the Commerce Department had the authority to consult with federal and state agencies when a project would impair fish populations. In

1958, the Congress passed the FWCA, which mandated that fish and wildlife receive equal consideration with other project purposes. The NEPA of 1969 subsumed the FWCA, since the environmental impact statement became the primary vehicle to assemble, display, and evaluate fish and wildlife impacts. As the 1973 National Water Commission framed the issue: "[t]he basic need. . . is to assure that fish and wildlife receive full consideration and reasonable protection in all water resource activities where potential damage to these values could occur." Neither the FWCA nor NEPA required a federal or state agency to follow the Service's recommendations. Parity with, rather than superiority to, development values remained the goal until the passage of the ESA in 1973.

The passage of the ESA fundamentally changed the role of the Service and the National Marine Fisheries Service. The act mandates that federal agencies or licensees take all necessary steps to prevent further jeopardy to the species and, in some cases, to recover it. The act provides very few options to balance species preservation against economic and social goals, although the provisions in the 1982 amendments to the act concerning habitat conservation plans (and the subsequent implementation of the "no surprises" and "safe harbor" policies) have created a somewhat more flexible environment for the implementation of the act.

Federal environmental regulations have an indirect rather than direct effect on water rights because these regulations overlay existing rights, posing a particularly acute problem in the West. Many pollution laws have the potential to conflict with the law of prior appropriation because they require reducing discharges which form part of downstream water rights. The protection of endangered fish and wildlife may require flow regimes that are inconsistent with the exercise of appropriative or riparian rights. With respect to tribes, however, the situation is different—in some cases, wildlife

protection measures enhance tribal trust resources; in others, they delay or prevent development of tribal water projects.

Federal Watershed Management

The watershed, according to Professor George Coggins, is the "key, integrative public resource" (Coggins, 1991). Government efforts aimed at watershed protection on federal lands date back to the first reservations of lands from the public domain in the 19th century. Watershed management practices contrasted between two extremes, such as: (1) prohibiting timber harvests and other activities in order to protect water quality; and (2) removing trees and engaging in other land manipulation in order to increase water yields. In either case, "watershed management not only deals with the protection of water resources, but also the capability and suitability of land and vegetation resources to be managed for the production of goods and services" (Brooks et al., 1991). In other words, "managing for watershed protection mostly consists of affirmative steps, such as reforestation and erosion control projects, combined with the negative actions of forbidding, restricting, or conditioning practices that cause watershed deterioration" (Coggins, 1991).

Accordingly, "watershed" came to be included among the multiple uses for which lands are managed by the USDA Forest Service (Forest Service) and the Bureau of Land Management. The National Park Service (NPS) is obligated to protect watershed resources as part of its preservation mandate. The statutory bases for these agencies' management responsibilities are discussed in the sections that follow.

Forest Service

Close on the heels of the irrigation movement of the late 19th century came calls for government action to protect the forests. There was a close relationship between the leaders of the emerging reclamation and forestry movements, both of whom believed that protecting forest cover from fires and over-cutting would improve water supplies (Hays, 1959). Indeed, one of the principal proponents of a national reclamation program, Frederick H. Newell, advocated the extension of the national forest system from his position as secretary of the American Forestry Association (Hays, 1959). Gifford Pinchot, the nation's first professional forester and the founding chief of what would be called the Forest Service, joined with Newell in pushing the 1902 Reclamation Act (Hays, 1959).

Irrigators sought to withdraw public forested lands from all commercial use, timber cutting, and grazing:

Forests, they argued, absorbed rainfall, retarded stream runoff, and increased the level of groundwater; forests retarded snow melting in the early months of the year, reduced spring floods, and saved water for summer use when supplies ran low; forests retarded soil erosion and silting in irrigation ditches and reservoirs (Hays, 1959).

The first national forest reserves were authorized by the Creative Act of 1891 (Act of March 3, 1891, ch. 561, sec. 24, 26 Stat. 1095, 1103). This legislation was followed by the 1897 Organic Administration Act (Act of June 4, 1897, ch. 2, 30 Stat. 34, 35 [emphasis added]), which provided management authority and direction for the forest reserves. The Organic Act expressed congressional intent that forest reserves be managed for both timber production and watershed protection:

No national forest shall be established, except to improve and protect the forest within the boundaries or for the purpose of securing favorable conditions of water flows, and to furnish a continuous supply of timber for the use and necessities of the citizens of the United States (16 U.S.C. sec. 475).

According to those who have examined the legislative record, many congressmen believed that watershed protection was, in fact, the sole justification for the forest reserves (Wilkinson and Anderson, 1985; Satterlund, 1972).

For the first few decades of their existence, the national forests were left in relative peace, with early forest management plans regulating grazing and timber harvesting in order to protect recreational opportunities, watersheds, and wildlife (Arjo, 1990). The national home-building boom following World War II, however, brought pressures to cut more trees and provide more water for consumptive uses. The Forest Service's policy of restricting timber harvests to protect watersheds was supplemented by a new view that timber cutting in the upper watersheds would increase stream yields, thus providing more downstream runoff (Wilkinson and Anderson, 1985).

In an effort to codify the Forest Service's increasingly complex management regime, the Congress enacted the Multiple-Use, Sustained-Yield Act of 1960 (MUSYA) (16 U.S.C. secs. 528-531) which included watershed protection as one of the specified multiple uses (the others are outdoor recreation, range, timber, and fish and wildlife) for which the Forest Service was to manage its lands. This was followed by the National Forest Management Act of 1976 (NFMA) (16 U.S.C. secs. 1600-1614), which added new procedural requirements to the Forest Service's planning process and included several new statements regarding watershed protection.

First, NFMA repeated the congressional directive to manage for all renewable resources, including watersheds (16 U.S.C. sec. 1604(e)(1)). It directed that guidelines for the creation of forest plans insure consideration of such environmental concerns as the protection of watersheds (16 U.S.C. sec. 1604(g)(3)(A)). NFMA went on to prescribe more exact standards under which timber harvesting may occur on national forests, stating that Forest Service regulations must insure that no harvesting will take place in areas where irreversible watershed damage will occur, where restocking within 5 years is not assured, or where wetlands and water quality are not protected (16 U.S.C. secs. 1604(g)(3)(E)(I)-(iii)). Moreover, NFMA said that if clear-cutting is to be used to remove trees, the Forest Service must determine that it will be implemented in such a manner that other resources, including the watershed, are protected (16 U.S.C. sec 1604(g)(4)(F)(v)).

Forest Service regulations written to implement NFMA address watershed protection by: (1) requiring planners to identify and evaluate hazardous watershed conditions, such as unstable soils; (2) providing instructions to avoid or mitigate damage at specific sites; and (3) requiring planners to give special attention to approximately 100-foot-wide riparian zones along perennial streams, lakes, and other water bodies (Wilkinson and Anderson, 1985). Critics have charged that the 100-foot buffers are inadequate to protect watersheds because timber harvesting and other activities on nonriparian upper slopes can have serious impacts on water quality and fish habitat (Doppelt et al., 1993).

Multiple-Use, Sustained-Yield Act of 1960 and NFMA remain the principal legislative directives governing Forest Service activities. While it has been pointed out that "some of the NFMA's most prescriptive provisions concern water quality" (Wilkinson and Anderson, 1985), others have criticized its emphasis on procedural rather than substantive requirements (Arjo, 1990). By contrast,

the Congress has placed substantive restrictions on federal land management agencies through provisions in the Clean Water Act (33 U.S.C. secs. 1251-1376). Water quality standards (for point sources of pollution) and best management practices (to control nonpoint sources, such as many aspects of timber harvest) promulgated by states are binding on federal land agencies such as the Forest Service (*Northwest Indian Cemetery Protective Association v. Peterson*, 1985). In practice, few states have exercised this authority to regulate activities that threaten watershed health; instead, most have entered into agreements making federal land managers primarily responsible for nonpoint pollution control within the lands they administer (Wilkinson and Anderson, 1985).

Bureau of Land Management

The Bureau of Land Management (BLM) has a much shorter history of managing its lands for watershed protection than does the Forest Service. BLM lands tend to be located at lower elevations and in more arid regions than national forest or national park lands and thus produce a smaller proportion of surface water runoff. It has been estimated that BLM lands produce only about 3 percent of the water yield from public lands (Doppelt et al., 1993).

The first statement of legislative intent for the stewardship of public domain lands came in the Taylor Grazing Act of 1934, which addressed watershed concerns by stating that one of its primary purposes was to "prevent soil deterioration" (Act of June 28, 1934, P.L. No. 482, ch. 865, 48 Stat. 1269). The Taylor Grazing Act was a response to decades of unregulated grazing of domestic livestock on lands that were essentially a public commons (Braun, 1986). Its provisions proved inadequate, however, to prevent continued deterioration of public rangelands, particularly the most ecologically

fragile riparian areas. A 1975 BLM report on range conditions indicated that 83 percent of the range was in fair or worse condition (Braun, 1986).

The Congress explicitly directed federal land agencies to manage for watershed protection in 1964 (Classification and Multiple Use Act) and then included resources dependent on watershed protection as part of BLM's multiple use mandate in the Federal Land Policy and Management Act of 1976.⁴ The Federal Land Policy and Management Act amended the Taylor Grazing Act in a number of ways, primarily aimed at providing more opportunities for public participation in grazing management and requiring land managers to manage for a broader array of public resource values. Most relevant for watershed protection, the Congress directed the BLM to designate and protect "areas of critical environmental concern," defined as including "areas within public lands. . . where special management attention is required to protect and prevent irreparable damage to important. . . fish and wildlife resources or other natural systems or processes" (43 U.S.C. sec. 1712(c)(3)).

Two years after enacting the Federal Land Policy and Management Act of 1976, the Congress passed the Public Rangelands Improvement Act of 1978 (Act of Oct. 25, 1978, P.L. No. 95-514, 92 Stat. 1803), which recognized serious deterioration of public rangelands due to a variety of watershed problems: soil loss, desertification, increased siltation and salinity, reduction of water quantity and quality, loss of fish and wildlife habitat, increased surface runoff and flood danger, and the

⁴ Public Law 94-579, 90 Stat. 2743. The Act defines multiple use as including but not limited to: "recreation, range, timber, minerals, watershed, wildlife and fish, and natural scenic, scientific, and historical values" (43 U.S.C. sec. 1702(c)). It defines "principal" uses of BLM lands as: "domestic livestock grazing, fish and wildlife development and utilization, mineral exploration and production, rights-of-way, outdoor recreation and timber production" (43 U.S.C. sec. 1702(1)).

potential for undesirable long-term local regional and climatic and economic changes (43 U.S.C. sec. 1901(a)(1)).

The Congress directed BLM to take rehabilitative measures to "restore a viable ecological system that benefits both range users and the wildlife habitat" (43 U.S.C. sec. 1901(a)(3)).

BLM's planning regulations seek to implement these legislative mandates. They state that watershed management

... involves the protection, regulated use, and development of any public lands in a manner to control runoff; to minimize soil erosion, siltation and other destructive consequences of uncontrolled water flows; and to maintain and improve storage, yield, quality and quantity of surface and subsurface waters (43 C.F.R. sec. 1725.3-3(h)).

The agency is paying increased attention to the protection of riparian areas, wetlands, and stream ecosystems in its broader policy statements (Doppelt et al., 1993).

While the two key statutes guiding BLM activities provide authority for the agency to take steps such as excluding livestock from sensitive riparian areas, they do not require the agency to do so (Braun, 1986). Like the Forest Service, BLM is also bound by the requirements of the Clean Water Act, which provides more specific standards for water quality protection.

National Park Service

The NPS operates under the preservation mandate of the National Park System Act of 1916, which requires NPS to manage designated parks, monuments, and reservations "to conserve the scenery and natural and historic objects and the

wildlife and to provide for the enjoyment of the same in such a manner and by such means as will leave them unimpaired for future generations" (16 U.S.C. sec. 1). Specific park units are managed according to the purposes and objectives for which they were designated in their enabling legislation and under the broader provisions of the National Parks and Recreation Act of 1978 (16 U.S.C. secs. 1a-7(b)).

NPS management policies related to watershed protection include provisions for the protection of water quality and quantity, flood plains and wetlands, and federal reserved water rights (Doppelt et al., 1993). The agency, however, has very limited abilities to deal with impacts arising outside of park boundaries, which constitute a growing source of pressure on park resources. Such external activities often pose the greatest threats to watershed resources.

The NPS' Rivers, Trails, and Conservation Assistance Program helps citizens conserve rivers, establish trails, and provide outdoor recreational opportunities. The NPS, in partnership with citizens and state and local governments, is involved in the early phases of projects in setting up goals, resolving difficult issues, and reaching consensus about the future use and protection of important land and water resources, generally on nonfederal lands. The NPS is less often involved once a project reaches the implementation stage. Assistance is provided in developing greenways and trails, protecting river access and views, converting abandoned railbeds into trails, conserving open space, redeveloping and restoring mistreated resources, establishing nonprofit organizations, and enacting new ordinances. In 1996, the Rivers, Trails, and Conservation Assistance Program worked on more than 200 projects in 49 states.

A Brief History of Federal Water Resources Commissions

Federal water policy commissions have played a large role in defining federal water policy. This is the fourth major comprehensive federal water policy commission created in this century, in addition to other commissions that have included water policy within their charter or that have dealt with a single aspect of water management. The commissions have reflected the dominant thinking of their time and have both ushered in new eras and pointed to the transition from one era to another. The commissions' conclusions also have reflected the persistence of some basic ideas of water management that have remained relatively constant—ideas rejected at one time reappear later in the same or new form. The work of these past commissions provides a context for this Commission, which, while it builds on the work of previous commissions, reflects the values of a new generation of westerners.

Albert Gallatin's 1808 report calling for a nationwide network of canals, navigation improvements, and roads is considered to be the first major regional water resources report, but modern water resource commission reports generally date from President Theodore Roosevelt's appointment of the Inland Waterways Commission a century later. This commission was appointed after the federal government had committed itself to the reclamation of the arid West and at the height of the progressive conservation era, which stressed that resources should not be left unused—"wasted"—but should be put to the full range of their maximum possible human uses.

The Inland Waterways Commission was composed of high government officials with a knowledge of land and water, including Senator Newlands of Nevada, the primary force behind the Reclamation Act of 1902. The Commission reflected President Roosevelt's enthusiastic support for the widely

shared idea that river basins should be developed for multiple purposes—primarily carryover storage for summer irrigation, hydroelectric power generation, and flood control—and that the federal government should take the lead in river basin development. Commercial navigation was still the dominant water use, and coastal and inland cities were pushing large-scale interregional navigation improvement projects. The Bureau of Reclamation was starting to construct reservoirs to support its projects, while the Geological Survey was promoting the idea that water was a single resource with multiple uses.

The Inland Waterways Commission proposed that a single new federal agency be created to recommend multiple-purpose river basin plans to the Congress. The idea, however, was ahead of its time. Opposition from the Corps defeated Senator Newlands' bill to implement the Commission's report, and the Corps has been able to resist every effort since that time to merge it into the Department of the Interior or a new Department of Natural Resources. The Inland Waterways Commission's legacy nonetheless was substantial, and its recommendations still influence federal water policy debates. As a leading historian of natural resources policy observed: "The Roosevelt administration for the first time worked out the general principles and the specific elements of the multiple-purpose approach to river development which the New Deal put into practice over two decades later" (Hays, 1959). The report also laid the foundation for the long—but ultimately fruitless—effort to coordinate water resources development through a single federal agency.

The next effort, the Hoover Commission, was constituted after World War II and reflected the continued enthusiasm for federal water resources development as well as strategic general concern that there was a danger of resource scarcity unless resources were conserved and efficiently managed. The Hoover Commission also reflected a growing skepticism about the efficiency of federal water

projects. It was authorized a year after the First Hoover Commission report, which reiterated the Inland Waterways Commission's call for a single federal agency. The Hoover Commission, chaired by former President Herbert Hoover, recommended that the Corps, Reclamation, and the Bonneville and Southwestern Power Administrations be combined into the Water Development and Use Service within the Department of the Interior. It also revived the Inland Waterways Commission's call for a presidential "Board of Impartial Analysis for Engineering and Architectural Projects" composed of independent expert engineers.

The Hoover Commission carried forward the idea that the drainage basin was the best organizing unit for multiple-purpose water development and management. Coordination would be achieved by an interagency commission chaired by an independent presidential appointee. The assumption was that the Tennessee Valley Authority model would be carried to other basins starting with the Missouri basin. To support this idea, the Hoover Commission prepared an extensive analysis of federal and state water law and legislation to support the proposition that there was ample federal authority to support coordinated federal water resources development (President's Water Resources Policy Commission, 1950).

Two years after the Hoover Commission's report, the Eisenhower administration came into office, and that administration made two contributions to water resources development which triggered the next two national commissions. President Eisenhower appointed a cabinet committee which sought to reconcile the existing division of water responsibility with fiscal responsibility. The Advisory Committee on Water Resources reiterated the lack of federal agency coordination, generally endorsed the river basin idea, and called once again for an independent Coordinator of Water Resources who would report directly to the President. However, the report shifted coordination responsibility to the

Congress. The call for greater fiscal responsibility was politically premature, especially when it was implemented by President Eisenhower's "no new starts" policy in the 1958 budget.

Congressional reaction was swift. In 1959, the Congress created the Senate Select Committee on Water Resources. The Committee was composed almost entirely of western senators and supported by a distinguished professional staff. After one round of public hearings, the staff and consultants prepared a report that was submitted to the Congress in 1961. The Committee's report ushered in the last great era of water resources construction and recognized that new uses such as pollution abatement were important. It also acknowledged the close relationship between water and land development.

From 1907 through the 1960, the commission reports and other white papers were premised on the assumption that further western settlement had to be induced through water resources development. This was particularly true in the 1940s, when reclamation projects were viewed as an important component of the reabsorption of veterans into the economy. Development continued through the 1950s, despite mounting criticism of the efficiency and effectiveness of federal water investments. Gilbert White's classic 1968 National Academy of Sciences study, *Water and Choice in the Colorado River Basin*, was one of the first major studies to question the case for water resources development to promote regional growth and equity. The 1973 National Water Commission report made a comprehensive survey of the relationship between water development and regional growth and population distribution. Its conclusion was that "in the future, increased emphasis must be placed on the management of *existing* water developments as a means of improving regional growth potential rather than relying as heavily as in the past on new projects" (National Water Commission, 1973).

The National Water Commission: Still a Benchmark

The National Water Commission grew out of the politics of Colorado River development in the 1960s. The Congress was considering legislation to authorize the long promised and planned Central Arizona Project and to finance it with revenues from two new dams at either end of the Grand Canyon. Southwestern water users also wanted the Congress to study the possibility of importing water from the Columbia to the Colorado River basin. The final 1968 legislation authorizing the Central Arizona Project created a National Water Commission to make a comprehensive assessment of the nation's water resources and their management.

The National Water Commission's report is a good baseline for this report because it partially reflected the transition from the Reclamation Era to the post-Reclamation era. While most of its recommendations remain as relevant today as they were in 1973, some specific problems did not emerge as the 1973 Commission had predicted. The Commission could not foresee the relatively rapid current collapse of the political consensus for continued water development and the redirection of federal fiscal policy from domestic spending to budget reduction. *Water Policies for the Future* assumed that federal water resources project development would continue at a slower rate than post-World War II activity but that it would continue to be the primary federal water resources function.

The 1973 Commission sought to impose a measure of fiscal responsibility on federal water spending and to assure that greater weight was given to alternative means of meeting demand and to environmental quality. Thus, the final report devoted a great deal of attention to improving the process of project planning and selection rather than to project operation. Further, 4 years after the 1973 Commission's report, President James E. Carter created a furor in the West by his "hit list,"

which sought to eliminate a number of long proposed water resources projects. Four years later, much less political controversy occurred when President Ronald Reagan used increased cost sharing to implement another "no new starts" policy. Today, the congressional consensus to balance the federal budget and reduce the debt burden has lessened interest in federal funding of water projects as well as the intense rivalry between the Corps and Reclamation to build projects.

The 1973 Commission defined pollution primarily as a point source rather than a nonpoint source problem. They did not explore the relationship between water pollution and biodiversity, a term not yet coined. The basic thrust of the 1973 Commission's report was that the case for subsidized water development no longer existed. It called for an end to future subsidies for reclamation projects and navigation improvements, greater use of water transfers, and the more accurate pricing of both irrigation and municipal and industrial water. It criticized over-reliance on structural flood control measures.

It advocated the increased use of rigorous economic analysis in evaluating new projects such as inter-basin transfers and cast a cautious and cold eye on technological fixes such as desalinization, precipitation augmentation, and brushland management.

The 1973 Commission's chapter on the accommodation of environmental values supported the use of the new NEPA as the focus of environmental review and recommended that the Congress reserve for itself the final balance. It assumed that the agencies or the Congress would be the ultimate decision-makers; thus, it failed to anticipate much of the current diffusion of power among other levels of government, user groups, nongovernmental organizations, and other stakeholders. Because the 1973 Commission assumed that the federal government would be the primary water developer and

regulator, it logically focused much of its attention on the improvement of decisionmaking at the federal level.

The 1973 Commission's pivotal chapter on making better use of existing supplies defined the post-reclamation era, and the list of suggested reforms remains the reform agenda today. The National Water Commission endorsed:

- Improved groundwater management
- The need to move toward marginal cost pricing of water to fairly and accurately reflect the opportunity cost of the specific use
- The reduction of transaction costs and legal barriers to the transfer of water to new uses
- The passage of laws that allow instream flow rights to be acquired and the liberalization of standards of navigability to allow greater stream access
- The increased efficiency of water use both on the farm and in urban areas through new technology and demand management
- The reuse of municipal and industrial wastewater

Water Policies for the Future contained a penetrating critique of water resources decisionmaking, and this Commission has studied the lessons of the 1973 Commission in order to implement and improve on them. In other areas, the National Water Commission called for greater integration of land use and water planning on the erroneous assumption that the Congress would pass a national land use planning act which would include federal grants for improved state and local planning. It called for the integration of water quality and quantity planning which still occurs today only on an ad hoc basis. It

also called for the protection and quantification of tribal reserved water rights and gave a qualified endorsement to increased public participation. Considerable attention was given to the budget process, and the 1973 Commission endorsed regional breakdowns of major portions of the budget (National Water Commission, 1973). It also addressed the longstanding problem of competition and duplication among agency functions and called for a centralized data collection agency. The National Water Commission stopped short of calling for a Department of Natural Resources because it forecast Reclamation's long-term role as resource manager rather than project construction agency and saw a similar, but more radically diminished, role for the Corps.

The National Water Commission carefully studied existing river basin management. The river basin planning commissions authorized by Title II of the Water Resources Planning Act of 1965 were still functioning, but the 1973 Commission noted their lack of construction and management authority (that ultimately contributed to their demise). It endorsed the interstate compact as the preferred allocation method, but it concluded that more innovative governance mechanisms were needed, and endorsed the creation of a new type of federally chartered river basin corporation that would have planning, construction, and regulatory functions.

Themes Common to Previous Water Commission Findings

Several ideas have remained relatively constant in these commissions' studies. The first is the assertion of a strong federal interest in water development and management to promote the more efficient uses of water, to overcome sectionalism, and to provide equity among states. The control of western water resources has always been decentralized; users developed a variety of customary and experimental allocation regimes before the courts developed the

ground rules for entitlements and states tried to do so through administrative regimes. The federal government asserted its constitutional powers to regulate water after the principle of state control was firmly established. Multiple-purpose water resources development has been an engineering vision designed to benefit specific regions as well as to achieve the efficient use of public funds and the available water budget.

The second recurring idea is the endorsement of the river basin as the right management unit. This idea can be traced to the scientific surveys of the West starting with the Lewis and Clark expedition. John Wesley Powell's famous *Report on the Lands of the Arid Region of the United States* and his subsequent writings proposed to settle the West with private, community-based irrigation districts, based on the Hispanic pueblo communities and the Mormon settlement towns, whose boundaries corresponded to river basins rather than the rectangular public lands survey.

The third great constant is the need for the federal government to get its house in order. The separate development of federal programs to deal with the first-generation multiple uses—irrigation, flood control, and hydroelectric power generation—has frustrated coordinated and efficient water resources development. Federal water policy remains an unrationalized accretion of the interests of many constituencies. The overlay of the second generation of multiple uses—water pollution prevention and biodiversity maintenance—has only complicated matters. New federal agencies, with no direct responsibility for water development and management, have been given strong environmental protection mandates by the Congress. These mandates are not well integrated with previous agency missions and authorities.



How Federal and State Agencies Are Addressing the Challenges of Sustainable Water Management in the West

This chapter describes the various ways that state and federal agencies are attempting to address the water management challenges analyzed in chapter 3. It begins by sketching the variety of entities and institutions involved in water management—federal, state, local, tribal, public, and private. Then, the state programs and initiatives are discussed, followed by the federal programs. The chapter concludes with a discussion of the ways that the federal government and the states are working together on critical water problems, perhaps defining, through these activities, the new water resources federalism.

Although they are not addressed in precise order, this chapter revisits many of the central concerns raised in chapter 3 related to the sustainable use of existing supplies (including groundwater, efficient use, and other areas), modifying operations of existing projects improving governance, fulfilling obligations to tribes, continuing environmental protection/restoration, and protecting communities.

The Many Players

Although the Western Water Policy Review Advisory Commission has focused primarily on the

role of the federal government in water management, clearly the states play an equally important and multifaceted role. Further, a great variety of local institutions and private organizations are important participants. As the Western States Water Council (WSWC) stated in *Water and the West Today*, "Every major set of competing interests in the use and management of water resources has fashioned institutions to advance those interests" (WSWC, 1997).

Private Interests

The most basic water manager is the private rights holder. Whether the rights were acquired through application, inheritance, or purchase, the individual rights holder has a constitutionally protected private property right to use water. The rights are conditioned as to when, where, and how they can be used, and in what amount. Private rights owners are generally not part of a water group (other than a ditch company which conveys their water to them) and have a largely independent say regarding their management decisions. Groundwater pumpers can be even more independent.

Agricultural contractees of state or federal storage projects are organized by irrigation district and have

other conditions attached to their water—who can use it, what it costs, and whether it can be transferred or used outside of district boundaries. In addition to the irrigation districts, private companies also contract for federal project water, often at higher rates. Powerplants are significant water users, as are many other industrial users such as high tech manufacturing firms. Most contracts are long term, usually for 40 or 50 years, and for relatively low cost (which is often determined at the time the storage reservoir was built).

Similarly, contractees for federally generated hydropower usually have long-term contracts based on embedded costs (essentially the cost of construction, operations, and maintenance), and although they do not use water directly (other than as the power is generated), they are strong stakeholders in water management decisions.

Nongovernmental Groups and Special Interests

In addition to private rights holders, many private individuals—including rafters, fishermen, farm groups, and others—organize in groups to influence water policy. Some of these advocate their particular use or need. Others, including wildlife and water quality groups, are concerned about specific or broad issues.

Although these groups have little formal authority, they are nonetheless important stakeholders in the decision process. They may lobby, write letters, attend meetings, file lawsuits, and influence debate in every way they can. Those with water rights may object to these groups as not being stakeholders, but the groups consider themselves as the representatives of the public interest, and their involvement is recognized by administering agencies and the courts.

Local Governments and Special Districts

Local governments also come in a number of forms, but all have legal standing and authority over certain aspects of water management. Local and substate/regional governments provide the greatest variety of institutions for delivering water resource services (WSWC, 1997). These services include urban and industrial water supply, irrigation, drainage, navigation, recreation, fish and wildlife enhancement, and environmental amenities. They vary in size. The Metropolitan Water District of Southern California, a large water wholesaler, has an annual budget almost as large as that of the Bureau of Reclamation (Reclamation). The majority, however, are small, single-purpose entities.

Irrigation districts were formed to contract with Reclamation for federal storage project water and to build and maintain the conveyance facilities to get the water to the fields. Conservation, grazing, watershed, and natural resource districts may be responsible for site-specific concerns such as groundwater management, wetlands protection, riparian management, environmental restoration, and nonpoint source remediation.

County governments often control many processes which can have strong impacts on rivers and lakes, including road construction, road maintenance, solid waste landfills, and land use planning. Cities control zoning and development, wastewater treatment, drinking water supply, recreational use, and flood planning. Either cities or counties may assume responsibility for environmental protection and restoration within their jurisdictional limits.

Large cities have a significant interest in water, primarily through water acquisition, delivery, and disposal. They may build their own storage systems, arrange transbasin diversions, generate hydropower, build large sewage lagoons and wastewater treatment facilities, contract with federal facilities, and create their own river segment hydrographs either for amenity or disposal purposes. A number of the West's largest cities have formed

the Western Urban Water Council, which has become an effective information and lobbying organization. Municipal water boards such as Los Angeles, Las Vegas, and Denver have gained reputations as powerful actors in their regions. Other coalitions, such as the Metropolitan Water District of Southern California (MWD), are recognized for their aggressive and innovative efforts to secure water for their members.

Tribal Governments

Indian tribes and nations also are major players in water usage. As described earlier, most tribes and nations have significant *Winters* rights. These rights are often substantial, very senior, and not subject to beneficial use or other state doctrines. Most tribes' rights have not been quantified, much less actually secured and put to use, and often they have not been factored into the basin systems. As a result, the existence of unquantified tribal rights adds great uncertainty to all other rights holders in a given basin.

In addition to their water rights, Indian tribes and nations may have jurisdiction over other aspects of management (Olinger, 1997). Tribes may manage reservation water resources, manage their lands, control economic activity, and provide wildlife and other ecological protection. The U.S. Environmental Protection Agency (EPA) recognizes tribes and nations as equivalent to states, both in policy and under several environmental statutes. They are important participants in many coordinated programs and may be the initiators of such efforts. In the Northwest, tribes have their own hatcheries and fishing regulations, and several have joined

together in the Columbia River Inter-Tribal Fish Commission to provide watershed protection for salmon (Columbia River Inter-Tribal Fish Commission, 1996). The Pyramid Lake Paiute Tribe was one of the prime initiators of the agreement that was reached for the Truckee-Carson Rivers (Pratt, 1997, Western Governors' Association (WGA)/WSWC, 1991).

State and Federal Governments

Both state and federal government roles, and the need for better coordination, are described in greater length in the balance of this chapter and elsewhere. States are the major arbiter of water allocation and water rights, but they increasingly play a number of other roles as well. Federal agencies have built and operate most of the largest water projects, have trust responsibility for tribes, are responsible for international agreements, and, through a number of statutes, protect and secure national interests.

International Agreements

The United States has treaties with both Mexico and Canada regarding transboundary rivers. Major rivers such as the Columbia and Colorado are shared internationally, and a number of smaller rivers are as well. The main treaties affecting the Columbia, Colorado, Rio Grande, and Red Rivers establish flows to be delivered in the downstream countries and also establish water quality standards. Ancillary issues such as use of hydropower, fish populations, transboundary aquifers, and related water issues are covered either in separate agreements or through working relationships between the nations involved. Both borders have one or more boundary commissions or other committees to solve problems as they emerge.

The Role of the States in Western Water Management

States are regarded as having the primary responsibility for the allocation and use of water resources within their boundaries on behalf of the residents of the state. Historically, states have been most concerned with establishing the rules under which individuals may use water, supervising the allocation of water and its use, and sorting out disputes among and between users. Development of water has been driven primarily by users, often through local water districts, and with the support of states and the federal government.

States play a central role in water management because they are at the fulcrum between national and local concerns. States have the resources to help at the local level and the contacts to work with the federal agencies. In addition, states have delegated authority under a number of federal water programs. (See "The Changing Federal-State Relationship" in chapter 3 for additional discussion on this point.)

A generation ago, states' primary concerns were administering water rights and developing adequate water supplies to serve the rapidly growing water demands in an arid area. Delegation of water quality protection was still in its infancy, and ecosystem awareness was just emerging. Since then, the breadth of states' roles has expanded, together with state capacity to fill those roles. Roles filled by states today are described below, under the general headings of water supply, environmental protection, technical assistance, and other support roles.

Water Supply, Water Use, and Management of Droughts and Floods

Administering the Prior Appropriation Doctrine

The bedrock of western water use is the prior appropriation system (WSWC, 1997) (see also "Protecting Productive Agricultural Communities" in chapter 3). In every western state, some public official or entity administers the state's programs for allocating the use of water resources. These programs involve a permit and application system administered by a person often referred to as the "state engineer," a quasi-judicial officer whose responsibilities are broadly defined and governed by state statutes and case law.

The cardinal principle of the appropriation doctrine is that priority is based on the proposition that "first in time is first in right." The doctrine thus protects those who put water to beneficial use against impairment of their uses by subsequent appropriators. An important characteristic of the appropriative water right is that, once vested, it becomes a constitutionally protected property interest which can be sold, leased, or otherwise alienated, although such transfers must be approved by the state. Historically, the prior appropriation system was developed to provide certainty to promote the investments of capital necessary to develop water supplies and to assure that any change in point of diversion or nature of use of a water right did not adversely affect the water rights of third parties.

Uses of appropriated water are closely circumscribed, and uses must be beneficial—that is, they must be for statutorily identified uses such as irrigation, domestic, or industrial purposes (over time, a few states have recognized other uses—such as fish and wildlife purposes—as beneficial). Beneficial use also refers to the manner in which

water is used. Before state waters became fully appropriated, excess withdrawals were not uncommon; but today, rigorous enforcement of reasonable and beneficial use is becoming much more important.

Most states have approved appropriation of all available surface water, although some states still have significant amounts of groundwater available. Water appropriated today is generally so junior in right that the appropriator can have little confidence in his or her ability to obtain a reliable supply of water other than in very wet years. Given the decline in construction of new storage in the past 2 decades, new demands for water are being met through market-like transfers, conducted through leases, water banks, and outright sales of water and/or water rights. All states allow transfers, and considerable reallocation takes place through them; but to date, almost all of these transfers have been conducted instate.

Idaho, California, Arizona, and Texas have established water banks. Colorado has perhaps the most active water market, with rights and water itself sold through a unique water court system (WSWC, 1997).

Planning, Funding, and Developing Water Supplies

Historically, states have worked closely with local water users, federal water development agencies, and the Congress to ensure adequate storage and delivery capacity to meet the demands of new users. The National Water Commission in 1973 estimated that states and local entities provided 57 percent of total historical expenditures for water resource development, with federal appropriations accounting for 26 percent and private expenditures accounting for 17 percent (WSWC, 1997). Users and local districts have been the prime impetus for water development.

Today, with the pace of growth in the West still strong (Case and Alward, 1997) and the demand for many new instream and offstream uses of water escalating, water supply continues to be a vital concern. Virtually every state expressed the need to provide additional supplies of water in the survey conducted by the WSWC for its report to the Commission (WSWC, 1997).

States also made it clear that storage projects today are unlike the large projects of the past. Rather, they are smaller, more efficient, and more environmentally sensitive (WSWC, 1997). Modifications to projects or their operation are more apt to be undertaken to provide flows for ecological purposes (virtually all river basins), to improve the operations of the entire system (the Dakotas), to assist rural communities (Montana and South Dakota), or to meet Indian water rights (Colorado, Arizona, Oklahoma, and Washington).

While early state water plans were often developed in response to federal water development proposals, states are now refining and revising their own plans to ensure the most effective use of their waters. States like Oregon, Montana, and Washington have engaged in large statewide exercises in joint planning with key interests. Texas recently passed legislation which calls for a comprehensive state water plan and regional plans which, among other things, will address drought response, conservation, development, and management.¹

Increasingly, states are playing a larger role in financing their own water development. All western states have some type of water financing program, and a number of states are trying to levy user fees (WSCS, 1994). However, state funds are usually tight, too. Respondents from the state of Washington put it this way:

¹ Texas Senate Bill 1, signed June 17, 1997, took effect September 1, 1997.

Although water resources are acknowledged by nearly every interest to be a critical issue for the future of the state, the state financial resources being devoted to water have continually shrunk for four years. A large backlog of unaddressed water right applications has accumulated. Needed water right adjudications are being delayed. Enforcement of existing rights and instream flows is lax. Information collection is hampered. Capital projects are on hold (WSWC, 1994).

Increased Efficiency

With the prospects dim for finding significant new supplies of water, states are turning to ways to stretch available supplies, recognizing that conservation must be undertaken with full awareness of return flows and existing rights holders. A new policy adopted in the state of Washington has made conservation, if cost effective, the first choice for meeting new needs. Oklahoma and Texas have changed the definition of "beneficial use" to include conservation. California's Water Resources Control Board enforced its reasonable-use provisions of beneficial use in a widely reported order against the Imperial Irrigation District (IID) in 1986. The result was the 1988 ground-breaking agreement between IID and the MWD of southern California whereby MWD agreed to pay the costs of lining IID canals in exchange for MWD's receiving the conserved water for urban use.

Water transfers are a common and effective way to allow water to move to new uses. Some states allow rights holders to market conserved water as an incentive to conserve; in the 1980s, the state of Utah was able to find water for the Intermountain Power Project by allowing irrigators to sell a portion of their rights to the project and to use the proceeds for increasing onfarm efficiency. As a result, no agricultural loss occurred, and substantial water was made available for the powerplant. Texas' 1997

legislation includes a state water bank, other temporary water sales, and guidelines for interbasin transfers.

States are testing groundwater recharge as a way to store water, to replenish diminished aquifers, and to provide flexibility through conjunctive use. The state of Arizona is initiating large-scale groundwater recharge as a way of storing its Colorado River allotment being delivered through the Central Arizona Project and of recharging depleted aquifers. The state plans to draw on its groundwater during periods when Central Arizona Project flows are insufficient. Nevada currently operates four active large-scale artificial recharge programs for underground storage. Similarly, the state of Kansas is working with the city of Wichita on a pilot project involving recharge with excess flows and conjunctive use. Orange County has a long history of conjunctive use, and both the state of California and other local agencies are studying a number of conjunctive use projects. The Sierra Pacific Power Company in Reno has also conjunctively used groundwater and surface water for many years. The Nevada State Engineer's office has recently allowed the additional use of groundwater reserves when Truckee River supplies are insufficient or when water quality is impaired.

Onfarm efficiencies are being achieved through such tools as laser leveling of fields, low-head sprinklers, drip and surge irrigation, enclosed conveyance pipes, and low-water-use crops. Similarly, cities promote xeriscape, low-flush toilets, low-head showers, and other means to reduce urban usage. Increasing numbers of cities are using inverted block and other pricing techniques and are experimenting with different kinds of reuse. California is considering wastewater reclamation (recycling), as is Hawaii. Both states also are researching and testing less expensive

General Stream Adjudication

General stream adjudications are complex and lengthy proceedings to recognize and quantify most, if not all, of the existing water rights in a river system, watershed, or other body of water. These proceedings are underway in many western and midwestern states, some involving only a few water users asserting a dozen water rights and others involving tens of thousands of parties claiming hundreds of thousands of rights.

As water uses developed in the West, courts were often unable to settle water rights conflicts since, under common law procedures, it was difficult to join all necessary parties in one suit. Also, future water users could not be bound by the court. After the turn of the century, many states addressed this problem by enacting comprehensive water codes that provided for administrative permitting of new water users and adjudication of existing water rights. Often, statutory water adjudications were called for by federal officials who were concerned that existing water rights on a river system be identified before reclamation projects could proceed. Some states conducted adjudications to quantify riparian water rights and integrate them into an appropriate water system.

Many statutory stream adjudications were frustrated by the inability of courts to require the participation of federal and tribal governments in the litigation. Congress attempted to solve this problem by passing the McCarran Amendment in 1952, which waives the sovereign immunity of the United States from suit in a general adjudication of all the water rights in a particular water system. Another 30 years passed before the U.S. Supreme Court clarified that these suits could go forward in state as well as federal court and that Indian water right claims, along with those of federal agencies, could be adjudicated in these cases.

General stream adjudications are often said to have three purposes: (1) to increase the title security of individual water users by allowing them to predict the risk of curtailment in times of shortage; (2) to improve state and private water management by developing information about water supply and existing uses; (3) and to quantify inchoate federal Indian and non-Indian reserved water rights that, because of their frequent senior status, have cast a long shadow over western water titles. The large adjudications begun in the 1970s and 1980s, however, resulted from broader trends in the West. These included the energy crisis of the 1970s, which threatened the rapid development of western resources including water; the continued growth and urbanization of the region's population; and the emergence of strong tribal governments and organizations dedicated to protecting tribal water resources.

Montana's adjudication, processing more than 210,000 water rights, is a statewide proceeding. Adjudications emphasizing major river systems, often as the result of large federal or tribal landholdings, are pending in Arizona, Idaho, Oregon, Washington, and Wyoming. Some states, such as New Mexico and Utah, have been gradually adjudicating most of their watersheds over many decades. Several states have completed adjudications of riparian rights (Nebraska, Kansas) or surface water rights (Texas), but their task has been made easier by the absence of federal or tribal claims. California adjudicates surface water or groundwater as necessary to solve local water management problems. Colorado has had a continuous, statewide water adjudication process since 1879. While most adjudications occur in state court, New Mexico's adjudications are uniquely divided between federal and state court. Important federal rulings influencing state court adjudications have been rendered in Arizona, Nevada, and Oregon.

Stream adjudications can be conducted as judicial proceedings, administrative proceedings, or a hybrid proceeding where the court and administrative agency cooperate. (Administrative adjudications are possible only in basins with no federal or tribal presence.) The cases can involve every type of water user including federal and state agencies; tribes; cities and towns; utilities; mines and other industries; irrigation districts; homeowners associations; and individual farmers, ranchers, and homeowners.

A typical adjudication begins with the petition of the state attorney general or engineers, followed by water users filing claims. The administrative agency investigates the claims and prepares a report or proposed determination of water rights for the court. Parties have an opportunity to object to the claims, report, or proposed determination; the court hears and resolves the objections. The court then issues a decree enforced by court-appointed officials, the state administrative agency, or both. Many disputes are settled in advance of trial; and, in recent years, major settlements have involved the large claim of federal agencies and tribes (National Park Service, Fort Peck, Fort Hall, Salt River Pima-Maricopa Indian Community, among others).

From start to finish, the adjudication process may take a few years, or even several decades, to complete. The cost of these cases is difficult to determine but certainly totals tens of millions of dollars in technical, legal, and court expenditures throughout the West.

- John E. Thorson, Special Master for the Arizona General Stream Adjudication. #

means for desalinization. Nevada is expecting to meet 15 to 25 percent of new municipal demand through conservation.

State and federal agencies provide technical assistance, information exchange, and incentives for encouraging these changes. In California, over 100 urban water agencies and 50 nonprofits signed a memorandum of understanding to implement certain best management practices; a similar effort initiated by state legislation is now being finalized for agricultural water conservation best management practices. Nevada changed its water law to allow temporary changes in water use, opening the door for municipalities to use poor-quality water sources for such activities as road construction, dust control, and other temporary uses. Oklahoma has created a leak detection program which provides funding to conduct water audits/leak detection surveys and to correct problems. Washington was one of the first states to adopt a water-saving plumbing code.

Modifying Existing Operations

As discussed in chapter 3, both state and federal agencies are assessing the need for changes in operations for facility rehabilitation and to gain greater efficiencies. California, Nevada, Wyoming, Idaho, and Colorado are among the states working with federal agencies to reconfigure flows through reservoir reoperation. Often initiated by the need to change flows for endangered species, improved efficiencies are nonetheless a result. Rehabilitation goes beyond facility reliability to include leak detection, reduction in reservoir surface losses, and lining canals. Colorado's Front Range Metropolitan Water Forum, established by Governor Roy Romer in 1993, is evaluating four areas: conjunctive use, effluent management, interruptible supply arrangement, and systems integration among the many separate water systems in the Denver metropolitan area.

Groundwater Management

Groundwater management has lagged behind management of surface flows. Groundwater withdrawals typically are treated separately, not as a routine part of the prior appropriation system, although over the last 30 years, prior appropriation systems for groundwater are becoming more common (Fort et al., 1993). Often states delegate groundwater management to local districts. Several states have designated priority or active management districts when overdraft has created serious problems.

States have considerable discretion on how they manage groundwater, and some states are beginning to recognize the groundwater/surface water connection. In Colorado, any aquifer whose flows will reach a stream within 100 years is considered tributary and must be treated as surface water, with water rights permits under the prior appropriation system. In 1996, Nebraska moved to recognize the groundwater/surface water connection in legislation passed to benefit the Platte and Republican River basins. The Nebraska natural resources districts have been given the authority to integrate management of groundwater and surface supplies as a way to implement solutions for water supply problems in those basins. Utah is developing integrated groundwater plans which will address safe yield, water quality, future appropriations, and other management issues needed to protect the resource.

In the 1980s, court cases related to interstate aquifers, including the Sporhase and El Paso decisions, made it clear that states that wished to protect their portion of such aquifers from interstate transfers would have to have soundly based management plans to justify the reservation of groundwater for instate use. These court decisions have spurred some states to develop statewide plans for aquifer management as well as plans for the total use of state waters.

California State Drought Water Bank

In early 1991, California was facing its fifth consecutive year of below-average water availability. So little water remained in storage in federal Central Valley Project and California state reservoirs that some users faced the prospect of no deliveries and others of receiving only a small fraction of their normal supply. The state formed a Drought Action Team that, among other things, recommended establishing a water bank to purchase water from willing sellers to sell to others with crucial, unmet needs.

The California Department of Water Resources (DWR) moved ahead with establishing the bank in late February. First, it established the Water Resource Committee, consisting of representatives of both potential buyers and sellers, to draft a model contract. A price of \$125 per acre-foot was set, based on an evaluation of the user's opportunity cost—that is, what the user expected to earn by using the water. Remarkably, within 100 days the water bank had entered 351 contracts for the sale of 821,045 acre-feet of water.

Water came from three general sources: (1) surface water made available by temporarily fallowing (not irrigating) land; (2) surface water made available because of replacement supplies from groundwater; and (3) unused storage water. Land fallowing contracts accounted for 51 percent of the water. The quantity of transferrable water was based on an estimated consumptive use for particular crops. Groundwater exchange contracts provided 32 percent and stored water about 17 percent of the water.

DWR established priorities to guide its sale of water, beginning with health and safety-related emergency needs, then areas with "critical needs." Such areas included urban areas with less than 75 percent of their normal water supply and agricultural lands growing permanent or high-value crops. Twelve water agencies purchased 389,770 acre-feet of water from the bank at the fixed price of \$175 per acre-foot. More than three-quarters of the water went to urban uses. DWR stored about 250,000 acre-feet of purchased water in state reservoirs for use in the following year.

The state operated the water bank in 1992 and again in 1994 until a return to normal water supply conditions brought its use to a temporary end. Bank uses in these 2 years were more modest than in 1991. DWR made several important changes: it reduced its purchase price to \$50 and its selling price to \$72 (\$68 in 1994) per acre-foot, decided not to purchase water under fallowing contracts (because of concerns about local economic impacts when crops are not grown), and gave purchasers more flexibility concerning when they used the purchased water. #

Drought and Flood Management

The WSWC has long taken the lead in working with its member states to develop a model state drought plan (WSWC, 1987) and, as a result, most western states have plans in place. The focus of these plans has been on drought response, including monitoring, emergency actions, and mitigation for economic losses. Drought was the motivation for creating California's water bank, which allowed irrigators to supply their water to the bank at a state-fixed price for sale to communities and others needing additional water. State agencies in Montana, working with local conservation districts, developed portable irrigation diversion structures to use when stream-flows are low. Kansas has formed "assurance districts" on three key rivers to assure that water rights will be met during low-flow periods through state releases of state-owned water storage to raise water levels in the stream. In addition to individual state plans, the WGA, U.S. Department of Agriculture (USDA), Department of the Interior (Interior), Federal Emergency Management Agency, and the Small Business Administration have signed a memorandum of understanding to develop an integrated drought policy and plan to improve planning, communication, data, and response for current and future droughts. The memorandum establishes a council which will emphasize preventive, anticipatory, risk-management approaches to drought management (WGA, 1996).

Building on the success of its drought initiative, the WGA advocates a similar assessment for flood response. In a resolution adopted in June 1997, which recognized the primary role of the federal government for floods, the governors called for adoption of coordinated federal, state, and local policies to respond to and reduce flood damages. In particular, the governors propose starting with the report of the 1994 Interagency Floodplain Management Review Committee (the Galloway Report) to determine which recommendations are appropriate in the West, by reviewing other policy

guidance, developing recommendations for states, and providing strategies for local governments for regulating activities in flood plains (WGA, 1997a).

Environmental Protection

Protecting the Public Interest

For many years, states and local water users equaled the beneficial use doctrine with the public interest, but beneficial use applies principally to offstream, not instream, uses. There is a strongly emerging belief that the historic focus on water as a commodity that can be separated from the watersheds and rivers of the basin must be broadened. Values of the riverine system are far from trivial: they include habitat for fish and wildlife; focal points for enjoyment of scarce river and stream environments in an arid region; and mainstays of the economies of communities through recreation, tourism, and the attraction of permanent and seasonal residents and businesses. Today, with the increased recognition of instream values, some states are beginning to review water rights applications for their consistency with this aspect of the public interest. Several states require such a review for proposed transfers, and a few states have established a list of factors which must be considered in that review.

The public interest standard for issuing new rights has included considerations of efficiency, streamflow adequacy, water quality, public health, alternative uses that might be precluded, and effects on fish and wildlife, recreation, aesthetics, and even cultural values. Such criteria apply to new requests, not to the reexamination of existing water rights, with the exception of the public trust doctrine application in California.

The WGA/WSWC Park City Workshop II focused on defining the public interest (WGA/WSWC, 1991). One of its key findings was that there is no

single "public interest"—participants identified over 40 aspects of the public interest. Thus, decisions, policies, and actions are most likely to be in the public interest when they are reached in a manner that provides an opportunity for full participation and for a full range of values and interests to be considered. Public interest considerations are triggered by a number of state legal requirements for: public interest review, water quality and instream flow protection, area of origin protection, ad hoc negotiations, planning, voluntary transfers, public trust, and administrative review of rights.

As noted earlier in this chapter, some states (Alaska, California, Hawaii, Idaho, Oregon, Texas, and Washington) have changed state water law to expand the definition of beneficial use to better reflect contemporary needs and the public interest (Getches et al., 1991). Similar changes may be needed in other states, especially to encourage conservation and instream flow protection. Because beneficial use is the basis for the prior appropriation system, such changes to state law create a property claim rather than a public interest claim.

Instream Flow Protection and Environmental Restoration

Closely related to the public interest, instream flows are important for aquatic ecosystems, uses such as recreation, and simple aesthetics. Most states consider fish and wildlife needs as a beneficial use, but only a few have designated instream flows themselves a beneficial use. States have a variety of means to protect instream flows, if they choose to apply them. However, there are no standards setting a baseline or formula for minimum streamflows; actual protected flows vary site by site. As with public interest considerations, the application of instream flow protection prevents depletion beyond the minimum only in limited settings; although new

rights may be conditioned, rights which precede the instream flow laws or regulations are not affected by instream rights.

Some states have authorized public agencies to acquire existing rights or to appropriate new rights to instream flows to protect instream values, and a few states allow private parties to purchase and retire rights to protect the flows as noted earlier. Montana allows public entities to reserve unappropriated water for instream flows and permits water interests to lease existing water rights for the purpose of protecting flows. The state of Washington is working with tribes and federal agencies to develop a water budget which will benefit wild salmon by assuring the necessary amounts and periods of flow for both spawning migrations upstream and for smolt returning to the ocean. Washington also allows for state acquisition of "trust water rights," which may be acquired through purchase, lease, or gift, or by state or federal investments in water conservation. Texas has also created a Texas Water Trust to hold rights dedicated to environmental needs. Oklahoma and Idaho protect instream flows through their scenic rivers designations, while Kansas has basin-of-origin protection. Nevada's Washoe County and the cities of Reno and Sparks will be purchasing water rights to augment flows in the Truckee River in order to improve water quality.

In addition to protecting instream flows, a few states—usually in conjunction with federal agencies—are investing substantial funds in efforts to restore the functioning of rivers, wetlands, and riparian ecosystems, often to comply with the Endangered Species Act (ESA). At the basin level, these states have joined with federal agencies to participate in programs to restore hydrographs to more normal patterns, reshape rivers to enhance habitat, and restore flood plains. On the Columbia River, the Northwest Power Planning Council

The TMDL Dilemma

The Clean Water Act of 1972 included a little noticed provision for addressing nonpoint sources of pollution—a standard for water quality known as a "total maximum daily load" (TMDL). After 20 years of worsening nonpoint pollution of rivers and streams, a number of environmental coalitions around the country filed approximately 30 lawsuits and intents-to-sue to force EPA to force states to address TMDLs. How EPA and the states resolve this crisis will significantly affect future state and federal relations over water management.

A TMDL is the amount of pollution a water body (lake, river, or stream) can absorb and still support uses such as drinking water, aquatic life, and recreation. The law requires that a state establish the allowable pollutant loading (and thereby the amount of pollution reduction needed) in each water body and that the state allocate the allowable load among all pollution sources, including point sources, nonpoint sources, thermal pollution, air depositions, effects from contaminated bottom sediments, and groundwater flows into the surface water.

The staff and funding needed to assess every water body in a state and to develop TMDLs (if warranted) is considerable, and the information needed for a comprehensive analysis may have significant gaps. Allocating the TMDLs has the potential for creating considerable conflict. Those living in a watershed are afraid that current uses may be curtailed or burdensome requirements imposed. Nonetheless, TMDLs are a way to move beyond generic standards to actually tie cumulative pollutants together within specific locations. They take a wholistic, geographic-based approach which supports watershed protection concepts.

Despite the difficulties in establishing TMDLs and managing according to them, states are beginning to have some success. EPA responded to a lawsuit filed in 1994 by working with the state of Idaho to develop a plan to establish TMDLs for each watershed over the next 8 years.

Basin Advisory Groups (BAGs) have been established in each of the six major basins in the state. BAGs include representatives of a number of interests—mining, forestry, cattle, agriculture, sportsman, environmental, nonmunicipal dischargers, local governments, tribes, and at-large representatives. BAGs are advisory to the Division of Environmental Quality. They set priorities, review the TMDLs, recommend the formation of watershed groups, review uses in the basin, review 319 applications, and in general provide guidance and coordination.

Watershed Advisory Groups (WAGs) are created where needed and cover 8 to 30 streams in the watershed.

WAGs are open to any interested party; 10 WAGs currently are in existence, with another 5 or 6 in process. The Division of Environmental Quality coordinates and covers basic expenses, and the Department of Water Resources can be asked to advise. Although the WAGs are primarily concerned with TMDLs and nonpoint sources, they can also take on other issues, such as habitat restoration. Issues brought by WAGs and BAGs are brought by the agencies to state policymakers.

The original lawsuit has been dismissed based upon Idaho's plan, and Idaho participants are determined to continue with the process, including implementation. They have learned that they prefer to determine their own priorities and action steps.

Utah is a second state moving forward with its TMDL process. Utah is undertaking one of its five major basins per year, with all of the basins being revisited once every 5 years. The Bear River assessment has been completed for Utah; but because it is a three-state river, efforts are now underway to coordinate with Idaho and Wyoming as well.

The legislature has funded detailed TMDL studies and data collection. In the Bear River, the state has allocated TMDLs to sources of contamination; animal waste is a large contributor of pollutants. Other entities—including other water quality programs (319), the National Resources Conservation Service (NRCS), conservation districts, and the extension service—have been brought into the process. As a result, the total funding has been 3-4 times, and technical assistance 10 times, that for TMDLs alone.

The state sees the TMDL process fitting within a watershed model, including local committees and participation. Because local residents recognize the potential for TMDLs to include considerations such as carrying capacity and future uses, they want to be involved, especially with other agencies such as NRCS.

In general, states which have programs or processes which can be adapted to include TMDLs are likely to find that the TMDL program is not a large burden. Wyoming, for example, has a number of coordinated resource management groups which are a logical tool for establishing TMDLs. South Dakota has a successful program where the state has provided facilitators, technical expertise, and local processes to determine on-the-ground options for other water quality programs. Montana's existing watershed program should also make the TMDL program easier. With little extra effort, these processes should lend themselves to establishing TMDLs. #

administers approximately \$400 million a year from Bonneville Power Administration revenues for salmon recovery programs. The Northwest Power Planning Council was created as a four-state interstate compact through federal legislation. In California, state and local agencies are spending millions of dollars in research, pilot testing, and construction projects to make water projects and diversions more fish friendly. Recently, California's first pool-and-chute fish ladder was constructed on an agricultural diversion. Additional expenditures in the California Bay Delta and on the Missouri, Colorado, and Platte Rivers, to mention only a few, come to large dollar amounts for both state and federal agencies.

Wetlands recovery currently tends to be addressed through the Natural Resources Conservation Service working through local conservation districts and the U.S. Fish and Wildlife Service's (Service) Partners for Wildlife Program, while both the U.S. Army Corps of Engineers (Corps) and EPA have permitting jurisdiction.

Protecting Water Quality

Nearly every state has delegation from EPA to protect water quality under either the Clean Water Act (CWA) or the Safe Drinking Water Act (SDWA). Under CWA delegation, most states issue National Pollutant Discharge Elimination System permits for point sources of pollutants. States follow EPA-established, technology-based standards to limit "end-of-the-pipe" discharges, but then determine whether the federal standards are sufficient, based on state stream quality standards. If not, states establish water-quality-based effluent limitations, based on designated uses and numeric criteria for specific stream segments. States are also required to adopt plans for addressing nonpoint sources of pollution from mine runoff, logging, urban discharges, and farm and irrigation return

flows. Such plans need not be enforceable, nor are there federal standards for such plans.

Under SDWA delegation, states have enforcement authority to protect the safety of public drinking water systems according to EPA-established maximum contaminant levels. States that assume primacy must also establish an approved underground injection control program that regulates underground disposal of wastewater within a quarter of a mile of underground drinking water sources. EPA also has created a state revolving fund which states can use to grant funds for treatment plants. Under the 1996 amendments to the SDWA, states will be required to delineate source water protection areas for community water systems.

Current innovations in water quality protection tend to focus on nonpoint source problems. Using funds authorized under section 319 of the CWA, Nevada successfully tested the use of alum as a coagulant to remove sediment and phosphorus from a severely degraded stream. Nevada has also developed artificial wetlands to improve water quality in streams. Some states, working with local conservation districts and others, are beginning efforts to keep cattle out of selected riparian areas, develop buffer zones next to streams, regulate chemigation, and require construction setbacks from streams and other measures to reduce nonpoint source pollutants. The Montana legislature passed a law in 1991, allowing counties to form districts for the sole purpose of protecting, maintaining, and improving water quality. Montana provides a number of good examples of ways that states protect water quality; it has adopted the Montana Water Quality Act, Montana Solid Waste Management Act, Montana Hazardous Waste and Underground Storage Tank Act, Streamside Management Zone Law, Montana Groundwater Assessment Act, Montana Agricultural Chemicals Protection Act, Lakeshore Development Act, Natural Streamside and Land Preservation Act, nonpoint source control programs, and pollution prevention programs.

An issue of growing importance to both states and EPA is that of total maximum daily loads (TMDLs). A TMDL is the amount of pollution a water body (lake, river, or stream) can absorb and still support uses such as drinking water, aquatic life, and recreation. It must meet state water quality standards. The law requires that a state establish the allowable pollutant loading (and thereby the amount of reduction needed) in each water-quality-limited water body and that the state allocate the allowable load among all pollution sources, including point sources, nonpoint sources, thermal pollution, air depositions, effects from contaminated bottom sediments, and groundwater flows into the surface water. On the books since the Clean Water Act was passed in 1972, TMDL requirements were largely ignored until the 1990s, primarily because of the difficulty of achieving them. Approximately 30 lawsuits or intent-to-sue notices have been filed by various environmental groups to force compliance with the law by both states and EPA.

States are required to list (Perciasepe, written communication, 1997) all water-quality-limited water bodies in the state and to prioritize them, in order to maximize environmental benefits by dealing with the most serious water quality problems and most valuable and threatened resources first. EPA guidelines provide the following criteria for prioritizing stream segments:

- Risk to human health and aquatic life
- Degree of public interest
- Recreational, economic, and aesthetic importance of a particular water body
- The vulnerability of a water body as aquatic habitat

Following approval of the list and priorities, states are supposed to develop the allowable TMDLs for those prioritized waters, drawing on information

from existing state and federal water quality programs and on new data assessment, including biomonitoring. The state is then to develop a water quality management plan to achieve the approved TMDLs. States must provide EPA with updated lists of affected water bodies in April of every even-numbered year. The process to move through all water bodies in an entire state is anticipated to take from 8 to 13 years, based on 1998 lists for the initial assessment. As uses on streams and lakes change or new information becomes available, updated TMDLs will be done.

Although all states are proceeding in the face of the lawsuits which have been filed or threatened, TMDLs pose a range of problems for them. A given state's capacity to fulfill both TMDL and other water quality requirements is determined by the number of stream miles, the wide range of pollutants and sources to be considered, the level of information available, and the resources required to comply. The criteria for prioritizing stream segments are not the same as state beneficial uses, and they create a clear prospect for conflict between water quantity and quality agencies. Moreover, once completed, states are concerned that the results will still not be scientifically valid.

Various groups in Wyoming, for example, object to the application of TMDLs to nonpoint sources, which they view as a shift from congressional intent to apply TMDLs to point sources. They add that the current nonpoint source program is voluntary where TMDLs have the potential to become regulatory. Local land managers point out that individual nonpoint sources rarely contribute more than 5 percent of pollutants and that the expense of determining the allocation of TMDLs is not an effective way to proceed. Wyoming contends that many partnerships have been addressing water quality involving landowners and permittees, environmental groups, and state and federal agencies. The fear is that TMDLs are being pushed by environmental groups in their threatened lawsuits

so the groups can determine the conditions of future logging, grazing, and oil and gas permits.

At the same time, the TMDL process causes states to take a holistic, geographic-based approach, and it is being used to support watershed protection because it begins to come close to the concept of determining carrying capacities for watersheds and basins.

A Federal Advisory Committee Act group has been established to recommend steps to improve the TMDL program. It hopes to accommodate regional differences concerning point and nonpoint pollution source measures and alternative needs in a principled way, with what is referred to as "objective flexibility." Objective flexibility implies that national objectives will be established but responded to with flexibility. The Federal Advisory Committee's report is expected to be issued in mid-1998. The WGA passed a resolution in June 1997, that recognizes both the goals for TMDLs and the problems, including the likelihood that neither states nor the EPA may have the resources necessary "to conduct the extensive field measurements and computations needed to establish scientifically defensible TMDLs on each applicable water body in the states in the proposed time frame" (WGA, 1997b). While supporting the goals of the Clean Water Act, the governors urge EPA to work cooperatively with states to implement a program with flexibility to accommodate state and local conditions, with realistic funding needs, and with a watershed- and incentive-based approach.

The lack of linkages between water quantity and water quality agencies within state government has been a longstanding criticism from other arenas. Although most western states are taking steps to link quantity and quality, as yet California is the only state which integrates the two under the Water Resources Control Board. Washington and Texas have combined the programs in the same agency, while Kansas and Utah have created formal linkage

mechanisms through memorandums of understanding signed by the quantity and quality agencies. Seven others—Idaho, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, and Texas—have various cooperative mechanisms, such as overlapping board or committee assignments (Getches et al., 1991).

Groundwater Protection

Except for provisions of CWA concerning injections near drinking water supplies, groundwater is not covered by its own federal water quality legislation, although many federal laws have implications for groundwater. Management of groundwater quality has largely been left to states.

In 1992, EPA issued its *Final Comprehensive State Ground Water Protection Program Guidance*. That document, which details plans for comprehensive state groundwater protection programs, was the result of a series of meetings among EPA, the states, tribes, and local governments. The goal for these programs is to ensure protection of drinking water supplies and maintenance of the environmental integrity of ecosystems associated with groundwater (EPA, 1992). States are given the primary role of coordinating all groundwater-related programs using a resource-based approach. They are to establish groundwater protection goals and priorities; define roles, responsibilities, and coordinating mechanisms; implement the plans; coordinate information collection; and improve public education. While some states have sought EPA approval, others have proceeded with development of comprehensive state programs independently, seeking to avoid the need to meet EPA specifications. There is no comprehensive assessment of the adequacy of state programs in protecting and remediating groundwater.

State of Oregon Growth Management Program

In 1973, Oregonians passed important laws to protect their landscape and provide orderly ways for planning new development. The legislature created a new citizen board, the Land Conservation and Development Commission, which created 19 statewide land use planning goals. All Oregon cities and counties work to meet these goals through local land use plans. The job of the Oregon Department of Land Conservation and Development is to be sure these goals continue to be met.

Oregon's statewide goals are achieved through local comprehensive planning. State law requires each city and county to have a comprehensive plan and the zoning and land-division ordinances needed to put the plan into effect. Plans are reviewed for consistency by the Commission. When the Commission approves a local government's plan, the plan becomes the controlling document for land use in the area.

The state does not write comprehensive plans. It doesn't zone land or administer permits for local planning actions like variances and conditional uses. And unlike some other states, Oregon does not require environmental impact statements.

Urban Growth Boundaries

One of the most notable features of the Oregon land use program, and most relevant to the issue of urban encroachment into farming and riparian areas, is the concept of an "Urban Growth Boundary." Goal 14 requires each city to adopt a boundary "in a cooperative process between a city and the county or counties surrounding it." The boundary is drawn considering several factors, including expected growth, land suitability, and efficient provision of urban services and infrastructure. The boundary then defines the limits of urban growth, protecting surrounding areas from uncontrolled development and land speculation.

To amend an Urban Growth Boundary, a city must comply with the "exception" requirements defined in the Statewide Planning Goals. Between 1987 and 1990, 52 proposals to expand boundaries were approved. Oregon's 15 years of experience have shown that urban growth boundaries can be highly effective. They have saved a great deal of farmland from urban sprawl; led to better coordination of city and county land-use planning; and brought greater certainty for those who own, use, or invest in land at the city's edge.

Citizen Involvement

It's no coincidence that citizen involvement is the first among Oregon's 19 planning goals. Extensive citizen participation has been the hallmark of the state's planning program from its outset. Every city and county has a committee for citizen involvement to monitor and encourage active citizen participation. The State's Citizen Involvement Advisory Committee also encourages participation in all aspects of planning. #

Land Use and Growth Planning

As described in earlier chapters, growth in the West can have direct impacts on aquatic ecosystems, on water supplies, and on agriculture. Politically, it has been very difficult for states to address growth management in the West by any means—partly because growth is usually considered good, partly because it is considered a matter of local concern, and partly because of western aversion to planning and controls. That attitude is starting to change (Case and Alward, 1997; Riebsame, 1997b), as shown in a recent article in *The Denver Post*: ". . . Colorado has finally stopped seeing bodies as dollars. Each immigrant carries a price tag: sprawl, smog, higher housing prices, higher wage rates" (Carrier, 1997). Governor Romer's Smart Growth Initiative, transportation campaigns, and people's concern for the quality of life are credited for making it possible to consider such steps as taxsharing, growth boundaries, housing limits, purchases of open space, and conservation trusts and easements. Utah has also initiated a state growth initiative and has considered water supplies and policy as a factor, although transportation was seen as much more important in determining patterns and rates of growth.

The WSWC prepared a report on the role of water in growth management for the WGA in 1995 (WSWC, 1995). Although concluding that water is not the best vehicle to use for growth management, the report also points out the ways that its use affects growth.

A number of states, including Arizona, California, and Colorado, are trying to overtly link new development to having an assured water supply.

Technical Assistance and Other Support Roles

Improved Water Data and Information

States are developing geographic information systems, decision support systems, adaptive management programs, and other means to integrate data from a variety of sources for broad geographic reaches.

California, for example, has the heavily used California Irrigation Management Information System which gathers data from agro-climatic stations all over the state to calculate the evapotranspiration rate. Farmers and urban users (e.g., park and golf course managers) call in to use the information for scheduling irrigation.

Kansas is developing a way to obtain data in the Rattlesnake Creek basin to monitor the relative level of compliance with permit conditions. This will be used as a baseline to establish anticipated overall compliance throughout the state and to determine staff allocations.

Oklahoma has established a council of agencies and universities to develop a strategy to implement the Geographic Information Systems (GIS). The GIS will then be used as a planning tool for water system managers and resource professionals.

Colorado is developing a suite of tools to help with water planning and management, including the Colorado River Decision Support System, the South Platte Water Rights Management System, Hydrobase, the Satellite Linked Monitoring System, and, eventually, the Colorado Water Decision Support System. The goal is to integrate all these tools into one statewide technical information system.

The Northwest Power Planning Council has pioneered use of the concept of adaptive

management in the West, testing scenario development for power management, monitoring various fish strategies, and trying to define carrying capacities for rivers, among other uses. What is important about these efforts is that they link social, economic, and ecological information into a flexible, iterative way of learning and adjusting.

Assistance for Rural Communities

Many states are concerned about the adequacy of rural domestic water supplies, the source of which is often groundwater of marginal quality or quantity or streams which may be too shallow in times of drought. Few communities have backup supplies if problems develop, and many rural residents must haul their own drinking water.

Rural communities also face difficulties with the cost of compliance in terms of testing supplies or putting required technical solutions in place. The Montana Department of Environmental Quality estimates that \$165 million will be required for 180 public water systems and \$160 million for improvements to 191 wastewater facilities. Nebraska pointed out compliance costs associated with sample collection, lab analysis, reporting, public notification, and system compliance (WSWC, 1997).

Still other communities lack personnel with the technical expertise to operate sophisticated water and wastewater treatment facilities. A Utah comment was: "Oftentimes the operator of the wastewater treatment plant also operates the water treatment plant, as well as takes care of the cemetery." Idaho reported a lack of expertise to develop programs that are understood and accepted at the local level. Washington cited the fact that the vast majority of 20,000 separate public water systems serve 15 or fewer hookups; small systems that cannot afford professional staff are then compelled to use expensive outside help.

Many states have developed rural assistance funding programs, including California, Hawaii, Montana, Texas, Utah, Alaska, Nevada, and South Dakota. Others, including Nebraska, Colorado, Montana, Utah, Oregon, Alaska, and Washington, provide technical assistance. Utah, for example, employs two circuit riders who travel throughout the state to provide assistance, while Nebraska has an Environmental Training Center to train operators.

Collaborative Partners and Problemsolver

Increasingly, states are participating in partnerships. Sometimes they provide the leadership to establish and support the partnerships, while at others they facilitate or mediate disputes. At still other times, they are merely participants. Circumstances usually determine the appropriate role for state and federal agencies, whether it is as leader, equal partner, or assistance providers. As experience is gained, states are considering guidelines for when and how they should take an active role.

In the early 1980s, states recognized that litigation which resisted Indian water or fishing rights and other tribal positions cost them large amounts of money with very little success, and they turned to negotiations as an alternative. These negotiations generally involved the relevant federal, state, and tribal agencies along with local governments, local water users, environmentalists, and others with a legitimate interest at stake. Although the resulting water settlements have had mixed success in implementation, the parties involved were usually satisfied with the results when they led to water rights solutions and helped build greater trust, which assisted in the resolution of yet other problems.

At about the same time, arising from the Bureau of Land Management's (BLM) Experimental Stewardship Program and others, land- and watershed-based partnerships were formed to deal with issues of resource management. Using such

processes as Coordinated Resource Management, state and federal agency representatives met with private land, permit, and rights holders to solve problems on the ground; again, participants were generally satisfied because problems were solved and relationships were established.

As success stories were recognized and as ecosystem approaches became more common, many states began adopting or providing incentives for such shared decisionmaking to address complex resource issues. Through initiatives such as EPA's community-based approach and the support provided by BLM and National Resources Conservation Service (NRCS) for coordinated resource management activities, federal agencies also recognized partnerships as a valid way of reaching goals.

The state of Oregon has developed perhaps the strongest statewide approach to support watershed partnerships. The state water agency, in cooperation with other relevant state agencies, has organized the state in regions to provide technical assistance to partnerships within their regions. A legislatively funded Governor's Watershed Enhancement Board provides seed and other funding to support watershed activities. Washington, Montana, and Alaska also have active statewide programs to promote and assist watershed partnerships. Other states, while not establishing a statewide watershed plan, work with and provide assistance to those partnerships within the state that have formed independently.

Other states have tried to work out conflicts by creating offices for dispute resolution. North Dakota created a state/private sector partnership called the North Dakota Consensus Council to assist any state agency with disputes. That Consensus Council is now expanding to serve the High Plains States and Canadian prairie provinces in a program called the Transboundary Initiative and has recently received a grant to provide assistance to the 18 state

dispute resolution offices nationwide. Of the 18, 9 are located in the West, with a variety of structures and agency locations. Montana has also established a public-private Consensus Council within the Governor's office, modeled in part after the North Dakota council.

Other states are considering setting up such councils or are turning to facilitators and alternative dispute resolution techniques. For example, South Dakota's Department of Environment and Natural Resources uses private contractors and partnerships routinely for water quality projects, and the Oklahoma Water Resources Board is currently using a facilitator to mediate disputes involving the state's rural water systems. New Mexico is attempting to employ alternative dispute resolution (ADR) in adjudications by tying funding levels to the use of ADR.

Future Directions for State Activities

In a time when problems and complexities seem to grow faster than solutions, the indication is that in the future, states, as well as others, will need to be more willing to experiment with processes outside historic patterns of behavior, including processes that address problems in ways that incorporate a wider range of participants and causative factors.

States can benefit from learning from each other. For any water problem in the West, one or more states can be identified which are implementing new solutions. These efforts provide a model and a test of success for the other states and often for the federal government.

For example, most states have an orderly process for transfers that allows water use to be changed. The amount of protection each state provides for equity and the public interest varies, and it is important to remember that the highest economic use is not necessarily the same as the highest public good.

Other future directions:

- States will benefit by looking more generally at reoperation of their facilities and flows. Clear evidence now exists that groundwater recharge and conjunctive use are very cost-effective ways to optimize water resources. To create incentives for developing "found" water—water freed up through conservation or better operations—alternative uses should be allowed.
- States have the authority and responsibility to ensure that waters are put to beneficial use.
- States should also help identify ways to quantify and adjudicate Indian water rights more quickly.
- States can also strengthen their capacity for developing their science and data bases to assist and back up management decisions.
- States will find that sustainability of the resource will become the principal criterion for water management. A better understanding of what sustainability means for a river or other water source is needed.
- States are contemplating ways to take into account the broader public interest. Although the public interest is not always easy to define, ignoring it leads to lawsuits and potentially greater input and involvement at the federal level.
- States could allow the dedication of private rights for instream flows as a voluntary way of solving the need for minimum flows.
- To the extent they have not already, all states would benefit themselves and the

resource by adopting a watershed approach as a way to integrate concerns.

- States should foster effective watershed partnerships by providing support, technical assistance, and openness to implementing group recommendations.
- All states should consider how to integrate across programs and levels of government within their own state and thereby facilitate improved collaboration.

The Federal Programs and Activities Related to Western Water

There are 15 federal bureaus and agencies with water-related programs operating in the western states, responsible to 6 cabinet departments, 13 congressional committees, and 23 subcommittees, and funded by 5 different appropriation subcommittees (EOP Group, 1997; WGA, 1989). Measured in terms of expenditures of federal funds, the Corps is the most significant of these agencies. Its 1997 budget authorizes Corps expenditures of \$944 million in the 19 western states (out of a total agency budget of over \$3 billion), compared to \$774 million for Reclamation and \$778 million for EPA. Table 5-1 shows the distribution of 1997 budget authority by state for the Corps, Reclamation, and EPA (EOP Group, 1997).

As described in chapter 4, the federal role in western water has grown and changed during this century. Planning, financing, and constructing projects needed to regulate rivers for water supply, flood control, navigation, hydroelectric power generation, and recreation remains important. But there has been a marked decline in the number of new federal water projects authorized for construction by the Congress since the 1970s. Moreover, the nature of

Chapter 5

Table 5-1.—1997 discretionary funding by state
budget authority
(Millions of dollars)

	Corps of Engineers	Bureau of Reclamation	Environmental Protection Agency	Total
Alaska	19		56	75
Arizona	10	81	31	121
California	225	112	192	529
Colorado	5	16	25	46
Hawaii	5		26	31
Idaho	14	1	24	39
Kansas	27	0	24	51
Montana	12	1	23	35
Nebraska	13	1	20	34
Nevada	13	4	21	38
New Mexico	14	5	19	38
North Dakota	18	23	19	61
Oklahoma	51	2	27	80
Oregon	118	13	31	162
South Dakota	26	44	19	88
Texas	189	26	114	328
Utah	4	27	18	50
Washington	179	8	67	255
Wyoming	1	1	21	24
Undistributed subtotal:		¹ 409		<u>409</u>
Western states	944	774	778	2,495
Percent of total (%)	27	100	24	34
Other states and territories	2,248		1,764	4,012
Undistributed	<u>267</u>		<u>659</u>	<u>926</u>
Total	3,458	774	3,201	7,433

¹ These funds were not allocated in the appropriations act to projects in specific states. They include operations and maintenance (O&M) (\$268 million), general administrative expenses (\$46 million), miscellaneous construction and dam safety (\$117 million), science (\$7 million), and unallocated construction reductions (-\$29 million).

Sources: 1997 Conference Report for Energy and Water Appropriations (House Report 104-782) and Budget Information for States, Budget of the United States Government, Fiscal Year 1998 (Office of Management and Budget).

the projects being authorized is shifting from large-scale, multipurpose facilities to smaller, less costly, more targeted projects. Generally, project beneficiaries are required to pay a somewhat larger share of project costs than in the past.

Environmental Protection and Tribal Rights Emphasis

Increasingly, federal water programs and policies emphasize environmental protection, as indicated in the following legislation:

- The National Environmental Policy Act (NEPA) makes environmental protection a national policy and requires all major federal actions with potentially significant environmental consequences to go through an extensive review process that evaluates likely adverse environmental effects, considers less environmentally damaging alternatives, and discloses these findings to the public (42 U.S.C. §§ 4321-4370c).
- The 1972 amendments to the Federal Water Quality Control Act establish a national program with the stated objective of restoring and maintaining the chemical, physical, and biological integrity of the nation's waters (33 U.S.C. § 1251(a)).
- The Safe Drinking Water Act requires national standards for drinking water supplies (42 U.S.C. §§ 300f-300j-26).
- The Wild and Scenic Rivers Act effectively withdraws designated river segments from additional water development (16 U.S.C. §§ 1271-87).
- The ESA establishes a policy that federal departments and agencies use their authorities to recover threatened and

endangered plant and animal species, prohibits federal actions likely to jeopardize the continued existence of such species, and prohibits any persons from "taking" an endangered species of fish or wildlife (16 U.S.C. §§ 1531-44).

- Some farm programs administered by USDA now actively promote water quality and wetlands protection.
- Environmental protection has been made a part of the Corps' mission.
- An increasing share of Reclamation's funding now goes to environmental protection activities.
- The Federal Energy Regulatory Commission (FERC) must give equal consideration to fish and wildlife values and the preservation of environmental quality, along with energy development in licensing hydroelectric power facilities (16 U.S.C. §§797(e), 803(a)).

In addition, the federal government has taken a more active role in assisting tribal efforts to clarify their water rights and enjoy the benefits of water. The Department of Justice represents tribes in the various legal proceedings around the West in which tribal water rights are at question. Interior has supported efforts to reach negotiated agreements that clarify tribal water rights, and the Congress has provided funding to help implement these agreements. Interior, through the Bureau of Indian Affairs (BIA) and Reclamation, is helping develop water supplies for use on reservation, and EPA has been supporting tribal efforts to establish their own water quality programs.

Federal Support for Water Development

As described in chapter 4, the primary task of Reclamation, the Corps, and USDA (related to western water) has been to construct dams and other structures on western rivers and streams for flood control and water supply purposes and to provide financial assistance for others to do so. New project construction and funding continue to be part of their missions are diminishing in importance. Moreover, the nature of federal water projects and the terms under which federal support is available are changing.

The Bureau of Reclamation

Viewed in budgetary terms, Reclamation still remains primarily a construction agency. In the 1980s, construction funds accounted for about 75 percent of its appropriations, but there has been a marked decline in the number of congressionally authorized Reclamation water projects since the 1970s. The last Reclamation traditional irrigation project approved by the Congress and constructed by Reclamation (North Loup Project in Nebraska) was authorized in 1972. By fiscal year 1997, construction accounted for only about 40 percent of total Reclamation appropriations, which began to decline in the 1990s and which, by 2002, are projected to be 33 percent less (in constant dollars) than 1997 levels (EOP Group, 1997). The number of employees has declined as well.

The nature of new Reclamation projects is changing. More than a third of the Reclamation projects authorized since 1979 are demonstration projects for wastewater recycling or water reuse, while only a quarter involve traditional multipurpose projects (Cody, 1997).

The financial terms under which new Reclamation projects will be planned and constructed also are changing. The Reagan Administration initiated new

cost-sharing requirements for project planning in 1984 and made it clear that it would support only new Reclamation water projects in which "partners" would agree to pay some part of the costs of project development. The 1986 Water Resources Development Act requires a 50-percent cost share for new project planning and engineering for both Reclamation and Corps projects. As discussed below, this statute also requires cost sharing for the first time for flood control-related projects and project features. Reclamation requires a 50-percent cost share for project feasibility studies; in 1992, the Congress instituted special rules related to cost sharing for appraisal studies and construction of water recycling and reuse projects (Title XVI, Public Law (P.L.) 102-575). In 1996, Reclamation established a policy providing that Reclamation water project beneficiaries will be responsible for funding their share of capital improvements to existing projects, while Reclamation will fund costs allocated to nonreimbursable purposes such as fish and wildlife (Reclamation, 1996b).

Reclamation remains responsible for the facilities it has constructed since 1902, even though operation and maintenance for part or all of most projects have been turned over to the water districts that are the primary project beneficiaries.² As the agency's dominant emphasis shifts away from new project construction, it has reorganized itself to better meet its ongoing responsibilities for administering existing projects. The five Reclamation regions in the 17 western states have been divided into 26 areas—generally along hydrologic lines—with a manager responsible for all projects within the area. Substantial authority has been given to these managers to administer projects within their areas.

In the 1982 Reclamation Reform Act, the Congress required all water districts receiving Reclamation project water to prepare water conservation plans

² Reclamation reports that water districts are responsible for O&M for 398 of 631 project facilities.

Yakima River Basin Water Enhancement Project

On October 31, 1994, President Clinton signed The Yakima River Basin Water Enhancement Project (YRBWEP), Title XII of Public Law 103-434, into law, authorizing the construction of the Yakima River Basin Water Enhancement Project. The enhancement project was the culmination of more than 15 years of intense negotiation between irrigators in the Yakima River basin, the Yakama Indian Nation, and the environmental community over water for fish versus water for irrigated agriculture. The enhancement project will protect, mitigate, and enhance fish and wildlife and improve the reliability of irrigation water supplies through construction of water conservation projects on irrigation districts.

This law also created two entities for establishing these water rights. First, it created a pilot program to begin water acquisitions and address the legal and institutional aspects of acquiring water rights and converting them to instream flows. Second, a Conservation Advisory Group (Group) was formed to create a Basin Conservation Plan.

Pilot Program

This legislation identifies water acquisition as one method to enhance instream flows for anadromous fish. As a forerunner to a full-scale water acquisition program authorized under the YRBWEP, the Upper Columbia Area Office of Reclamation undertook, in cooperation with the Environmental Defense Fund, a 2-year pilot water acquisition program. The pilot program addressed the legal and institutional aspects and public acceptability of acquiring water and transferring it to instream flow purposes. The pilot program began in fiscal year 1995 and extended through fiscal year 1996.

In 1996, Reclamation leased water rights from three irrigators for a total of approximately 9 cubic feet per second. As a result, approximately 450 acres of land were temporarily fallowed, and the irrigation water rights were protected as an instream flow pursuant to Washington state law. The price for the leased irrigation water rights ranged from approximately \$23 to \$40 an acre-foot. The pilot program helped assure the viability of the water acquisition program.

The Yakima Area Office currently is implementing the Yakima Basin Water Acquisition Program authorized under the YRBWEP. The YRBWEP authorizes Reclamation to seek leases, dry year lease options, permanent water acquisitions, acquisition of land with appurtenant water rights, water banking, or other innovative measures to acquire water for instream flows for the benefit of anadromous fish. Water rights under this program are acquired from willing sellers or lessors and protected as an instream flow right.

For irrigation season 1997, Reclamation leased irrigation water rights from four irrigators, for a total of approximately 18 cubic feet

per second. Approximately 872 acres of land are temporarily fallowed, and the irrigation water rights are protected as an instream flow. The price for the leased irrigation water rights ranged from approximately \$23 to \$35 an acre-foot..

To date, Reclamation has only leased water rights under this program but is pursuing opportunities for permanent water rights acquisitions or permanent acquisition of land with appurtenant water rights.

Conservation Advisory Group

The water conservation program is based on a Basin Conservation Plan being developed by a federally appointed Conservation Advisory Group (Group). The Group consists of six members appointed by the Secretary of the Interior. These six members individually represent the nonproratable irrigators, proratable irrigators, Yakama Indian Nation, environmental interests, Washington State University Agricultural Extension Service, and the Washington State Department of Fish and Wildlife.

The Group is a nonvoting, consensus-seeking body with a 5-year life. The act requires the Group to submit a draft Basin Conservation Plan to the Secretary of the Interior within 2-1/2 years of its enactment. The Group started work on the plan in January 1996. Since this time, the Group met approximately every month and finally reached consensus on the plan as scheduled in April 1997. The process of consensus building was slow and arduous. There were times when it appeared the differences could not be overcome. The turning point occurred well into the process when several members rewrote controversial sections of the plan incorporating their own ideas. This moved the Group from conceptual discussion to negotiation and consensus building on language that would appear in the plan.

The plan is currently going through a 60-day public review process and should be published early in 1998. It will have broad public acceptance because of the process and should allow Reclamation to implement the Basin Conservation Program without having to overcome opposition.

When the water conservation projects are completed, two-thirds of the conserved water will be left in the Yakima River or its tributaries for improved instream flows, and one-third of the conserved water will be available to the irrigators to improve the reliability of the water supply. The program is strictly voluntary, and the costs are shared between the federal government (65 percent), state (17.5 percent), and local irrigators (17.5 percent). #

—Walt Fite, Area Manager, Upper Columbia Area Office, Bureau of Reclamation, Yakima, WA

(43 U.S.C. § 390jj). Plans are to include "definite goals, appropriate water conservation measures, and a time schedule for meeting the water conservation objectives." Reclamation has established a Water Conservation Field Services Program to provide technical and financial assistance to districts for implementing these plans. Funds are to be matched by local cost-share partners (Reclamation, 1997).

Project uses are directed and constrained by their authorizations and by federal contracts with the governing services to be provided (e.g., annual water deliveries), payments for their allocated portion of the construction costs, and payments (if any) for ongoing operation and maintenance, as well as other matters. As demands for water controlled and delivered through Reclamation facilities change, water uses have also been changing. Increasingly, these changes require some change in the contract or even in the project authorization—for example, when the project or the contract only authorizes irrigation water uses and the desired use is for nonirrigation purposes.

In 1988, Interior established policy for guiding transfers of federal project water to new uses (Interior, 1988; Reclamation, 1991). Generally supportive of such transactions, the policy limits federal review to such matters as whether there would be any diminution of service to other users, whether federal and state laws are met, and whether there will be adverse third-party consequences. Transfers had occurred with federal approval prior to institution of this policy (MacDonnell, 1991), but now there are generally known and accepted rules and procedures governing such transactions.

The Army Corps of Engineers

Like Reclamation, the Corps historically was primarily a construction agency; but today, both agencies spend more on O&M than construction. The Corps' work on western rivers has focused

almost entirely on construction and operation of dams for flood control, coupled in some locations with hydroelectric power generation and water supply. As is the case with Reclamation projects, the number of new Corps flood control projects authorized by the Congress has declined markedly in recent years. While Corps appropriations generally have increased over the years (in current dollars), the share going to construction of new projects has declined from more than 80 percent in the 1960s to about 40 percent in 1997. By 2002, total Corps appropriations are expected to decline 20 percent in constant dollars from 1997 levels (EOP Group, 1997).

The decline in Corps construction of new water projects reflects, in part, a changing view of flood management. In simple terms, the focus is shifting from controlling floods to managing flood plains. Thus, reliance on dams for holding back floodflows and on levees for keeping floods within channels is broadening to include such things as removing high-risk human uses of flood plains, floodproofing continuing human uses, and improving flood warning and temporary evacuation systems (Floyd, 1997). The 1994 edition of the *Unified National Program for Floodplain Management* lists four strategies:

- (1) Modify human susceptibility to flood damage and disruption
- (2) Modify the impact of flooding on individuals and communities
- (3) Modify flooding
- (4) Preserve and restore the natural resources and functions of flood plains

This broadening in emphasis to include nonstructural approaches increases the importance of local participation, including planning, land use management, and implementation. Reflecting the changing nature of flood damage management, the 1986 Water Resources Development Act included

EPA's Watershed Protection Approach

Despite great improvements in some water resources following implementation of environmental statutes and voluntary initiatives, many difficult and controversial water resource quality problems remain. Environmental statutes do not address, and in some cases specifically exempt, the most significant remaining sources of environmental quality pollution and degradation, including:

- Pollutants in runoff from urban and agricultural nonpoint sources.
- Groundwater leaching of pollutants from nonpoint sources and related surface water impacts.
- Losses of wetlands and their associated ecosystem benefits.
- Toxics and microbial contamination in communities' drinking water supplies.
- Water availability problems for both human and ecosystem uses institutions and incentive structures that make conservation difficult.
- Environmental laws and regulations that treat land, air, water, and living resources as separate entities.

What is EPA's Watershed Protection Approach?

The watershed protection approach represents an effort to address the above problems by integrating EPA programs and all other tools available to protect and restore aquatic resources. The concept is to focus on hydrologically defined drainage basins—watersheds—as the areas of study, rather than areas defined by political or other boundaries.

The watershed protection approach identifies the primary threats to human and ecosystem health within a watershed; engages people most likely to be concerned or most able to take action in a watershed; and takes a comprehensive, integrated approach to solutions and actions. The ability to monitor progress and modify actions is also a cornerstone of the approach. The watershed approach emphasizes all aspects of water quality—physical, chemical, and biological—and encompasses all waters—surface, ground, inland, and coastal.

Building Capacity in Watersheds

EPA's 10 regional offices work to implement watershed protection activities in partnership with state, tribal, and local governments; professional and other interest groups; landowners; and the general public. EPA has recognized that voluntary approaches are needed to protect water resources not adequately protected by environmental statutes. Numerous watershed protection tools are available, including workshops, indicators of water resource health, databases, financial assistance information, water quality and other models, data collection/measurement/assessment, outreach and education, and others.

Clark Fork-Pend Oreille Watershed

The Clark Fork-Pend Oreille watershed covers 26,000 square miles in Montana, Idaho, and Washington. Congress initiated the project to address problems with nutrient overloading in lakes and rivers caused by runoff from irrigated agriculture fields, inadequate septic tank systems, municipal and industrial wastewater treatment plant, and heavy metals from active and inactive mining and smelting. Watershed protection actions were initiated (under Section 525 of the 1987 Clean Water Act) to conduct a comprehensive study of pollution sources in Pend Oreille Lake, the Pend Oreille River, and the Clark Fork River and its tributaries. The study involved the states of Montana, Washington, and Idaho; EPA Regions 8 and 10; and EPA's Las Vegas Environmental Monitoring Systems Laboratory. A study of Pend Oreille Lake was conducted by federal, state, and local government agencies. In all, participants included nearly 30 organized groups from federal, state, local, and tribal governments; private industry; and the local citizenry.

Project objectives include reducing nutrient loadings and controlling algae in the Clark Fork River, Pend Oreille River, and Pend Oreille Lake. Water quality problems include algal blooms and eutrophication of near-shore lake areas. Project objectives are being pursued by controlling land use activities that contribute to nonpoint and point source nutrient loading. EPA has provided funding and technical

(See "EPA," next page)

EPA (continued)

support for numerous projects in the watershed. Actions taken by the states and communities to control nutrient loadings of the rivers and lakes have included:

- A Tri-State Implementation Council to implement recommendations.
- A basinwide phosphate detergent ban.
- Numeric nutrient loading targets for the Clark Fork River, Pend Oreille River, and Pend Oreille Lake.
- Education programs for the public to help protect water quality.
- Eurasian milfoil (a noxious aquatic weed) control.
- Centralized sewer systems for developed areas on Pend Oreille Lake.
- Improvements at the Missoula wastewater treatment facility.
- Enforcement of regulations and laws, particularly state antidegradation statutes.
- A basinwide water quality monitoring network to assess effectiveness and trends and to better identify sources of pollutants.
- Development and enforcement of stormwater and erosion control plans and county ordinances.

Idaho received a Clean Lakes Program grant in 1987 for a Phase I diagnostic and feasibility study of Lake Pend Oreille and its watershed to analyze the lake's condition, examine sources of pollution, and evaluate solutions and recommendations to restore and protect lake water quality. In 1993, a Phase II Clean Water Lakes grant was awarded to take actions on Phase I recommendations, including in-lake restoration and watershed management activities to control nonpoint source pollution.

Boulder Creek, Colorado

The Boulder Creek Enhancement Project demonstrates a holistic approach to water quality

improvement and encompasses several aspects of the TMDL process. Although not formally submitted as a TMDL, the enhancement project closely parallels the phased TMDL approach outlined in the TMDL guidance (U.S. Environmental Protection Agency, 1991). Following identification of water quality impairment, all possible causes were examined, and the location and extent of controls necessary to correct the impairment were identified. An adaptive management plan was developed to implement the proposed controls in phases, a few at a time, to permit monitoring and evaluation of their effectiveness. The implementation plan was modified between phases based on the evaluations.

A use-attainability study, one of the first conducted in Colorado, showed that aquatic life in Boulder Creek was impaired. Traditional monitoring indicated that instream concentrations of unionized ammonia were exceeded downstream of the city's wastewater treatment plant (WWTP). Pollution contributions from each point source (the WWTP and other dischargers) and nonpoint source (agriculture, cattle grazing, surface mining, and water diversion) along the 15.5-mile stream section below the WWTP were evaluated and monitored to determine the most effective strategy for reducing the instream unionized ammonia concentrations and improving stream conditions. Data showed WWTP was meeting its effluent limits for ammonia, indicating either that (1) the effluent limits were not strict enough or (2) other factors were responsible for the impaired water quality of Boulder Creek.

Further investigation showed that high water temperature and pH were the primary causes of the unionized ammonia excursions. These were linked, in part, to physical degradation of the creek's riparian zone; species diversity and density were low even in reaches with good water quality. Therefore, more stringent effluent limits and plant upgrades alone would not solve the problem. A combination of plant upgrades, best management practices, and habitat restoration was needed to improve water quality in Boulder Creek. #

—Brad Crowder, U.S. EPA, Region VIII, Denver, CO

cost-sharing requirements for Corps flood control projects and flood control aspects of Reclamation projects. Previously, local sponsors had been required only to provide lands needed for Corps projects. The 1986 Act required local sponsors to pay for feasibility studies plus a share of the construction costs. The Act further increased the local share for project construction costs and required local sponsors to prepare and implement flood plain management plans within 1 year following project completion (Floyd, 1997).

USDA Water Programs

The 1954 Watershed Protection and Flood Prevention Act provided state and local government with up to 100 percent of the funding needed to construct flood control structures in "small" watersheds (250,000 acres or less) (USDA, 1997). According to USDA, 482 watershed projects involving flood control have been constructed in the 19 western states since 1954, including the construction of more than 3,000 flood control dams (USDA, 1997). Funding for these projects is expected to decline sharply, and no new projects are expected to get federal support except by specific congressional appropriation (EOP Group, 1997).

The USDA, through its Rural Utilities Service, operates loan and grant programs supporting provision of drinking water supplies and wastewater treatment in rural areas (less than 10,000 people). Nationwide, this program provided funding of \$1.3 billion in 1997 (USDA, 1997).

Through its extension service and NRCS, USDA provides research, demonstration, and information directed at improving onfarm irrigation practices (USDA, 1997). One well-known product funded through the extension service is the "Low Energy Precision Application" modification for center-pivot irrigation systems, which has improved irrigation water use efficiency while lowering energy costs.

Water-Related Environmental Protection

Perhaps no area of federal programs has grown more rapidly since the 1960s than that related to environmental protection. As described earlier in this chapter and in chapter 4, the Congress enacted a broad array of laws during this period, making water quality and endangered species protection national priorities; directing that federal actions not impair, but rather enhance, environmental values (especially those related to fish and wildlife); and providing in other ways for environmental protection. This section discusses selected water-related environmental protection programs.

Environmental Protection Agency Programs Under the Clean Water Act

The Clean Water Act (CWA) declares that the restoration and maintenance of the chemical, physical, and biological integrity of the nation's waters is a national objective and sets out requirements that apply on a nationwide basis. Most prominently, it prohibits discharging any pollutant from a point source into the nation's waters except in compliance with a permit requiring technologically based, nationally established levels of treatment (33 U.S.C. §§ 1311, 1342). It requires water quality standards for all lakes and streams, setting out designated uses of the water and adopting water quality criteria supporting such uses (33 U.S.C. § 1313). It encourages voluntary approaches for dealing with nonpoint sources of pollution (33 U.S.C. § 1329).

EPA is given a number of direct responsibilities under the CWA. For example, EPA is required to establish national standards of performance for treatment of discharged pollutants (33 U.S.C. § 1316), more stringent treatment standards for discharges of toxic pollutants (33 U.S.C. § 1317), and minimum water quality criteria supporting designated water uses (33 U.S.C. § 1314).

As described above, states for the most part implement the Clean Water Act. Most states have assumed responsibility for administering the point source permit system. They have set water quality standards for their streams, assessed sources of nonpoint source pollution, and set up programs intended to reduce pollution from these sources. EPA acts primarily in an oversight capacity, assuring that state programs meet statutory and regulatory requirements.

In addition to its responsibilities related to establishing national standards and criteria and overseeing state implementation activities, EPA manages the distribution of congressionally authorized funding to help meet the objectives of the CWA. Most significantly, the federal government has funded more than \$66 billion in grants to construct municipal treatment plants since 1972 (EOP Group, 1997). Between 1974-87, the program involved a 75/25 match, with funding going to specific projects prioritized by states and approved by EPA. At this point the program moved to a State Revolving Fund, with federal funds going as grants to the states to be disbursed for waste treatment or treatment-related programs beyond municipal waste treatment construction. In fiscal year 1995, Congress appropriated \$1.235 billion for EPA distribution to the Clean Water Act State Revolving Fund—of which about \$350 million went to the 19 western states (EPA, 1996). Federal funding for water pollution abatement soon is expected to exceed that for other kinds of water resources programs (EOP Group, 1997).

Next in importance, based on funding, is the EPA program for water quality research. In fiscal year 1995, \$545 million went to support development and analysis of data and technologies specific to protecting designated uses of water. About \$100 million went to grants under section 319 to support implementation of nonpoint source management programs, of which roughly \$17 million went to the western states. Seventy-nine million went to

section 106 grants, used by states and tribes to establish and maintain measures to prevent and control surface water and groundwater pollution, of which about \$19 million went to western states.

USDA Conservation Programs

With the 1985 Food Security Act, the Congress greatly increased the emphasis on environmental protection in USDA conservation programs. Following in part the model of the 1970 Water Bank Program, the Congress initiated the Conservation Reserve Program and the Wetlands Reserve Program. The Conservation Reserve Program provides funds to pay an annual rental to farm owners and half the cost of establishing a permanent land cover such as grass or trees in return for retiring cropland from agricultural use for 10 to 15 years (USDA, 1997). The Wetlands Reserve Program provides funds to pay landowners to retire areas with significant wetland values from farming uses for specified time periods.

The 1990 Food, Agriculture, Conservation and Trade Act established the Water Quality Incentives Program to help fund farm practices that reduce nonpoint source pollution. The incentive program provided payments to farmers who agreed to implement approved management practices for 3- to 5-year periods. This program now has been subsumed within the Environmental Quality Incentives Program described below. USDA also established the Water Quality Program in 1990 to focus technical and financial assistance on areas with identified agricultural-related water quality problems.

The 1996 Farm Act established the Environmental Quality Incentives Program, consolidating the functions of the Agricultural Conservation Program, the Water Quality Incentives Program, the Great Plains Conservation Program, and the onfarm

Chalk Creek Watershed: Reducing Erosion and Sedimentation of Streams

The Chalk Creek watershed in northeastern Utah covers 176,000 acres and is used primarily for livestock, wildlife production, hunting, fishing, oil and gas production, timber harvest, and recreation. Chalk Creek is a major tributary to the Weber River, which provides the water supply for the cities of Ogden, Roy, and Layton. These downstream water users experience serious taste and odor problems during the spring and fall lake overturns at Echo Reservoir, and they also experience unusually high water treatment costs.

In 1991 the Summit County Soil Conservation District initiated the Coordinated Resources Management Plan (CRMP) process. A Steering Committee and Technical Action Committee were formed to identify watershed problems, seek solutions, and put together a CRMP.

Of the several pollution problems identified, sediment loading is most serious. Studies found that Chalk Creek, a major tributary to the Weber River, exceeded by 10 times the sediment contribution of any other tributary, resulting in severe eutrophication and excess nutrient loading of Echo Lake and the Weber River.

Causes of Chalk Creek water quality problems were identified as overgrazing by livestock and wildlife causing range erosion, heavy livestock concentrations along the riparian corridor, and indiscriminate creek spraying for weed control, destroying deep rooted shrubs necessary for healthy streambanks and a functional riparian flood plain. Most of the sediment flowing from Chalk Creek comes directly from the streambed or its banks. Heavy oil and gas exploration activities, and the related road construction, also contributed to sediment loading. Overirrigation has also contributed to nutrient loading to Chalk Creek. Not only are nutrients leached from the soils, but irrigation return flows flow directly into Chalk Creek, carrying sediment, animal waste, pesticides, and nutrients.

The CRMP sets forth selected treatment alternatives. Plans for the uplands include range seeding, sagebrush control, juniper removal, gully plugs, improved grazing management, creating functioning

alluvial fans and wetlands for sediment filtration, protecting oil and gas activities from excessive erosion, and developing offstream water source for livestock and wildlife. Plans for the riparian areas include streambank protection, grade stabilization, riparian revegetation and protection, corridor and/or riparian pasture fencing, and improved grazing management. Plans for the irrigated pasture and hayland in the lower watershed include installation of a communitywide gravity flow sprinkler irrigation system to replace present flood irrigation systems and subsequent improved irrigation water management. Plans for the scattered irrigated lands in the upper watershed include improvement of existing diversion structures, improved irrigation water management, and sprinkler irrigation systems wherever practical.

The expected benefits will be range and forest protection, riparian restoration, wildlife enhancement, improved trout fishing, decreased sediment delivery to Echo Reservoir and the lower Weber River system, slower eutrophication in Echo Lake, and reduced water treatment costs for downstream water users. If these goals are met, it is expected that Chalk Creek will meet Utah Water Quality Standards for its designated use.

To date, approximately one-fourth of the area has been treated using \$400,000 in contributions from a variety of sources including EPA's 319 nonpoint source fund, Agriculture Conservation Program, Stewardship Incentive Program, the Service's Partners for Wildlife fund, the Utah Division of Wildlife Habitat fund, the Utah Division of Oil, Gas and Mining bond reclamation fund, the National Fish and Wildlife Foundation, Questar Pipeline, and other considerable private sources.

Projects completed include brush control, range seeding, fencing and grazing management for the range, riparian pastures and riparian corridors, spring development, stockwater lines, troughs, ponds, water gaps, channel revegetation, deferred grazing, grazing rotation, stream stabilization using vortex weirs, streambank protection using stream barbs, conifer revegetment, and biotechniques using willow fascines and blankets and several sprinkler irrigation systems. #

portion of the Colorado River Basin Salinity Program. Farmers and ranchers who adopt practices determined to reduce environmental and resource problems over a 5- to 10-year period receive technical assistance, education, cost sharing (up to 75 percent), and incentive payments.

Not only has the USDA shifted its conservation program emphasis from soil conservation to environmental protection, but it also has shifted emphasis within its programs from technical assistance and support of public works to cropland retirement through rental and easement payment and incentive payments to adopt environmentally protective agricultural practices. In short, it is paying farmers and ranchers to make environmentally desirable changes.

Appropriations for USDA conservation programs steadily increased in current dollar terms until 1995, when budget tightening reversed that trend. The mix of program expenditures has shifted to reflect increased emphasis on the use of direct payments to farmers instead of support for public works or cost sharing onfarm improvements. Since 1988, rental payments for retired lands—virtually all for the Conservation Reserve Program—account for the largest share of USDA conservation expenditures (USDA, 1997).

Implementation of the Endangered Species Act

The ESA represents a national commitment to protect plant and animal species threatened with extinction. It requires federal agencies to insure that their actions are not likely to jeopardize the continued existence of such species or to result in the adverse modification of their critical habitat (16 U.S.C. § 1536(a)(2)). It makes it unlawful for any person to harm or destroy an endangered species of fish or wildlife (16 U.S.C. § 1538 (a)(1)(B)).

Under the ESA, the Fish and Wildlife Service and, for marine species, the National Marine Fisheries Service (NMFS) are given a number of specific responsibilities. First, they are to identify and list plant and animal species determined to be either threatened or endangered and identify their critical habitat (16 U.S.C. § 1533). Second, they are to develop and implement plans for the recovery of listed species (16 U.S.C. § 1533(f)). Third, they act as consultants to other federal agencies in evaluating whether their proposed actions are likely to further jeopardize a protected species (16 U.S.C. § 1536). Finally, in the event of a "jeopardy" finding, they suggest reasonable and prudent alternatives.

Native fish species are in danger of extinction in all of the major river basins of the West as reflected in the basin studies prepared for the Commission. The development and use of western rivers that has accompanied settlement and development of the region have been a major factor in the decline of these species. Proposals for additional water development face review under ESA for their impacts on protected aquatic species. However, predictions by some that ESA would prevent any new water development and reduce yields from existing projects have proved largely unfounded. Since passage of the ESA, the Service has reviewed nearly 100,000 proposed federal actions for possible harm to protected species. Fewer than 1 percent of those actions have been found to involve unavoidable jeopardy (Service, 1997); in nearly all cases, either no jeopardy was found or reasonable and prudent alternatives were identified that would avoid further harm to protected species.

One of the more striking developments related to western water since the 1970s is the emergence of multiparty efforts to deal with endangered fish problems. In some cases, these efforts are connected to recovery plans under ESA. In other cases, they are proceeding as habitat conservation

Water Conservation in Agriculture

As the largest consumer of water in the West, the agricultural sector's water use practices are always under scrutiny. Growing demands for municipal and environmental water, coupled with the federal subsidy of irrigation water supplies, fuels the common perception that agriculture should use water more efficiently. There is no doubt that, in some areas, the abundant supply of cheap water has encouraged overapplication of water to crops and has discouraged investment in conservation improvements. However, irrigated agriculture as a whole has been responding to the increasing economic, regulatory, and social pressures toward more efficient water use.

The U.S. Department of Agriculture data indicate that irrigators nationally have reduced rates of application to crops by almost 20 percent from the late 1960s to 1994. In the West, between 1982-92, 6.2 million acres of farmland were brought under improved irrigation conservation practices. A 1994 survey of western irrigators found that more than one-third of farm operations undertook recent improvements in their irrigation systems, reducing water requirements on 68 percent, and energy consumption on 50 percent, of their acres. From 1976-93, acreage with surface irrigation systems decreased from about 37 to 26.6 million. Sprinkler irrigation was installed on approximately 6 million acres, and microirrigation systems, including drip irrigation, increased from 150,000 to 1.6 million acres. Even though the number of irrigated acres nationally has remained stable, the value of crop sales from these acres has risen from 30 to 41 percent total sales since 1982—reflecting, in part, improved water use efficiency.

The most commonly cited obstacles to improved irrigation systems are installation costs and inability to obtain financing.

While much discussion of agricultural water conservation occurs in the context of obtaining more water for other uses, such as instream flows, major benefits of increased efficiency are more reliable supply for farmers with junior water rights and improved crop production per acre. Institutionally, the challenges for agriculture are to implement water metering and institute more progressive water rate structures that reward water use efficiency. #

plans under the statutory provision relating to incidental taking of a species in the course of an otherwise lawful activity.

The Upper Colorado River Recovery Implementation Plan, in place since 1988, seeks to recover four species of fish native to the Colorado River and listed by the Service as in danger of extinction. Large-scale water development in the Colorado River basin is acknowledged to have been a major factor in the decline of these species. Plan implementation is overseen by a voluntary partnership involving federal agencies (Service, Reclamation, and Western Area Power Administration), the three Upper Basin states (Colorado, Utah, and Wyoming), a water development coalition, an environmental coalition, and an entity representing public power interests receiving hydroelectric power generated at facilities in the basin (the Colorado River Energy Distributor's Association). Recovery efforts focus primarily on habitat improvement and restoration and fish rearing and stocking. Roughly 90 percent of the funding comes out of Reclamation and Service budgets, with the states and the water developers providing the remainder. The Service regards continuing progress under the plan as sufficient basis for allowing additional water development in the Upper Basin. As of 1997, the Service had consulted on proposed federal agency actions involving more than 400 water projects that would develop more than 225,000 acre-feet of water in the Upper Basin and had supported their approval in every case because of progress under the Recovery Plan (Kantola, written communication, 1997).

Parties in the Lower Colorado River basin are in the process of putting in place a Multi-Species Conservation Plan. The partnership involves the three Lower Basin states (Arizona, California, and Nevada), water and power user interests within these states, six federal agencies (Service, Reclamation, BLM, National Park Service, BIA, and the

U.S. Geological Survey), Indian tribes and nations, environmental organizations, and others. The plan's goal is to establish a 50-year program to conserve necessary habitat and aid recovery of rare, threatened, and endangered plant and animal species native to the Lower Colorado River and its 100-year flood plain.

Still another approach is represented by the CALFED Bay-Delta Program. Multiple environmental problems, including the presence of endangered fish, limit water use from California's major source of supply. The CALFED program, initiated in 1995, involves 12 federal and state agencies working with an advisory council of 34 water leaders. The initial focus is on identifying a mix of actions acceptable to these interests that will successfully address the major environmental problems of the Bay-Delta. In 1996, the Congress authorized funding of \$3.3 million per year for 3 years to support this program.

The Army Corps of Engineers Civil Works Program

Since 1986, the Congress has been moving the Corps' traditional engineering mission in the direction of environmental improvements, creating what has been referred to as the "Corps of Environmental Engineers" (Grumbles and Kopocis, 1993). The 1986 Water Resources Development Act declares that the benefits of environmental improvements accomplished by the Corps as part of its projects are to be regarded as equal to their costs (making their justification automatic) and specifically provides mitigation measures for fish and wildlife for Corps projects (§§ 907 & 906). Moreover, it provides authority to the Corps to revisit existing projects to evaluate and make changes that will improve the environment (§ 1135). The 1990 Water Resources Development Act established environmental protection as a primary mission of the Corps (§ 306(a)).

Water for Wildlife Refuges

The National Wildlife Refuge System will soon be celebrating its 100th birthday. In 1903, public outrage over the devastation of wading bird populations in Florida led President Theodore Roosevelt to create the first refuge, Pelican Island Federal Bird Reservation. By the time he left office in 1909, President Roosevelt had established wildlife reservations in 17 states and 3 territories. Today there are over 500 Federal Wildlife Refuges encompassing more than 92 million acres of land. The refuge system is managed by the Service.

Virtually every species of bird in North America has been recorded in the refuge system, but the wide diversity of refuge wildlife also includes hundreds of other species of mammals, reptiles, amphibians, fish, and plants, including over 60 endangered species. In Alaska, the refuge system includes entire river basins and ecosystems. In Hawaii, the refuge system includes wetlands and remote islands which provide habitat for a vast array of water birds and marine life. The prairie pothole regions in Minnesota, the Dakotas, and Montana encompass hundreds of thousands of potholes, lakes, and marshes that are vitally important as waterfowl breeding areas. This area, which extends into Canada, can produce a fall flight of over 25 million migratory waterfowl. The deserts, prairies, mountains, and coastal wetlands of the West and Southwest provide habitat for big game, marine mammals, and shorebirds, as well as waterfowl. In the West, some refuges were established as game ranges or to protect endangered species, but the vast majority were created to protect migratory birds and fulfill the international migratory bird treaty obligations of the United States. Most of these waterfowl refuges are located along the Central and Pacific flyways (major north-south waterfowl migration routes) and provide critical feeding and resting areas during the spring and fall migrations.

Approximately one-third of the refuge system acreage is wetland habitat, reflecting the important value of wetlands for wildlife and the continuing threats to this diminishing resource. The majority of this acreage is not manipulated in any way. However, about 1.6 million acres of wetlands are actively managed. Wetland or flood plain ecosystems historically maintained by periodic river flooding and wet climatic conditions,

prior to flood control and channelization, can now be maintained only through active water management. Refuge managers divert water to maintain marshes and impoundments, create moist soil units, irrigate nesting cover or grain crops, and sustain streamflows for fisheries and riparian habitat. Water level manipulation to mirror natural processes is used to aerate soils and stimulate plant growth. Refuge wetland restoration and, in some cases, creation of new wetland habitats, has become increasingly important in the effort to stem the continuing decline of wetlands nationwide.

Adequate and reliable high quality water supplies, and the legal rights to use that water, are critical if refuges are to fill their wildlife objectives. Given the relatively late establishment dates of most refuges, the U.S. Fish and Wildlife Service faces major challenges in protecting sufficient water to meet resource management objectives, statutory responsibilities, and international treaty obligations. Of 226 western refuges responding to a 1994 questionnaire, only 98 reported that their existing water rights assured delivery of adequate water in an average year.

One difficulty encountered by the Service in protecting refuge water resources is that *in situ* uses of water, such as natural marsh/wetland areas or instream flows, cannot be protected under the laws of several western states. Without a water right, the Service lacks standing, except under a broad public interest criteria, to protest projects which drain or dewater refuge water sources.

A second problem stems from the lack of funds to adequately document water uses on many refuges. Additional funds are necessary if the Service is to move its water rights management program beyond its current reactive mode to a planned hydrological and biological data collection program. A proactive program would improve data collection and analysis for use in defense of refuge water rights; increase the efficiency and effectiveness of existing water management; and enhance the Service's ability to form partnerships, work with other entities on watershed-based solutions to achieve wildlife objectives, and resolve water resource needs. #

Under its authority to make modifications to existing projects for environmental benefits, the Corps has:

- Made changes at Boyer Chute, Nebraska, to restore seasonal flows in an oxbow to restore fish habitat.
- Improved wetlands at Fern Ridge Lake, Oregon.
- Increased waterfowl nesting habitat at Homme Lake, North Dakota.
- Restored salmon access to the Sammanish River, Washington.
- Restored the direct hydraulic connection between an intertidal area and the estuary at Trestle Bay, Oregon.
- Restored historic wetlands at Davis Site, California (Martin, 1997).

In connection with new flood control projects, the Corps has restored aquatic and riparian habitat and channel integrity in Rapid Creek, South Dakota, and has studied ecosystem restoration opportunities at Jackson Hole, Wyoming (Martin, 1997).

Arising out of individually authorized ecosystem restoration studies, the Corps has:

- Evaluated the feasibility of modifying its Cougar and Blue River Lakes projects in Oregon to make available water at temperatures favorable to anadromous and other native fish.
- Evaluated the feasibility of improving stream channel and riparian habitat to benefit the cui-ui and the Lahontan cutthroat trout in the Lower Truckee River, Nevada.

- Examined the potential for wetland and riparian vegetation restoration within an existing urban flood control channel in Rio Salado, Arizona.
- Evaluated restoration of tidally influenced wetlands in the Sacramento-San Joaquin Delta, California (Martin, 1997).

The Bureau of Reclamation and Environmental Protection

Like the Corps, Reclamation increasingly finds itself concerned with matters of environmental protection. In the 1974 Colorado River Basin Salinity Control Act, the Congress gave Reclamation major responsibility for dealing with salinity concerns in the Colorado River (43 U.S.C. § 1592 et seq.). First, it directed Reclamation to construct a large desalting facility on the Colorado River near the Mexican border at Yuma, Arizona, capable of treating river water to ensure its salinity content meets the levels agreed to with Mexico. Second, Reclamation has constructed salinity control units at several locations in the basin to reduce salinity loadings to the river.

Reclamation has been making structural changes and modifying operation of many of its facilities over the years to mitigate adverse environmental effects or provide increased environmental and recreational benefits (numerous examples are discussed in a 1996 report produced by the Natural Resources Law Center [1996]). In some cases, these changes have been made under specific authority and direction from the Congress; in other cases, Reclamation has made the changes on its own authority to meet local needs and interests or to respond to its obligations under NEPA or the ESA.

The shift in emphasis from project construction for water development to environmental protection is dramatically reflected in the Reclamation Projects

National Fish and Wildlife Foundation

From "Bring Back the Natives" and "Partners in Flight" to Hungry Horse Reservoir Fish Passage, Upper Blackfoot River Restoration, Boulder City Wetlands, Algodone Dune Watchable Wildlife, and hundreds more projects—small and large and all across the United States—the National Fish and Wildlife Foundation (Foundation) is making a significant contribution toward protecting and restoring fish, wildlife, plants, and their habitats.

The Congress chartered the Foundation in 1984 as a charitable and nonprofit corporation. It is not an agency of the U.S. government but is authorized to receive federally appropriated funds. Its mission is to aid in achieving the mission of the U.S. Fish and Wildlife Service through public-private partnerships. The Foundation's unique status has allowed it to pioneer innovative funding mechanisms; to build private, public, and governmental relationships many would have thought impossible. It has funded and fostered a "bottom-up, hands-on" approach to protecting and restoring natural resources and had many successes.

The Foundation's role is primarily one of facilitating promising projects: it raises funds to provide grants or "seed" money to the projects, brings other partners into the projects if appropriate, and provides technical assistance. With greater competition for shrinking federal dollars for conservation projects, the Foundation has been able to harness funds from a variety of sources for local projects. It meets needs that might otherwise be overlooked or not funded by governmental programs.

Part of the success of the Foundation can be seen by looking at their financial history. The Congress required the Foundation to match the funds they receive from the Congress on a minimum one-to-one basis. All of the Foundation administrative costs must come from private sources. Over the years, the congressional contribution to the Foundation has been relatively small, beginning with \$250,000 in 1987 and gradually increasing to \$15.9 million in 1997. Due in large part to its ability to get things quickly with minimal red tape, the Foundation has attracted broad and diverse sources of funds. More federal agencies contribute to Foundation programs today than in earlier years, and the total dollar amount from those agencies has increased from \$250,000 in 1987 to \$16,171,000 in 1996. A similar dramatic increase in funds from private sources has occurred with \$580,000 in 1987 increasing to \$27.6 million in 1996.

As policymakers and others seek to meet environmental protection and restoration needs under increasingly challenging circumstances, the Foundation's experiences provides useful lessons on the importance of building private-public sector relationships, the need for leveraging diverse sources of funds, and the importance of producing on-the-ground results quickly. #

Authorization and Adjustment Act of 1992 (P.L. 102-575). This Act contains 40 separate titles related to water resources projects and other western water matters. Nine of these titles deal largely or totally with environmental concerns. Title 34, the Central Valley Project Improvement Act, is characterized by Reclamation as "a major aquatic ecosystem protection and restoration program" (Reclamation, 1997). Perhaps its most important provisions are the dedication of 800,000 feet of project yield to fish, wildlife, and habitat restoration purposes (1992 Reclamation Projects Act, § 3406(b)(2)) and the requirement of a plan for doubling existing populations of anadromous fish in Central Valley streams and rivers by the year 2002 (Id., § 3406(1)). Title 3 is a companion to the title authorizing completion of the Central Utah Project. It provides for creation of the Utah Reclamation Mitigation and Conservation Commission, with responsibility for coordinating implementation of environmental mitigation projects spelled out in the act (Id., § 301(a); § 315).

In the Pacific Northwest Region, the major Reclamation initiative related to environmental protection concerns flow augmentation in the Columbia/Snake River system to benefit endangered stocks of salmon. Annually since 1991, Reclamation has provided water for this purpose from its facilities—primarily from uncontracted reservoir storage space, storage space reserved for power generation, and annual purchase of water available from rental pools (Reclamation, 1997). As of 1997, Reclamation had purchased about 57,000 acre-feet of storage space from which it can now deliver water, and the agency is acquiring additional direct flow rights. Funding directed to flow augmentation efforts in fiscal year 1997 totaled \$6.75 million. Other major initiatives include construction of a project pumping water out of the Columbia River into the Umatilla River to help restore salmon spawning access and making improvements to the Yakima Project and to water

uses within the basin to improve instream flows needed by salmon and other anadromous fish.

Environmentally related Reclamation efforts in the Great Plains Region focus primarily on wetlands. In 1989 the Great Plains Region initiated the Wetlands Development Program. Fiscal year 1997 funding for this program was \$4.489 million supporting 53 projects. In addition, as mitigation for the Garrison Diversion Unit, Reclamation has purchased approximately 6,180 acres of wetlands, restoring some previously drained lands. Additional adjacent uplands also have been acquired and planted to permanent cover.

In the Lower Colorado Region, Reclamation has focused largely on endangered species concerns—primarily relating to the endangered razorback sucker and the bonytail chub. These efforts are folding into the Multi-Species Conservation Program, intended to address the habitat and other needs of more than 100 species.

As already mentioned, in the Upper Colorado Region, Reclamation is a major participant in the Upper Colorado River Recovery Program—providing \$10.3 million in funding in fiscal year 1997. The other major Reclamation initiative in the Upper Colorado Region involves reoperation of Glen Canyon Dam; following years of study under an environmental impact statement process, dam operations were changed to improve downstream environmental conditions in the Grand Canyon. Moreover, experimentation with controlled flood releases began in 1996 to evaluate the benefits of periodic large-flow releases.

Ecological restoration activities initiated under the 1992 Central Valley Project Improvement Act dominate Reclamation's environmental protection efforts in the Mid-Pacific Region. Funding for these activities in fiscal year 1997 was \$58.3 million. In addition, Reclamation provides substantial funding in support of the Trinity River Fish and Wildlife

Restoration Program (\$5 million in fiscal year 1997) and the CALFED Bay-Delta Program (\$4.1 million in fiscal year 1997). A temperature control structure at Shasta Dam on the Sacramento River to provide late summer and fall water releases at temperatures beneficial to winter run chinook salmon spawning was installed at a cost of \$80 million.

The Federal Energy Regulatory Commission and Hydropower Licenses

The Congress established the Federal Power Commission (now the Federal Energy Regulatory Commission) in 1920 to allow private development of hydropower facilities in a manner that would maximize the potential for water power development (Act of June 10, 1920, ch. 285, 41 Stat. 1063). It required all such proposed facilities to obtain a license from FERC by demonstrating that the proposed project would promote comprehensive development of the river on which it is located (16 U.S.C. § 797(e); 16 U.S.C. § 803(a)). However, in 1986, the Congress directed FERC to give equal consideration to fish, wildlife, recreation, and other uses along with power development, in its licensing decision (P.L. 99-495, 16 U.S.C. § 803(a)). FERC is required to consult with federal, state, and local resource agencies in its consideration process and to include federal and state fish and wildlife agency recommendations for fish and wildlife resources in a license unless it finds such recommendations inconsistent with the purposes and requirements of the Federal Power Act (FPA) or other applicable laws. FERC is also required to include federal agency requirements in licenses for the adequate protection and utilization of federal reservation lands occupied by a project and for fish passage. Under NEPA, FERC is obligated to prepare an environmental impact statement or an environmental assessment to examine the environmental consequences of the project.

While FERC typically issues licenses for 30- to 50-year periods, hundreds of licenses have expired or will soon do so. Licensees seeking a new license file a notice with FERC 5 years in advance of license expiration and prepare information for public review respecting their relicensing plans. They consult with federal and state resource agencies and Indian tribes respecting measures for resource protection, mitigation, and enhancement, and they conduct studies needed to support license application (National Park Service and American Rivers, 1996). FERC may initiate formal environmental review under NEPA for licensees seeking new licenses until the application is regarded as complete, although there is a trend to initiate environmental review earlier in the process under new authorities provided as part of the Energy Policy Act of 1992. Under section 4(e) of the FPA, after FERC finds that the license will not interfere or be inconsistent with the purpose of the federal reservation, the license conditions necessary for the adequate protection and utilization of the reservation may be prescribed. Under the FPA, the Secretaries of Interior and Commerce may prescribe fishways.

In addition, under section 10(j) of the FPA, FERC is required to include conditions that adequately and equitably protect, mitigate damages to, and enhance fish and wildlife. Those conditions are to be based on recommendations of the NMFS, the Service, and state fish and wildlife agencies. If FERC believes a § 10(j) recommendation or a part of the recommendation is inconsistent with the FPA or other law, FERC must attempt to resolve such inconsistency. If any part of such agency recommendation is not approved by FERC, FERC must make a finding of inconsistency. FERC license decisions may be appealed either by the applicant or by an intervening party to a federal court of appeals.

As a quasijudicial commission, FERC proceedings operate according to formal, court-like rules and requirements. The limited flexibility in these

proceedings, coupled with the reluctance of FERC to have to decide complex environmental matters, has encouraged use of settlement processes outside the formal FERC proceeding. FERC itself encourages applicants and other parties to agree to terms and conditions which can then go through the NEPA process. License terms and conditions have included such things as instream flows for boating and for fisheries, changes in reservoir operations, facilities for fish passage, watershed and river channel improvements, and the creation of trust funds for decommissioning or other purposes.

Water for Indian Nations and Tribes

As noted in earlier sections, Indian nations and tribes have become major participants in western water matters during the past 30 years. While the process of specifically defining tribal water uses under their rights has proceeded slowly, the existence of these rights is firmly established. Courts have found that a tribe's *Winters* rights may include uses other than irrigation.³ Courts also have found that tribal rights may even predate establishment of the reservation, based on pre-existing uses.

³ In *United States v. Adair*, 723 F. 2d 1394 (9th Cir.), *cert. denied*, 467 U.S. 1252 (1985), the Ninth Circuit held that the Klamath Tribe's treaty intended to reserve water necessary to support the hunting and fishing activities relied on by the tribe. The Ninth Circuit also upheld the existence of a reserved right to support the fishery on the Colville Reservation (*Colville Confederated Tribes v. Walton*, 752 F.2d 397 (9th Cir. 1985)). Also, the Washington Supreme Court upheld a decision in the Yakima River adjudication, finding a reserved water right for "the minimum instream flow necessary to maintain anadromous fish in the [Yakima] river, according to annual prevailing conditions" (*State Dep't of Ecology v. Yakima Reservation Irrigation District*, 850 P.2d 1306 (Wash. 1993)). The Wyoming adjudication, on the other hand, found that the Wind River Tribes could not claim reserved rights on the basis of fisheries maintenance.

However, much has been done since 1963 to further clarify the nature of tribal reserved water rights and to integrate these rights with other water rights established under state law. Procedurally, the U.S. Supreme Court has decided that quantification of tribal rights generally may be determined in state adjudication proceedings rather than in federal courts.⁴ State courts must follow federal law in determining the existence and extent of tribal water rights. Few tribal reserved rights have yet made their way completely through such proceedings, though tribal rights are under consideration in a large number of river adjudications around the West (Burton, 1991). As noted heretofore, negotiations also have been used to produce settlements that define and quantify Indian reserved water rights.

Federal efforts to build facilities necessary for tribal on-reservation water uses have increased somewhat since the 1960s. As, for example, with the Navajo Indian Irrigation Project, Reclamation generally is responsible for planning and building the primary water storage and delivery facilities, and BIA is responsible for the on-reservation and onfarm facilities. Tribes in Arizona are important beneficiaries of the Central Arizona Project. Water from the Dolores Project in southwest Colorado is delivered by pipeline to the Ute Mountain Ute Reservation. The Mni Wiconi Project, authorized by the Congress in 1988, provides water for tribal municipal and industrial uses in South Dakota. Some tribes are taking advantage of special funding and technical assistance provided by Reclamation for feasibility studies of municipal, rural, and industrial water projects.

⁴ *Arizona v. San Carlos Apache Tribe of Arizona*, 463 U.S. 565 (1983). The Court's conclusion was that, by the 1952 McCarran Amendment, the Congress decided that federal claims held on behalf of Indian tribes to use water may be determined in state general adjudication processes. It concluded that tribal reserved rights had been included.

Some tribes now operate their own water quality program under Section 518 of the Clean Water Act, which authorizes EPA to treat tribes as states for such purposes (33 U.S.C. § 1377).

Contemporary Federal Involvement in Western Water: Summary and Assessment

As this brief review of selected federal water-related policies and programs shows, the federal role in western water has changed quite markedly in the last 30 years. Historic types of water development are no longer its primary objective. Federal agencies are now trying to balance water development, project operations, and many environmental statutes such as NEPA, ESA, and the CWA.

Sustainability

In actual practice, federal policies and programs related to western water present a far from coherent and integrated approach to sustainable water use. Indeed, nowhere is sustainability even articulated as an objective of federal water policy. Rather, what has happened over a roughly 30- to 40-year period is the piecemeal emergence of policies directed at water quality, endangered species, fish and wildlife enhancement, and preservation of land and water, coupled with a de facto decline in the authorization of new water development projects. Less visible but equally important has been the shift in using federal funds from primarily development-oriented purposes to a rough balance between support of development and support of environmental protection, enhancement, and restoration. New agencies have emerged to carry out some of these policies, and the missions of existing agencies have changed, either explicitly or implicitly.

Nevertheless, federal policies in this area remain contradictory in some respects—incomplete and

largely unintegrated. In many instances, federal water facilities continue to provide water and electricity to users below the actual costs of those services. An inevitable effect of below-cost pricing of any valuable service is to encourage its overuse—hardly the road to sustainability. Some efforts are being made to change the terms and conditions of contracts with project beneficiaries, particularly at the time that contracts are renewed. For example, under Title XXXIV of the 1992 Reclamation Projects Act, the Congress limited renewal of contracts for water supply from the Central Valley Project to no more than 25 years, required tiered pricing and the installation of water metering as conditions of renewal, imposed an annual "mitigation and restoration" payment, and conditioned transfers on the new user paying full costs of service. Water districts are being encouraged to use tiered pricing for water deliveries as a way to influence water use. Consideration is being given to defederalizing at least some federal water and power facilities so that federal support no longer will be available.

Federal support for new water projects has declined but not disappeared. Even though cost-sharing requirements for most new projects are considerably greater than in the past, federal support remains extremely attractive if project proponents can successfully navigate the political process.

Environmental Issues

The promise of the Clean Water Act—to restore and maintain the chemical, physical, and biological integrity of the nation's waters—remains unfulfilled. Its regulatory structure has largely controlled the discharge of pollutants from point sources. Increasingly, the focus has turned toward meeting water quality standards that have been established for all surface water bodies; meeting existing standards will require reductions in pollution from

nonpoint sources beyond those obtained through the voluntary programs and activities employed to date.

Even more challenging in some respects is the federal commitment to protection and recovery of threatened and endangered species. Thousands of proposed federal actions now have gone through ESA-Section 7 review, with remarkably few found to produce unavoidable jeopardy. Development activities following reasonable and prudent alternatives developed under ESA-Section 7 or implementing habitat conservation plans are being guided in ways that are believed to be not only protective of endangered species, but also of help in their recovery. Nevertheless, scientific understanding of species' needs lags far behind protection efforts. In the case of aquatic species, the alteration of western rivers has so changed habitat conditions relied on by native species that feasible measures necessary for their recovery remain uncertain. It is fair to say that the mandates of the ESA are driving sometimes dramatic changes in river management throughout the West, changes intended to find a balance between rivers' developed uses and their natural functions.

Tribal Issues

Considerable progress has been made since 1963 in defining tribal rights to water. Far less progress has been made in tribal enjoyment of the benefits of those rights. With the reduction in new federal water projects, tribes have been unable to look to this avenue for satisfying their rights, although, as noted, negotiated settlements of tribal water rights have been used successfully in several cases. Also, off-reservation leasing of tribal rights, except under specific conditions, remains contentious. In short, the manner in which tribes can and will use their reserved water remains uncertain.

Changing Roles

The process of major change is rarely smooth and elegant, and certainly that is true in western water issues. Much effort and energy have gone into developing the many new federal programs instituted by the Congress since the 1960s, into clarifying through regulation and litigation the intention and reach of some of the provisions, and into making them workable on the ground. In some cases, advocates of the changes remain unsatisfied and work aggressively to broaden and strengthen federal programs. On the other hand, those whose activities are most directly affected by new federal programs have tended to resist their implementation and to seek changes in laws reducing what they regard as their most onerous impacts. Moreover, those who have been the historical primary beneficiaries of federal programs have tended to resist changes that reduce their traditional benefits or increase their costs. In addition, laws such as CWA substantially shifted the balance of federalism by establishing specific, nationally established requirements that the states were expected to implement.

Some of the measurable effects, viewed as both positive and negative, of the changing federal role are the decline in the number and size of new federal water projects, the increasing cost of these projects to their beneficiaries, the decline of pollution added to streams through point source discharges, the increase in the cropland acreage taken out of production, and the increase in the number of federal river restoration projects. In many respects, however, the most striking effect of federal changes is reflected, not by such measures, but by the emergence of efforts across the West to integrate a far broader and more complex set of interests into the governance of western waters.

When the dominant objective was water development for economic use and human consumption, water matters were almost exclusively the province of those with legal rights to divert and use water (typically a water district), the state

engineer who administered the state water rights system, and—if a federal water project was involved—Reclamation or the Corps. If the project involved hydropower generation, then those interests would be involved as well. Then-Governor Bruce Babbitt nicely summed up this relationship in a 1990 speech to the Western States Water Council:

That was an era in which most Governors and citizens of these western states did not have anything to do with [federal] water development. It was handled in Washington, with the assistance of the state engineer. It was a federal issue, and local folks did not mess around with it. That is what I loved about Steve Reynolds [longtime New Mexico state engineer]. He was honest enough to say, "Bruce, I loved the good old days, when governors were irrelevant." It was the state water engineer and the Washington delegation that counted in an era of supply side, reclamation-driven water resources development.

Concerns focused on priority rights to divert water and on ways to make more of the water usable. The federal focus was on planning the development to maximize its economic benefits, engineering the project, constructing it, perhaps operating it, and collecting any payments that were to be made.

Now the values of water are viewed far more broadly, and those with an interest in the ways streams and aquifers are used extend well beyond groups holding water rights or hydropower contracts. Over the years, congressional authorizations of water projects brought in more of those interests—providing directly for fish and wildlife enhancement features, for example, or for recreational uses such as boating, fishing, and swimming in project reservoirs. As noted earlier, the Wild and Scenic Rivers Act gave those who favor free-flowing rivers a few rivers with special protection from further water development. CWA recognized those with special water quality

concerns, and ESA recognized those concerned with species protection. NEPA forced all federal agencies to evaluate the environmental effects of their actions, including those related to water. EPA required FERC to give consideration to environmental values in its licensing decisions.

The sum effect of these and other such federal actions has been to greatly extend federal power over how water resources are used and to legitimize the participation of multiple interests in federal water-related decisions. The effect of laws like the CWA and the ESA is to create federal regulatory water rights—that is, they gave the federal government control over water in a manner similar to that given to water users by water rights (Tarlock, 1985). In practice, federal agencies generally have worked hard to find an accommodation between the interests of water users and their responsibilities under these laws (MacDonnell, 1989). Not uncommonly, such accommodation has been sought through public processes involving multiple participants with direct interests in the matter (stakeholders) searching for acceptable solutions that meet the legal obligations of the agency, while allowing land and water uses to go forward. Federal agencies often hold a significant legal stick in these processes (e.g., denial of a section 404 permit or issuance of a jeopardy opinion). They may also possess valuable carrots in the form of grants moneys available under the CWA or cost sharing and incentive payments under USDA conservation programs. Skillfully used, these programs can provide considerable assistance in reaching some agreement.

On the other hand, federal agencies often find themselves restricted by the legal requirements they are directed to implement and by the processes they are required to follow. For example, the Clean Water Act sets out a number of very specific

HCPs, "Safe Harbor," "No Surprises": New Approaches to Protecting Threatened and Endangered Species

The number of endangered, threatened, and "at risk" species has increased steadily over the last 20 years. The need to protect the shrinking habitat of endangered species has caused conflicts with homeowners, developers, and other private landowners. Developers have worried that efforts and expenditures they made to preserve critical habitat would be for naught when the next endangered species was discovered on their land. Was there any end to their obligation? Some advocated a major overhaul of the ESA.

On the other side of the issue, environmentalists were not happy that action was being taken only when a species became critically endangered. Even then, the actions were piecemeal, not a coordinated effort to preserve major habitats.

The Administration responded to this growing crisis by examining the way the ESA was being implemented, finding that the ESA could provide protection to both the species and the private landowners if a "habitat conservation plan (HCP)" (permitted under the ESA) was implemented to preserve wildlife before a species became endangered. When such coordinated proactive plans are adopted, participating interests are assured they will not be obligated to make additional expenditures for protecting additional species that became endangered in spite of their efforts—there would be "no surprises."

The policies are working. Currently, 212 HCPs are in place with private landowners, and over 200 are in various stages of development. By September 1997, 18.5 million acres of land will be covered by HCPs. These agreements will protect over 300 species, including state and federally listed, candidates for listing, and species of special concern.

The Legal Basis for HCPs. The ESA states generally that it is unlawful for any person to "take" endangered fish or wildlife (16 U.S.C. § 1538). "Take" means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect (16 U.S.C. § 1532(19))." During the 1982 reauthorization of the ESA, the Congress included amendments to section 10(a) of the Act to allow the Service and the NMFS to issue "incidental take" permits. These permits would allow a private landowner to "take" a species while carrying out lawful activities which are conducted as part of an HCP. Such plans are viewed as necessary, since more than half of the species listed under the ESA have 80 percent of their habitat on private land. Incidental take permits are viewed as necessary to encourage private landowners to take measures to protect endangered species on their lands.

HCPs must contain:

- An assessment of impacts likely to result from the proposed taking of one or more federally listed species.
- Measures the permit applicant will undertake to monitor, minimize, and mitigate for such impacts; the funding that will be made available to implement such measures; and the procedures to deal with unforeseen or extraordinary circumstances.
- Alternative actions to the taking that the applicant analyzed and the reasons why the applicant did not adopt such alternatives.
- Additional measures that the Service may require as necessary or appropriate.

Congress intended that this process be used to reduce conflicts between listed species and private development and to provide a framework that would encourage 'creative partnerships' between the private sector and local, state and federal agencies in the interest of endangered and threatened species and habitat conservation. Since the primary cause of species extinction is often loss of habitat, a typical HCP outlines measures for maintenance, enhancement and protection of a given habitat area. Developers, landowners and local officials work out the details; the Service acts as an adviser during HCP development, eventually weighing both public comment and the best available scientific evidence before making a permit determination. Plans typically include the establishment of mechanisms to minimize 'take,' provisions for land acquisition, habitat restoration and the relocation of plants or animals (<http://www.fws.gov/~r9endspp/factshts.html>).

The No Surprises Policy: Further Clarification of HCPs.

In May 1997, Interior proposed a rule to codify its "no surprises" policy. Although the policy was issued by the Service and NMFS in 1994, codifying the policy now is intended to further assure private landowners who have HCPs in place that the agencies will not impose additional conditions or requirements on the landowner if unforeseen circumstances arise during the life of the HCP. This means that once an agreement has been reached between the landowner and the federal government and the HCP permit

(See "New Approaches," next page)

New Approaches (continued)

issued, the government will not require additional lands or land use restrictions or additional financial resources from the landowner, even if unforeseen circumstances indicate that additional mitigation is needed for a species.

The Lower Colorado HCP. In 1994, the Service designated almost the entire lower Colorado River as critical habitat for four endangered species. In response, representatives of Arizona, California, and Nevada, along with many other interest groups, have formed a regional partnership to develop a multispecies conservation program aimed at protecting sensitive, threatened, and endangered species of fish and wildlife and their habitat. The program covers the mainstem of the lower Colorado below Glen Canyon Dam out to the 100-year flood plain and covers more than 100 federal or state listed, candidate, and sensitive species and their associated aquatic, wetland, riparian, and upland habitats.

Over a 3-year planning period for development of the comprehensive program, interim conservation measures will be implemented to address the immediate critical needs for certain endangered species. Interim measures to benefit the endangered razorback sucker and bonytail chub are proposed for the first year. Planned to be implemented over a 50-year period, the comprehensive program will address future federal agency consultation needs under the ESA and nonfederal agency needs for endangered species incidental takings.

HCP Critics. Critics argue that HCPs give up too much regulatory authority without adequate assurances that its protection efforts will be successful. Some argue that HCPs are being developed too quickly, that years are required to adequately determine habitat needs. Others assert the lands being protected are either undevelopable or were already set aside as open space in development plan even without an HCP. Some support mitigation concepts only if the restored habitat is clearly greater than the lost habitat or if a fund were established for habitat acquisition (*High Country News*, 1997).

Safe Harbor Agreements. HCPs involve landowners who want to develop their property, while still providing some protection for endangered animals, and who need some certainty from the Service and NMFS their actions will not result in liability under the ESA. Conversely, Safe Harbor Agreements are for landowners willing to enhance habitat on their property now for ESA purposes, but who fear losing future use of their property.

Under the Safe Harbor Agreements policy, the Service and NMFS, in cooperation with appropriate state agencies and affected tribal governments, may provide property owners with credit for enhancing the recovery of a listed species by voluntarily improving habitat on private property above the current or baseline conditions. If the Service and NMFS find that a species will receive a net conservation benefit from voluntary conservation activities, property owners are assured they will not be held liable for protecting those improvements in perpetuity. The Service and NMFS would issue the property owner an "enhancement of survival permit" under ESA section 10(a)(1)(A) and at the end of the Safe Harbor Agreement, would allow the property owner to return the affected property back to baseline conditions even if it resulted in the incidental take of a listed species. As long as property owners complied with the terms and conditions of the Safe Harbor Agreement and permit, they could make any use of the property that maintained the agreed-upon baseline.

Candidate Conservation Agreements. Candidate Conservation Agreements are similar in principle to Safe Harbor Agreements but pertain exclusively to species that are facing threats but are not yet listed. The goal is to remove threats to eliminate the need for listing. If a species is nonetheless listed in the future, the Service and NMFS would authorize the property owner to return the property condition to the conditions mutually agreed to in the Candidate Conservation Agreement and would not require the property owner to do more to conserve the species. #

requirements for the control of point source discharges, limiting the potential for trading some of this control in return for cleaning up nonpoint source pollution. The Federal Advisory Committee Act limits an agency's ability to conduct multiparty negotiating processes. FERC operates under a very formal, quasijudicial procedure. The ESA prohibits federal actions considered likely to jeopardize the continued existence of protected species as well as private actions that might harm or kill such species.

Efforts are being made to work within these apparent limitations. FERC now encourages the license applicant and interested parties to seek negotiated agreement on terms and conditions prior to formal FERC involvement. Interior Department rules encourage participation of affected interests in recovery planning and implementation, as well as in using negotiated habitat conservation plans to accommodate development and conservation interests under the ESA. Nevertheless, there are limits to which existing legal requirements can be maneuvered to allow for negotiated resolution.

The nature of today's water problems is forcing a reexamination not only of related federal laws and programs, but also of the manner in which federal agencies are organized and operated. Traditionally, federal agencies have organized around program areas for broad policy objectives such as water development for irrigation, river regulation for flood control, or management of national forests. Agencies tended to pursue these objectives by working directly with the affected constituencies, usually with little or no connection to other federal or state agencies or to others not within these constituencies. Now, however, as noted earlier, federal environmental laws have opened federal decisionmaking to the public, and environmental interests have inserted themselves actively into many federal processes. It is no longer possible to make decisions about such things as irrigation water development, flood control, or national forests without considering their environmental effects.

Moreover, these effects can only be understood by reference to the place where the development activity will take place. The effects are not abstract matters of policy, but are tangible consequences to such things as the quality of water in a particular stream, the stream's fishery, recreational uses of the stream, or productivity of a particular wetlands. The degree to which human development can and should alter or diminish such values is a difficult decision. Federal law has set some baselines related to water quality and endangered species protection, and federal agencies are required to protect those baselines, but experience to date with purely regulatory resolution of such matters has proved to be unsatisfying in many instances (Howard, 1994), prompting increased use of more cooperative efforts to find mutually acceptable outcomes.

Agencies are reorganizing themselves more along ecosystem or watershed lines, often linking with other agencies working in these same areas, as well as with locally organized councils or other such informal organizations that have been formed to address some particular problem or need. Sometimes these efforts have themselves been formalized, as with the CALFED program in the Bay-Delta of California. More often, they simply reflect the agency's own sense of what will better enable it to carry out its responsibilities—for example, Reclamation's creation of area offices.

Federal objectives related to water have never been unidimensional, and that remains true today, but it is possible to generalize that the fundamental objective has shifted from maximizing water development to promoting its sustainable use. Much could be done to improve the manner in which federal policies and programs pursue this objective, and the Commission offers some recommendations to this purpose in chapter 6.

The Future Federal Role

Given the extensive federal water infrastructure in the West and the importance of national health and environmental standards for water, the federal government will continue to play a major role in western water management. However, a major historic tool of federal involvement—that is, the nearly exclusive federal funding of major water storage projects—will be less available in the future. New storage projects will be smaller, more efficient, more often located offstream, and generally part of a solution to larger basin problems. The federal share will be less than it has been in the past. Also, where major federal investment is made, the emphasis will now be on environmental restoration, improved operation of the federal river control systems, and settlement of Native American water claims.

Addressing tribal water rights is clearly an unfinished federal task, and it will likely occupy a significant part of the traditional federal water budget. While primarily a federal responsibility, this difficult task will also involve and affect state and local water organizations. Resolving these claims without massive infusion of federal funds will test the capacity of all western water institutions and political leaders to work together.

Although the federal government may continue to seek transfer of some of its water project facilities to nonfederal entities, future transfers are likely to be limited to single-purpose features, such as irrigation distribution systems. Thus, the operation of large multipurpose water projects will continue to be a major federal role in the West. As stresses on the western river systems grow, the role of the federal government also will grow as a convener and facilitator of negotiated reoperation of projects to meet new demands. A special challenge in this role will be for the federal estate to develop unified positions among its agencies representing diverse statutory goals and constituencies.

National environmental standards will continue to play a major role in driving western water decisions. Exploration of ways to enable more state and local participation in implementing these national standards should continue. The reduced and redirected federal role that may emerge will produce a general diffusion of power among federal agencies and present the states with new opportunities and challenges. The states will have more opportunity to influence federal policy, but they will be held more accountable for a broader range of issues than they have in the past. Incentives will need to play a greater role in the regulatory structure; however, given the reduction in federal budgets for water, incentive programs will need to rely on partnering, cost sharing, and nonmonetary incentives.

A substantial role remains for the federal government in water data collection, coordination, dissemination, and more regulatory science. Federal agencies must work with state and other water users and interest groups to define the needed data and research, to coordinate these functions efficiently among the federal and state agencies, and to make data available to all users in a timely and accessible fashion. Data are needed that can answer, over some reasonable time horizon, the difficult resources management questions that we all face.

The Prospects for Federal and State Collaboration

Despite their shared interest in water development, there have always been some differences between the federal government and the states concerning western water. Reclamation, for example, became primarily interested in building projects that it regarded as best suited to comprehensive river development, focusing first on those areas with the greatest opportunities to use the water and power made available. Thus, in the Lower Colorado River basin, Reclamation promoted projects benefiting users in California—much to the displeasure of

Arizona and the discomfort of Colorado and other Upper Basin states (McDonald, 1997).

The near-transformation of federal water projects into public works projects in the 1930s temporarily reduced some federal/state differences, but it also had the effect of greatly increasing federal control—not only of the planning and construction of individual projects and of the uses to which they were to be put, but also of the manner in which large river systems were to be developed and used. For the most part, states accepted this control as the price for getting projects that yielded substantial local and regional economic benefits.

In the 1950s, as the political popularity of federal water projects neared its apogee, a reaction set in—fueled primarily by the growing costs of new projects and their increasingly questionable economic benefits. Antidam environmental interests waged an effective campaign against Echo Park Dam, proposed for construction on the Green River within Dinosaur National Monument (Martin, 1990). And some in the more conservative Eisenhower Administration opposed such large-scale government involvement in matters they felt should be essentially private. By the time the Congress passed the Water Resources Planning Act of 1965, the movement toward more centralized water planning and development had peaked and was shifting in other directions.⁵

As discussed, the nature of today's water problems has changed from large-scale development to making uses sustainable, from increasing the usable supply of water to making efficient use of the available supply, from controlling rivers to restoring

their natural functions and processes where possible, from concerns about quantity to concerns about quality. Federal and state government functions are changing as well in response to these concerns, as is the relationship between the federal government and the states.

The Congress asserted a primary federal role in many aspects of environmental protection beginning in the 1960s. Thus, for example, it prohibited point source discharges except in compliance with nationally established treatment standards. Implementation authority could be delegated to the states, but only if they agreed to follow the requirements of the Clean Water Act. Federal agencies were given authority to control uses of wetlands and to prohibit activities that would harm or kill an endangered species. In short, just as federal river basin planning and management for water development purposes were falling out of favor, federal regulation of water development generally for environmental protection purposes was burgeoning.

At their core, federal environmental laws set a rough kind of baseline. In some cases they are quite specific—for example, regarding the manner in which pollutants may be discharged from point sources or in the quality of drinking water that public water suppliers must provide. In other cases they seek to induce desired results—particularly by offering grants or direct payments for those who will do things thought by the funding agency to promote certain environmental protection objectives. Occasionally these laws empower designated federal agencies to be a kind of consultant to other federal agencies on matters of environmental protection—as, for example, the Service and the NMFS determining whether proposed agency actions are likely to jeopardize a protected species. More commonly, they designate a particular federal agency to be the final arbiter of the environmental acceptability of certain types of development activities such as filling and using a

⁵ This law authorized federally driven river basin commissions to coordinate basin water development and established a Water Resources Council composed of the Secretary of the Interior; the Secretary of Agriculture; the Secretary of the Army; the Secretary of Health, Education, and Welfare; and the Chairman of the Federal Power Commission.

The Platte River Agreement: Historic Federal/Three-State Initiative¹

After 20 years of conflict over the effect of water projects on endangered species in the Central Platte River, the states of Colorado, Nebraska, and Wyoming have signed a cooperative agreement with Interior to undertake a joint program of restoration and management of the Platte River system to address endangered species concerns.

The Platte Rivers

The North and South Platte Rivers originate from snowmelt in the Colorado Rocky Mountains, enter Nebraska via Wyoming and Colorado, and join to form the Platte River at North Platte, Nebraska. Just above North Platte, on the North Platte River, is Kingsley Dam. Kingsley Dam holds back 1.8 million acre-feet. Lake McConaughy serves as the major storage facility for two irrigation and power districts and provides surface irrigation for 215,000 acres and groundwater supplies to 500,000 acres of highly productive farmland in central Nebraska. Lake McConaughy receives 70- to 80-percent of its inflow from upstream return flows from irrigated lands in eastern Wyoming and western Nebraska, which are supplied from Reclamation reservoirs in Wyoming.

Below North Platte, Nebraska, beginning at Lexington, Nebraska, is an area known as "The Big Bend." This marks the beginning of 51 miles of critical habitat for the endangered whooping crane and serves as migratory habitat for the only remaining wild reproducing population of approximately 136 birds. This area is also nationally and internationally significant for its annual use by 7 to 9 million waterfowl for breeding and migratory habitat.

Nine threatened or endangered species listed under the ESA depend on the Platte River in central

Nebraska, including piping plovers and interior least terns which nest on unvegetated sandbars in the river and sandpits along the river. The endangered pallid sturgeon inhabits the lower reaches of the Platte River and appears to need the high spring pulse flows for spawning.

FERC Relicensing. The original hydropower licenses for Kingsley Dam and its related facilities were issued to the Central Nebraska Public Power and Irrigation District and Nebraska Public Power District (the Districts) in 1937.

The Districts' FERC licenses expired in summer 1987, and the projects have been operating with annual licenses for 10 years. Interior, Wyoming, Colorado, U.S. Environmental Protection Agency, environmental organizations, and over 50 other parties intervened in the formal FERC relicensing proceedings, largely in response to irrigation needs and environmental concerns.

Consultation under section 7 of the ESA was initiated in 1996 to insure that FERC actions are not likely to jeopardize listed species or adversely modify or destroy critical habitat. The draft biological opinion concluded the continued operation of the project, as proposed by FERC staff, would cause an annual depletion of 305,000 acre-feet in the critical habitat area and was likely to jeopardize four species, through habitat degradation, and adversely modify critical whooping crane habitat. To conserve the habitat on which species depend, the Service established that an additional annual average of 417,000 acre-feet of water is needed to reduce the shortage relative to current flow conditions in the Big Bend reach. Additionally, a joint federal/state/water user study concluded that 29,000 acres of wet meadow and channel habitat should be restored and preserved.

(See "Platte," next page)

¹ This discussion was drawn from *Integrating New Values With Old Uses in the Relicensing of Kingsley Dam and Related Facilities (Making Part of the Problem Part of the Solution) Dams: Water and Power in the New West*, by Margot Zallen, Senior Attorney, Office of the Regional Solicitor, Rocky Mountain Region, U.S. Department of the Interior, Denver, Colorado. Ms. Zallen presented this paper in June 1997 at the University of Colorado School of Law, Natural Resources Center. The views expressed are the personal views of the author and not necessarily the views of the Solicitors Office, the Department of the Interior, or the United States.

ADR is not a panacea, but it does provide flexibility to address and involve a wider range of people and issues than is often the case with legal proceedings. This flexibility is an asset when trying to resolve complex issues with more of a watershed or river basin focus.

The Commission offers the following recommendations to encourage the greater use of ADR in water disputes and to direct its application appropriately.

1. State legislatures should consider legislation similar to the Federal Administrative Dispute Resolution Act to provide clear authority to state agencies to use ADR and to provide proper procedures.
2. The Congress should consider changes to regulations governing the major environmental statutes to:
 - (a) Identify specific decision points at which an individual or applicable agency could initiate an ADR process to address disputes.
 - (b) Authorize agencies to allocate funds for joint fact-finding and other ways of improving resolution of technical disputes.
3. Appropriate government research institutions should consider funding more research and evaluation on the use of ADR in resource disputes and other public policy matters.
4. We recommend that the emerging river basin processes institute mechanisms by which those who are in disagreement with governmental regulatory decisions may engage in mediation or, where appropriate, stipulated binding arbitration through an independent mediator or arbitrator or a coordinated agency tribunal.

Revising the Principles and Guidelines.—The *Principles and Guidelines for Water and Related Land Resources Planning* (U.S. Water Resources Council, 1983) were developed to guide the formulation and evaluation of water projects. They set the standard for analysis of proposed projects by the Office of Management and Budget and the Congress. The Commission recommends that these standards be updated to make them a more useful guide and decision tool for today's broader range of water management activities.²⁴

²⁴ Revisions to be considered should include:

1. In cases with significantly increased local cost-sharing, allow for greater flexibility in defining local objectives. Allow for some version of the "shared vision" approach in planning and designing water projects. This would move away from strict formulation criteria toward a consensus-building and negotiation process in which agreements are reached among stakeholders on the acceptable magnitude and distribution of costs associated with achieving a given social, economic, or environmental objective.
2. For federal portions of projects, allow the nonmonetary Environmental Quality account to be treated equally with the National Economic Development account.
3. Improve the methodologies used in the benefit/cost analysis performed under the *Principles and Guidelines for Water and Related Land Resources Planning*, addressing such changes as: discontinuing the use of "avoided costs" as measure of economic benefits for municipal and industrial projects; explicitly incorporating risk and uncertainty; providing a more comprehensive treatment of methodologies for estimating non-market benefits; including a specific discussion on the proper approach to valuing environmental quality changes; providing additional guidance on the issue of benefits transfers; and addressing the extent to which water resource projects should be required to use a discount rate that differs from the discount rate used for evaluating other federal investments.

Platte (continued)

Federal Projects. Federal dam operations on the North Platte River and the Colorado-Big Thompson Project on a South Platte tributary have been under ESA consultation for years. Since 1978, the Service had determined that basin depletions were likely to jeopardize listed species and result in critical habitat damage. In light of these ESA consultations, Reclamation, the Service, and water users have been constructing a basinwide hydrologic model so that Reasonable and Prudent Alternatives under the ESA could be developed. As the hydrologic model was being finalized, water users in Wyoming and Nebraska became increasingly concerned that water deliveries would be curtailed.

Municipal Water Supply. Additionally, a number of Forest Service authorizations have expired or are about to expire in the Colorado Front Range. In 1993, the Service issued a draft biological opinion for seven municipal and industrial water projects that recommended foregoing diversions equal to the projects' consumptive use so as to avoid violating the ESA. Project sponsors objected, asserting that the water would never get to the Nebraska habitat but would be diverted by surface water users in Colorado and Wyoming.

Nebraska v. Wyoming. Additionally, Nebraska filed suit in 1986 petitioning the Supreme Court to enforce a 1945 decree limiting irrigation use in Colorado and Wyoming and apportioning the surface water of the North Platte River between the Whalen and Tri-State diversion dams (the pivotal reach) during irrigation season, 25 percent to Wyoming and 75 percent to Nebraska. The claim alleged that existing and threatened tributary development, including the construction of the Deer Creek Dam and Reservoir, threatened the equitable apportionment of the 1945 decree.

The Agreement

With various licenses, lawsuits, water projects, and water permits in three states all impacting the habitat for endangered and threatened species of the Platte River, a basinwide solution was a necessity. After 20 years of conflict and studies, and 3 years of active negotiation, common ground was created in the form of a cooperative agreement signed on July 1, 1997, by the Secretary of the Interior and the Governors of Colorado, Nebraska, and Wyoming.

Until water users in all states faced the real possibility that they each would have to implement measures that were far more onerous than they believed tolerable, there was no way to begin basinwide negotiations. Without the pressure induced by the potential power of the ESA, the states and its water users lacked sufficient incentive to resolve the serious environmental issues of the Central Platte.

The cooperative agreement contains several key elements:

- During the anticipated 3 years of the cooperative agreement, the parties are to develop a basinwide recovery implementation program for whooping cranes, piping plovers, interior least terns, and pallid sturgeons that would serve as the reasonable and prudent alternative for existing and water-related activities in the basin. Another agreement between the Service and the districts will settle all of the wildlife issues in the FERC relicensing and sets forth the district's responsibilities during the cooperative agreement and the proposed program alternative.
- The parties developed a proposed program which will be evaluated under NEPA along with other alternatives. The Service is to give its biological opinion on the sufficiency of the proposed alternative to serve as the reasonable and prudent alternative for all projects in the basin and on the preferred alternative, if different from the proposed alternative. If the preferred alternative is not acceptable to the parties, new, more difficult negotiations will ensue.
- The cost of the studies for the NEPA evaluations is anticipated to be \$5 million, and the cost for the first increment of the proposed alternative is approximately \$70 million, with Interior responsible for 50 percent and the states responsible for 50 percent. Colorado and Nebraska are each responsible for 20 percent, and Wyoming is responsible for the remaining 10 percent.
- Under the proposed alternative, the states will regulate flows to reduce shortages by 70,000 acre-feet. The remaining 60,000 acre-feet of shortage reduction is to be achieved through water conservation and water supply projects, and each state will be responsible for mitigating the future depletions in its own state.

The cooperative agreement establishes a Governance Committee to oversee the effort. Each state, Reclamation, and the Service has one representative, the environmental communities in the three states have two, and the water users have three. A land committee is to be established to develop a plan for acquiring and managing the land habitat, with a long-term goal of 29,000 acres. A water management committee is to develop a water accounting procedure to determine water depletion or credits associated with existing or proposed water diversions or water conservation projects in the three states. #

wetlands or constructing and operating (or continuing operation of) a nonfederal hydroelectric generating facility, or of the acceptability of a proposed activity concerning certain kinds of environmental effects, such as jeopardizing protected species.

Assessing the adverse environmental effects of proposed federal actions or the environmental acceptability of proposed development activities involves matters about which reasonable people can disagree. The issues typically are complex and the uncertainties enormous. Federal law can make an agency the final decisionmaker, but it cannot make decisions. Partly in response to such concerns, there has been a pronounced trend toward using more collaborative, negotiated processes to develop agreement where possible. Federal law serves as the impetus to take action, as a convener of the interests necessary to reach resolution.

The Upper Colorado River Recovery Program and the CALFED Bay-Delta Program, already discussed, are examples of multiparty, collaborative efforts to meet what are primarily federally driven objectives in a manner acceptable to the responsible federal agencies, the states, and the affected interests. A more recent example is provided by the agreement reached between the federal government and the states of Colorado, Nebraska, and Wyoming concerning recovery of endangered species within the Platte River basin in 1997. Driven primarily by federal obligations under the ESA to protect the whooping crane, the interior least tern, the piping plover, and other species, the agreement creates a governance committee composed of one representative from each of the states, two federal agency representatives (Reclamation and the Service), two environmental representatives, and three water user representatives (one for the North Platte, one for the South Platte, and one for the central Platte). As with the Upper Colorado River Recovery Plan, efforts under the cooperative agreement avoid the need to develop individual

reasonable and prudent alternatives to offset impacts of existing and proposed water development within the basin. An interesting aspect of the agreement is that the states have agreed to take responsibility for mitigating the impacts of new water-related activities in their states.

Still another model is presented by the Northwest Power Planning Council (NPPC). In 1980, the Congress passed the Pacific Northwest Electric Power Planning and Conservation Act to better integrate planning to meet the region's growing power needs with environmental effects of power generation, particularly the impacts of hydroelectric power facilities in the Columbia River basin (Lee, 1993) (P.L. 96-561, Dec. 5, 1980, 94 Stat. 2697, codified at 16 U.S.C. §§ 839-839h) (Volkman, 1997, 1996). It established the Northwest Power Planning Council, with two members from each of the four Pacific Northwest states appointed by the governors. As described by former NPPC member Kai Lee: "The council is in effect an interstate compact, a form of government organization that shares both state and federal authority" (Lee, 1993). The NPPC has been a primary forum in the Pacific Northwest for the difficult work of attempting to restore the Columbia River ecosystem to a condition that can once again support viable salmon populations. The NPPC has brought together all of the stakeholders, including the full range of federal agencies, states, tribes, local governments, and interest groups. It has been the coordinator for data collection, scientific research, and public education on the issues throughout the basin.

States increasingly play a key role in such processes because of their intermediate position between federal requirements and the effects of these requirements on their citizens. In many instances, states can represent local water user interests in federally driven decision processes more effectively than can any single water district or coalition of districts. Governors and heads of state departments of natural resources remain committed to protecting

the legal rights and interests of water users, but they are aware of the growing pressures on their water resources and the need to reflect the broader range of interests now involved in water matters.

As illustrated, there has been increased interest in directly involving water user and environmental interests in such processes. The work of making water uses more sustainable begins in the watershed in which water supplies originate; moves to the places where water is stored, diverted, and used; and continues with the water that returns to the hydrologic system. Opportunities to make water development compatible with system functions are typically site specific and likely to be best known to those closest to the opportunity. Moreover, solutions commonly involve tradeoffs, and existing practices may need to be changed. Participation in a problemsolving process can help make participants more supportive of agreed-upon outcomes.

One of the motivations for national environmental laws was the perception that states were largely unwilling and unable to place the kinds of restrictions on economic development necessary to provide environmental protection. As public support for environmental protection has grown, some states, as mentioned earlier in this chapter, are developing their own programs and activities aimed at making water uses sustainable. Some of these are instigated federally but are developed and

implemented at the state level, such as efforts under Section 319 of the Clean Water Act to address nonpoint source problems. Some state programs might best be characterized as pre-emptive efforts to ward off the more onerous results of federal regulation, such as efforts by Colorado and other states to identify species with the potential to be listed for protection under ESA and to attempt to increase their viability so that such listing will never happen.

Many reflect the growing interest in the states themselves with matters of environmental protection, particularly related to such things as fish and wildlife, as well as recreation.

In the final analysis, federal and state interests in water probably do not diverge greatly on general objectives. Rather, the tension revolves primarily around means. How do we best move toward this elusive thing called sustainability? What does sustainable use of water mean? What does this mean for those with existing water uses? What does this mean for those with new demands? Who decides? Who pays? These are all difficult questions. No single level of government, no single water interest, no individual can pretend to have the answers. Indeed, there probably are no absolute answers. Instead, answers will be worked out issue by issue, problem by problem, proposal by proposal.

balanced slate of members, for deliberating policy options in a public setting, and for providing public notice of meetings and careful recordkeeping. Any group of non-federal employees which is utilized by the federal government for advice must meet the requirements of FACA.

However, many federal managers perceive FACA as restricting their efforts to work informally with groups that are addressing local watershed problems, but not providing formal recommendations to the government. In some cases, FACA has been interpreted as applying to these local groups. In such cases, the membership of such groups, their meetings, agendas, and recordkeeping would be subject to FACA requirements—an imposition that is unwanted by local groups.

A recent analysis of court cases involving FACA by Rieke (1997) suggests that this interpretation is not correct, but also suggests that clarification of FACA regulations is needed. Recently, the General Services Administration, which administers FACA, has announced its intent to revise the FACA regulations.

The Commission recommends as part of their review, that the definition of groups "utilized by a Federal agency" be clarified based on recent court rulings to make clear that it is permissible for an agency, without triggering FACA requirements, to:

- (a) Participate with or on local groups in order to provide technical assistance, advice, or coordination in pursuit of activities of interest to the agency, and
- (b) Obtain input on agency activities from such local groups, as long as the group is not the sole or primary source of public input to the agency, and as long as the membership and agenda of the group are not established by the agency.

The Commission also recommends that the Administration rescind Executive Order No. 12838 which directs that no new Federal Advisory Committees be chartered except based on compelling considerations of national security, health or safety, or similar interest. Because we view Advisory Committees as useful tools for consultation, we believe that this order sets the standard for creation of an Advisory Committee too high. As Rieke states, "The FACA standard, requiring advisory committees to be in the public interest in connection with lawful duties of the agency, appropriately leaves to agency personnel the decision whether an advisory committee is needed."

Alternative Dispute Resolution.—The last two decades have seen a great increase in the use of alternative dispute resolution (ADR) methods. ADR is composed of a group of negotiation and conflict-resolving techniques for settling disputes outside of judicial proceedings, most often using a neutral facilitator or mediator to help structure and manage the process. ADR programs are widely incorporated in local and state justice systems as an alternative to trials, while the Congress and the federal government have promoted ADR within their own jurisdictions, primarily to resolve labor disputes, contract disputes, and human resources problems.

For the last 25 years, ADR has also been applied to resolve conflicts over natural resources, including water resources. Agencies such as EPA have instituted negotiated rulemaking to involve affected parties in the formulation of regulations. ADR methods have been used to resolve surface and groundwater allocation decisions; to address water quality matters including effluent standards, discharge permits, drinking water treatment, and instream habitat; and to construct projects related to port development, water storage, hydropower, and flood control (Bingham, 1997).



Findings and Recommendations

The Western Water Policy Review Advisory Commission (Commission) offers the following recommendations, fully recognizing that there are no simple solutions to the complex water problems of the next 25 years. Our public hearings and investigations have confirmed that, throughout the West, people are struggling energetically and creatively to address water problems. Innovative, collaborative approaches are being used almost everywhere. Mostly, we seek to promote the best of these efforts.

Further, we recognize some hard facts:

- The West's waters are overappropriated in many places.
- Substantial amounts of water are needed to address obligations to Indian nations and tribes, to restore endangered species, and to meet the needs of a rapidly growing population.
- National, state, and local objectives for the use of water may differ.
- Existing uses of water have deep economic, social, and political roots.

Therefore, there will be fewer truly win-win solutions in the future. Instead, we seek solutions that equitably share the burden and minimize social disruption.

We can improve the ways that federal, state, and local agencies work together and the way that laws and regulations are administered, but this will not make these hard facts go away—it will not make the fundamental competition for water less real. Instead, we seek to promote tools for working through these conflicts, to reaffirm national obligations that have not been fully met, and to promote shared investment in the resource to obtain greater environmental health and, from that, reduced social conflict.

The Commission offers both general and specific recommendations. First, recognizing the importance of general goals to guide programs as conditions change, the Commission developed Principles of Water Management for the Future. These may provide general guideposts against which current and future policies and programs might be measured. Second, the Commission offers specific recommendations in six areas:

1. *Improving Decisionmaking, Reducing Conflict:* Improving how we collect and use water-related information, work with the full range of water interests, and reach decisions.

2. *Management of Water and Water Facilities:* Improving the way federal water and flood control facilities are managed and operated to provide sustainable benefits.

3. *Governance*: Organizing and integrating the activities of federal, state, and local entities as they make decisions affecting water resources at the river basin and local watershed levels.

4. *Obligations to Indigenous Nations and Tribes*: Meeting our water resources trust and treaty commitments to Native Americans.

5. *Resources Management and Restoration*: Restoring and protecting aquatic systems, and bringing water use into sustainable balance with the environment, in accordance with applicable laws.

6. *Protecting Social Resources*: In addition to meeting obligations to Native Americans, supporting water and land use that sustains economically and environmentally sound ranching and farming operations and the rural communities and cultures which they help support.

Principles of Water Management for the Future

The Commission adopts the following principles of water management.

Ensure Sustainable Use of Resources

Use and manage water and related resources so that at the national, regional, and local levels, environmental, social, economic, and cultural values can be supported indefinitely. All water resources policies and programs in the West must recognize and address the dramatic current trends in population growth and movement. Consideration must be given at all levels of government to the management of growth impacts on water and associated land and open space resources. The sustainability of policies

which encourage growth must be assessed carefully in relation to the available resource base.

The Commission's overarching principle—the sustainable use of resources—is a principle articulated by the President's Council on Sustainable Development (1996). The principle is fundamental to the management of a finite resource like water and the life, culture, economies, and environments that depend upon it. However, we must recognize that sustainable use may require an adjustment in water uses. This will be a challenge for our water institutions in the future.

Maintain National Goals and Standards

National standards and goals for the quality of water and related resources have played a substantial role in maintaining and restoring resource health. There is a continuing need for national standards and goals.

The Commission has repeatedly heard from across the political spectrum that, while some may question the precise construction or implementation of national environmental statutes such as the Endangered Species Act (ESA), the Clean Water Act, and the Safe Drinking Water Act, all acknowledge that these enforceable standards have been a critical motivating force to bring action, often collaborative action, to address deteriorating environmental conditions and the unsustainable use of water supplies.

Emphasize Local Implementation, Innovation, and Responsibility

Federal, tribal, state, and local cooperation toward achieving national standards should define the future of water policy. Where possible, responsibility and authority for

achieving these national standards should rest with nonfederal governing entities. Reasonable flexibility should be allowed and innovation encouraged in the approaches taken to achieve national standards within a framework of monitoring and accountability.

The Commission recognizes that the best solutions to problems are nearly always fashioned by those most directly involved and affected. The Commission promotes approaches that link the efforts of local groups and communities with national standards and programs. Where meeting national standards has been set as the objective, flexible and creative local implementation usually produces the most effective and durable results.

Provide Incentives

Wherever possible, use economic and other incentives, including voluntary water transfers, to achieve national or local water resource goals. Existing incentives and policies for water use and associated land management should be examined to determine whether they promote or impede sustainable use of resources and serve contemporary social goals. Funding should provide incentives for state and local entities to achieve resource goals.

The Commission recognizes the powerful force of the marketplace and programs that reward individual action. Especially where resource use is controlled by a system of property rights, voluntary action has great advantages in meeting changing societal needs. The more that we promote and support mechanisms to voluntarily put water use on a sustainable basis, the more we can avoid the involuntary changes that result when requirements of state and federal law are triggered.

Respect Existing Rights

Acknowledge and respect existing treaties, compacts, and equitable apportionments with states and tribes. Respect existing water rights and state appropriation systems.

The Commission recognizes the very important role that these legal mechanisms play in developing and protecting water supply and use and believes that any necessary changes in water use should take place within these systems in order to provide certainty to water right holders and predictability of the process for change.

Promote Social Equity

Determining and fulfilling tribal rights to water and providing universal access to safe domestic water supplies should be a priority. We must also recognize that local economies have developed throughout the West as a result of government policies designed to encourage certain land and water uses. As those policies evolve, regardless of the reason, people and communities affected by such changes may need time and assistance to make a transition. Water transfers should be done with full consideration of the communities of origin, third party transfers, and unintentional consequences and should be open to participation by affected parties.

The challenge for the future is to meet our obligations to tribes, the needs of the environment, and the growth of the West, while helping traditional water communities adjust to these new forces and shape their own future.

Organize Around Hydrologic Systems

Strive to make tribal, state, and federal water programs and decisionmaking more efficient and effective. To help address the problems created by multiple, and often conflicting, jurisdictions, authorities, and program objectives, we should organize or integrate water planning, programs, agencies, funding, and decisionmaking around natural systems—the watersheds and river basins. This will require integrating institutional missions, budgets, and programs, as well as their congressional oversight. Duplicative or overlapping programs and activities should be integrated or modified. Planning and management of land and water, surface water and groundwater, water quantity and quality, and point and nonpoint pollution must be coordinated.

The Commission joins with many other advisory bodies in recognizing the logic of managing water and related programs on a river basin or watershed basis. This requires integration and coordination across jurisdictional (federal, states, local) and functional lines (management of land use, water quantity, water quality, fish and wildlife, etc.) and may require reorganization of existing offices and agencies to maximize efficiency.

Ensure Measurable Objectives, Sound Science, Adaptive Management

National, regional, and local water resource goals should be repeated as measurable objectives. Performance should be assessed through open, objective, scientific studies, subject to peer review. Where knowledge is incomplete, actions should be based upon the best available data within a framework of monitoring and adaptive management. Determination of the best use of resources

should take into account social, economic, environmental, and cultural values.

We have incomplete knowledge of water systems and how to manage them sustainably. Thus, it is even more important that we set goals and objectives explicitly and measure progress toward those goals in a open forum, using the best available data and analysis. Only in this way will our knowledge grow and our policies improve.

Employ Participatory Decisionmaking

National, regional, and local resource decisionmaking must be open to involvement and meaningful participation by affected governments and both interested and affected stakeholders. Sufficient information about the consequences of resource decisions should be made available to the public.

Some of the greatest strides in resources management have come in the area of citizen participation. Nevertheless, agencies in some areas need to provide additional meaningful opportunities for public participation. Further, agencies should look for ways to link local and national interests in place-based problemsolving, to bring difficult resource decisions to timely resolution, and to involve the public in ongoing monitoring and stewardship of their resources.

Provide Innovative Funding

Given declining federal budgets, innovative sources of funding and investment, including public and private partnerships, must be found to manage and restore western rivers.

We are in the midst of a major transition in the source of funding for water projects and water management. Many new, innovative approaches to

funding exist, utilizing public and private funds, nonprofits, volunteer efforts, user fees, and other means. The challenge will be to shape these approaches, along with declining federal dollars, into sustainable, stable programs.

Recommendations

1. Integrating River Basin and Watershed Governance

Perhaps the most useful and durable recommendation that the Commission can make is to promote mechanisms that help integrate the management of river basins and watersheds across agencies, political jurisdictions, functional programs, and time. This integrated governance will help improve our process of problemsolving and resources management in many areas.

The Shaping Forces

Several important forces argue for a new approach, and provide hope for its success:

1. The tremendous increase in the number of local watershed initiatives and groups, and the great energy and creativity they bring to resolving resource problems.
2. The value of driving regional and even basin-level programs through a bottom-up expression of values, goals, and commitments, generated by people's concerns about their local resources and communities.
3. The increasing need for federal, state, and tribal partnerships to manage collaboratively at the river-basin level to avoid legal gridlock and provide direction for comprehensive programs and expenditures.

4. The diminishing federal budget, creating the need for better priority setting, coordination, and efficiency in expenditures for all agencies, and the need to leverage federal funds with new sources of financing.

5. The need to manage more on an ecosystem or watershed basis, recognizing the consequences of many programs and actions within the watershed. The growing need for high-quality municipal supplies, and the importance of protecting the watersheds that provide them.

6. The growing need for efficient processes of planning and conflict resolution to address issues that involve many interests across many jurisdictions.

The Principal Goals

The integrated governance approach seeks to:

1. Improve decisionmaking and management at the river basin level by bringing all of the key political and agency decisionmakers into basin forums.
2. Clarify national and river basin goals by developing measurable objectives for basin management.
3. Improve the efficiency of agency activities at the basin level by requiring coordination and integration of programs and budgets.
4. Expand technical and financial support from agencies for the activities of local watershed groups.
5. Support basin trusts as a means of maximizing available funding for basin and watershed initiatives.

Elements of Integrated Governance

The Commission suggests the following as important elements of integrated basin and watershed governance.¹ Our emphasis is on the functions that must be accomplished, not the means to do so. Because each basin is different in its history, governing institutions, legal structures, and resource problems, various approaches for achieving these goals must be tried. Continued experimentation and evolution are encouraged. However, it is the Commission's belief that these governance efforts are evolving towards the following set of objectives:

(1) A new approach to governance based on hydrologic systems, linking basins and watersheds.

The federal resource agencies in the basin will adopt practices which encourage—through financial support, in-kind services, and cooperative interaction—the growth of collaborative watershed groups and initiatives on which all stakeholders are fairly represented.

The federal agencies will develop a cooperative process at the river basin level, utilizing entities where they exist and involving the leaders of federal, tribal, state, and local agencies; watershed council leaders; and other stakeholders as appropriate, created for the purpose of determining jointly supported solutions.

This cooperative process will provide for increased coordination among the federal regional offices in the basin and facilitate funding of

programs proposed by watershed councils as well as the agencies. The President should issue an Executive order or memorandum/directive to the heads of federal agencies and Cabinet Secretaries to require regional and/or watershed level coordination of agency budget requests. Agency budget requests pertaining to water resource management and development shall be subject to mandatory review for interagency programmatic coordination and consistency. The designated water resource management officials performing these reviews shall be located in the particular region they serve.

(2) Basin-level objectives.

The river basin planning process will lead to the joint development of measurable objectives for the basin, which comply with federal, tribal, state, and local substantive law, that will be communicated to interested parties in the basin including watershed councils.

(3) A basin trust fund.

The process will encourage the formation of basin accounts and basin trusts which integrate federal, state, tribal, and local funds with money or in-kind contributions from nongovernmental sources such as foundations, stakeholders, and utilities to fund activities that support basin objectives; once a fund is established, a mechanism should be developed which will permit retention of these funds in an

¹ Several of these concepts are outlined in Hatfield, 1994.

interest-bearing reserve account or trust and facilitate carryover management of the funds on a sustained multiyear basis

These funds, which may include federal appropriations, state funds, and local contributions, will be distributed in an orderly and equitable manner, primarily at the watershed level to further established objectives for the basin.

(4) A link with watershed councils.

Watershed councils will develop plans and identify specific projects to accomplish their own unique local needs consistent with the objectives established in basin plans. No specific process or format should be required, in order to stimulate local innovation and flexibility; watershed councils will utilize integrated databases of federal agencies, state agencies, tribes, and other parties, as well as gather new information to establish baseline conditions and resources.

Watershed councils will provide a forum to educate stakeholders about applicable laws and requirements.

(5) A greater consistency of proposed projects with federal, state, and local laws and regulations.

Any project which is submitted by a watershed council to comply with the objectives set at the basin level shall be presumed consistent with prevailing law unless within 60 days found inconsistent by relevant authorities;

this approach would be tested in pilot projects.

(6) A greater reliance on adaptive management.

There will be an orderly process for establishing baseline conditions and results of specific projects to document the achievement of objectives and to adjust the basin plan and objectives as appropriate.

These new governmental processes are already providing federal and state agencies, tribes, local agencies, and local organizations with tools to solve problems which, though complex at any level, are most effectively confronted by those in a position to observe the conditions directly. There may be a need for new federal authority to address the unique needs of these emerging governance structures, and it is the recommendation of the Commission that authority be given for pilot efforts to explore its full potential. It is hoped these ongoing efforts and future pilot projects will provide the Executive Branch and the Congress with invaluable empirical insights which maximize efficiency of federal expenditures, increase effectiveness of the administrative programs, and unify governmental actions to achieve federal goals.

Coordination of the Federal Agencies.—The Commission recommends two specific coordination strategies.

1. *Organization Around Basins and Watersheds.* Federal agencies with primary responsibility for managing water resources should be organized around river basins and watersheds to give focus to their programs and their interaction with citizens and other basin entities. Agencies should continue

Wherever Land Divides Us, Water Unites Us

How do we develop in a way that ensures the long-term health of our forests, soils, wildlife, rivers, and groundwater on which our lives, our jobs, and our spirits depend? Traditional land use decisions have not always dealt effectively with the balance between development and protection of our natural resources. Why not? Because development tends to be a reductive process; it subtracts land from the natural landscape and then divides it into mutually exclusive uses—roads, utility corridors, industrial parks, commercial office space, parking lots. In contrast, the natural landscape—with its complex living web between forests, watersheds, and wildlife—is an integrated whole, each piece dependent upon the others.

Our task as public officials is not to advocate one to the exclusion of the other but to seek balance, and to do so by looking at the entire landscape, even as you are called upon to make development decisions about specific parcels of land.

One of the most effective forces at drawing the connections between man and nature has been watershed councils; these councils are discovering how water connects us all. Watershed councils are bringing residents together to ask how we can develop in a way that maintains biological integrity of the whole and preserves open space for the spiritual needs of their communities. #

—Drawn from "*Wherever Land Divides Us, Water Unites Us.*" Remarks of the Secretary of the Interior Bruce Babbitt to the National Association of Counties, Baltimore, MD, July 14, 1997.

their efforts to colocate or merge water-related operations and staffs to improve coordination and efficiency.

2. *Coordination of Programs and Budgets.* To the greatest extent practical, federal agencies should coordinate the programs and budgets which affect the management of river basins and watersheds to achieve efficiency of budget and effectiveness of programs. This can be done in several ways. The Commission recommends that agencies be directed to coordinate their budget submissions for those programs aimed at addressing river basin goals or on major species or ecosystem recovery efforts. The Commission further recommends that greater effort be made to more routinely coordinate and approve collective federal agency regional budget requests along river basin lines on an interagency basis, such as for the CALFED Bay-Delta Program, the Everglades Restoration Program, and the Chesapeake Bay Recovery Program. For additional recommendations on coordination of federal water-related programs and budgets, see recommendation 6, "Improving Decisionmaking, Reducing Conflict."

All agencies should develop or update comprehensive project plans that are consistent with and that support implementation of the basin plan.

Staffing and Budgeting for Local Consultation and Program Implementation.—The Commission recognizes and affirms the value of implementing programs and regulations through close collaboration with local groups and communities. Two important requirements for this must be noted:

1. Agencies should continue efforts they have made to staff and implement their programs locally. This important trend in how agencies work with the public is not inexpensive. Today, many, if not most, resource managers spend the majority of their time in consultation with the public, other agencies,

and officials. The value of collaborative program implementation is achieved only if agencies maintain local offices with experienced staff possessing the skills to work on contentious issues with a diverse set of interests. Agencies must ensure that efforts to downsize and streamline government give priority to maintaining local staff capability. Also, greater flexibility must be available to local staff to effectively meet unique, site-specific needs.

2. Agencies must have the capability to provide assurance of long-term support of watershed groups and their projects, either through a long-term basin trust, multiyear budgets, revolving funds, or other innovative financing approaches.

2. Meeting Obligations to Tribes

Fulfill Trust Responsibilities

1. The federal government needs to fulfill its trust responsibilities to Indian tribes and nations to secure tribal water rights and assist the nations and tribes in putting those rights to use. Federal contributions toward meeting these obligations should not be limited to potential federal liability for breach of trust, but should recognize a moral and legal obligation to protect and assist the tribes. The federal government should recognize that it has often failed to protect prior and paramount Indian water rights while encouraging and financing non-Indian water development.

2. The federal government needs to fulfill its responsibility to assist Indian tribes and nations in managing and regulating tribal water resources and to exercise its trust responsibility to protect tribal uses of their water. Federal funding for this purpose should be increased. Federal efforts supporting development of tribal water codes should be increased.

3. The federal government needs to continue recognition of the role of tribal governments in setting water quality standards on reservations. Tribal treatment activities under the Clean Water Act should continue, and federal funding for the tribes to carry out the Clean Water Act should be increased.

4. The Congress should expand the Leavitt Act to defer repayment on capital costs for all water resource construction on Indian reservations instead of deferring it only for irrigation facilities. Such a change would be helpful in constructing municipal and industrial systems for tribes.

5. The Secretary of the Interior, in fulfillment of his trust responsibilities, should identify potential funding sources for hydrological studies for balancing water demands on a basinwide basis. General studies to document basinwide sources and needs would serve to allow the Secretary to evaluate the needs for structural or operational conservation measures and would be useful in reconciling Indian water claims and putting Indian water rights to beneficial use.

6. It is estimated that there are approximately 1 million acres of Bureau of Indian Affairs (BIA) irrigation project lands on reservations, of which approximately 750,000 acres are irrigated on an average annual basis. Up to 400,000 additional nonproject acres are irrigated. On average, tribal irrigation projects have a water delivery efficiency of approximately 15 percent. Reasonable improvements in the water delivery systems could achieve 50-percent project efficiencies in many cases, saving more than 1 million acre-feet of water for other tribal uses. The Secretary of the Interior should bring the department's resources and expertise to bear to evaluate and pursue such efficiency improvements (Olinger, 1997).

7. The Congress should appropriate funds and authorize the development of water supply and

sanitation systems to ensure that residents of reservations have sufficient potable water and modern sewage treatment facilities to maintain the public health and protect the environment.

8. As the Administration and the Congress consider a new small project loan program for the Bureau of Reclamation (Reclamation), provisions for investment in tribal irrigation and municipal water systems should be provided.

Resolve Indian Water Rights Claims

1. The federal government should increase its budget and use other federal resources to fully implement existing Indian water rights settlements and negotiate new Indian water rights settlements. Indian water marketing, hydropower revenues, and Reclamation funds should be used to facilitate Indian water rights settlements. The Congress should support these activities with additional appropriations.

2. The federal government should increase its budget and staff for negotiating and litigating Indian water rights claims. Funds also should be increased to allow greater tribal participation in negotiations and litigation of their claims. The Congress should support these activities with additional appropriations.

3. The federal government needs to improve the federal negotiation team process to facilitate more Indian water rights settlements. The process should be streamlined to provide the teams with authority to commit the federal government in a timely fashion.

4. The federal government should clarify federal policy regarding marketing of Indian water. Allowing water entitlements of Indian reservations

to be leased with no more restrictions than non-Indian rights would facilitate greater efficiencies and flexibility of water use.

Basin and Watershed Governance

In recognition of their sovereign status as governments, all recognized nations and tribes should be included, along with the federal and state governments, in any new basin and watershed governance structures affecting tribal assets.

3. Resources Management and Restoration

Protecting and Restoring the Environment, Including Aquatic Ecosystems and Water Quality

A number of reports prepared for consideration by the Commission and, in particular, the proceedings of the Aquatic Ecosystems Symposium held in February 1997, led the Commission to finding that many "Aquatic systems in the American West are broken and must soon be fixed if they are to again be sustainable" (Mickey, 1997; NRC, 1992a). By "fixing" aquatic ecosystems, the Commission does not mean returning these systems to predisturbance or predevelopment conditions; rather, the Commission's overall goal is to restore the systems so that important functions can be recovered and benefits can be realized and sustained over time.²

1. Many aquatic ecosystems are significantly impacted, and a number of actions, particularly

at the federal level, need to be taken to restore these ecosystems (Mickey, 1997).³

Examples of the impacts include:

- More than 20 native fishes have become extinct in the past century.
- 57 percent of freshwater native fishes in California have become extinct or are in need of immediate attention.
- 214 anadromous salmon and trout species in California, Idaho, Oregon, and Washington are in need of special management because of declining numbers, and 101 of these are at high risk of extinction (Forest Ecosystem Management Assessment Team, 1993).
- Of the 3.25 million stream miles in the lower 48 states, less than 2 percent are of "high" natural quality.
- Instream flows in the Rio Grande, Upper Colorado, and Lower Colorado water resource regions are insufficient to meet current needs for wildlife and fish habitat.
- Of the 123 million acres of wetlands remaining in the lower 48 states, a net 80,000 acres are lost annually. A total of 94 million acres (44 percent) of the wetlands existing in the lower 48 states have been lost in the last 200 years. (See Agricultural Resources and Environmental Indicators 1996-97 (1997), tables 6.5.1 and 6.5.2.).

² It should be noted that the Clean Water Act states, "The objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the nation's waters."

³ The Commission also used the National Research Council report, *Restoration of Aquatic Ecosystems*, National Academy Press, 1992, for reference and encourages the Administration and the Congress to carefully review this document and take appropriate actions based upon the recommendations of this report.

2. Current water management practices and decisions affecting numerous aquatic systems are not sustainable.

3. Without renewed efforts to protect existing healthy systems and restore degraded systems, present conditions will worsen due, in part, to population growth, climate changes, declining water quality, overappropriation of water supply, overdrafting of groundwater, flood plain management, land use practices, and other factors.

4. Aquatic ecosystems provide critical benefits for human, plant, and animal life, including improving water quality, reducing erosion and sediment losses, providing habitat (which more than 75 percent of the animal species in arid regions need), creating recreation benefits and other amenities for growing populations, and providing flood control benefits.

5. The Commission notes that, in general, federal environmental laws such as the ESA and the Clean Water Act have played important roles in protecting and, in some cases, requiring the restoration of, aquatic ecosystems. While some changes may be necessary to improve the implementation of these laws, the Commission believes these laws continue to be important in ensuring that aquatic and other ecosystems are protected and in setting the parameters within which locally driven watershed initiatives operate.

Federal Agency Plans and Activities

The Commission found that aquatic ecosystems are under stress from a variety of sources, some of which are directly caused by federal projects and activities. Federal agencies have begun implementing measures to mitigate impacts associated with their projects and activities. However, in many instances, these mitigation measures have not been sufficient, and federal agencies will have to exert

greater effort, in concert with others, to restore and sustain the health, productivity, and biological diversity of aquatic ecosystems.

To accomplish this, the Commission recommends that federal agencies develop and implement comprehensive project plans for aquatic ecosystem restoration and protection, coordinate their activities closely with each other, and incorporate the following measurable goals into such plans and activities:

1. Improve water quality in western waterways to meet state water quality standards and effluent limits and to support designated uses established by states and tribes (such as swimming, fishing, and support of aquatic life). Programs and strategies should be developed to address specific problems such as salinity, sediment loadings, temperature, and toxic contaminants. Where such programs already exist, agencies should reevaluate them and ensure that they include measurable goals, performance indicators, and a timeframe for resolving the problems.

2. Recover and protect threatened and endangered aquatic species and other species at risk by developing multispecies habitat conservation programs, where appropriate, in partnerships with other federal and state agencies, tribes, and private entities.

3. Specifically recognize the benefits of conserving native species, communities, and ecosystems and take steps to sustain native species through activities and programs which will maintain, restore, and enhance instream, riparian, and upland habitat and wetlands, and which will remove barriers to fish migration, spawning, and rearing. Such actions can potentially prevent additional listings under ESA.

4. Provide instream flows (pattern and volume of water) to achieve and protect the natural functions

of the riverine, riparian, and flood plain ecosystems. Operations of federal (primarily Reclamation and the Corps of Engineers [Corps]) reservoirs, as well as voluntary water transfers, can play a significant role in achieving this goal.

5. Eradicate and control the spread of exotic and non-native species and pests (e.g., zebra mussels, purple loosestrife) by establishing monitoring, inspection, eradication, and public education programs, including research in cooperation with other entities.

6. Identify and restore contaminated sites that are degrading aquatic ecosystems. Many of these occur on Forest Service or Bureau of Land Management (BLM) managed lands.

These activities should be an integral part of a basin plan whenever such plans are developed.

Establishing Environmental Restoration as a Priority

The Commission recognizes that the federal government has taken actions which have resulted in significant alteration of water quality or water-dependent ecosystems and that it, therefore, has an obligation to address the changes it has directly caused. Further, restoration of these water-dependent ecosystems can have important national benefits. Therefore, the Congress and the Administration should take steps to establish a clear federal policy of environmental restoration to address impacts from past and present programs and from federally owned or permitted facilities. Possible specific mechanisms include:

1. Develop a national aquatic ecosystem restoration strategy consistent with the recommendations of the National Research Council's (NRC) 1992 report, *Restoration of Aquatic Ecosystems*.⁴

2. Explicitly authorize Reclamation (as it has with the Corps) to include environmental restoration as a purpose of all of their projects and provide for funding and cost sharing for such activities.⁵

3. Require environmental impacts to be evaluated, and costs for restoration included in determining a project's true costs and benefits (both future and current).

4. Require projects to be operated and maintained to mitigate existing environmental impacts, even when such action may reduce other project benefits, and to address additional mitigation measures required to correct the full range of environmental impacts as part of the assessment recommended in the section, "Operation of Dams and Water Delivery Systems" later in this chapter.

5. Manage water resources and water projects in a manner that recognizes the benefits to be accrued from conserving native species, communities, and ecosystems.

6. Fund programs that address environmental management, protection, and restoration issues on a watershed basis, such as the Environmental

⁴ The 1992 NRC report listed four elements critical to a national strategy: (1) national restoration goals, (2) principles for priority setting and policymaking, (3) policy and program redesign for federal agencies, and (4) innovation in financing and in use of land and water markets.

⁵ Reclamation identified "lack of broad authority to undertake ecosystem management activities" as a constraint to its ability to broaden its aquatic ecosystem protection and enhancement activities (Reclamation, 1997a).

Protection Agency (EPA) Watershed Protection Initiative or the Bay-Delta process, with emphasis on stressed western rivers.

7. Encourage further recognition by states of beneficial use of water instream as an eligible water right.

Integrate Land and Water Management Agencies' Activities

There is a growing understanding of the interrelationship between land-based activities that take place in the watershed and the quantity and quality of water in associated streams and rivers. It is this understanding that has motivated resource managers to move toward more holistic management approaches such as integrated resource management, watershed management, or ecosystem management. Given the interconnectedness of land activities and natural water systems, the Commission believes that federal land and water management agencies should ensure that their programs and activities are managed by taking into account how they may impact water resources and aquatic systems, both individually and cumulatively with other activities occurring in the watershed. In addition, the need to improve our approach to flood mitigation through land-management activities, as well as water resources programs, creates the opportunity to protect and restore riparian, riverine, and watershed areas. The benefits of such activities include both a reduction in flood-related losses and also the potential for environmental improvements, including both water quality and water supply.

Given these understandings and objectives, the Commission recommends the following:

1. The Administration and the Congress should carefully review and take steps to implement the

recommendations, as appropriate, of the *Interagency Floodplain Management Review Committee* (1994; also called the Galloway Report), the 1992 Report of the National Research Council on restoring aquatic ecosystems, and the recommendations of the scientific panels at the Aquatic Ecosystem Symposium sponsored by the Commission, which include:

- (a) Encouraging federal agencies, through development of an Executive order or ecosystem restoration statute, to
 - (i) Coordinate activities across agency and program lines consistent with hydrologic units, such as river basins and watersheds.
 - (ii) Conduct federal programs according to the best available science of ecosystem management and adaptive management principles.
 - (iii) Put the ecosystems restoration approach at least on a par with other approaches to implementing their agency programs.⁶

2. Federal land management agencies should institute forest, grazing, gas and oil exploration, and mining management practices that conserve and sustain river, riparian, and flood plain ecosystems, including establishing riparian habitat management areas to apply to all streams large enough to provide

⁶ The Commission recognizes that the recommendation in (1) would require significant changes in federal agencies' programs. Accordingly, the Commission suggests that this sort of coordinated ecosystem management be carried out in pilot projects, perhaps projects which correspond to the units established under the governance proposals.

long-term stream ecosystem functions and designing key watersheds to be managed to conserve aquatic biodiversity.⁷

3. Land use policies should be adopted within federal agencies' jurisdictions that acknowledge the value of and require, as appropriate, riparian buffers for the maintenance and/or restoration of healthy aquatic ecosystems.⁸

4. Sources of unnatural sedimentation throughout federally managed portions of watersheds should be minimized, and future sources of unnatural sedimentation should be prevented, by protecting roadless areas and steep, unstable slopes from various management activities. In areas where timber production activities contribute significantly to stream-degrading sediment loading, inventories should

be conducted to classify and map unstable and potentially unstable lands and withdraw them from timber production.

5. The Commission also acknowledges the need for certain federally reserved or public lands to have allocated quantities of water of specified quality, timing, and duration to meet designated public purposes. Federal land management agencies should proceed to assert and quantify federal reserved water rights, to appropriate water under state law, and to seek negotiated solutions with other water users for meeting those rights.

Support for Aquatic Science and Research

1. *Science-Based Decisionmaking.* Federal agencies should base their programs on the best available science. A number of specific recommendations are included in this report to improve data collection, information sharing, and peer review processes of the agencies. (See recommendation 6, "Improving Decisionmaking, Reducing Conflict.") Further, the Commission recommends that the Administration and the Congress carefully review the proceedings and the recommendations from the Aquatic Ecosystem Symposium sponsored by the Commission in February, the Galloway Report, and the National Research Council report on restoring aquatic ecosystems (Minckley, 1997; Interagency Floodplain Management Review Committee, 1994; NRC, 1992a) and implement as appropriate.

2. *Science to Improve Decisionmaking.* The Department of the Interior should request, and the Congress should appropriate, sufficient funds to strengthen the U.S. Geological Survey (USGS) biological and hydrologic research programs needed to improve the understanding of how aquatic ecosystems function. Such investigations

⁷ An aquatic conservation strategy was developed for the Pacific Northwest as part of the Forest Ecosystem Management Assessment Team (FEMAT) investigation. This strategy included "riparian reserves, habitat restoration, and monitoring built around a system of drainages called 'key watersheds.'" The key watersheds are in generally good condition and are to be managed primarily for aquatic resources. See *Habitat Policy for Salmon in the Pacific Northwest* by James R. Sedell, Gordon H. Reeves, and Peter A. Bisson, *Pacific Salmon & Their Ecosystems*, Chapman and Hall, 1997, and the 1993 FEMAT Report.

⁸ The Commission recognizes that the buffer zones will vary according to the location, size, function, and coordination of the waterway; the aquatic species present; the future desired condition; and other factors. It is the Commission's expectation that such zones (and the width of such zones and the activities permitted in them) will be established in a scientifically sound manner. The Aquatic/Watershed Group of FEMAT developed an aquatic ecosystem strategy which sought to restore habitat and prevent further degradation over large landscapes. The Commission recommends that the experiences, expertise, and methodologies used by these scientists be reviewed and used as appropriate in other areas. See *Forest Ecosystem Management: An Ecological, Economic, and Social Assessment*, July 1993, for strategy and quantifiable objectives.

should be directed toward the knowledge needed to advance restoration and management of watersheds and river basins.⁹

Funding Mechanisms

1. Adequate funding is required to meet environmental restoration needs; innovative funding mechanisms are necessary to meet overall funding requirements. The Administration and the Congress should take steps to:

- (a) Allow and encourage federal agencies to pool funds to maximize total available funding for projects and provide greater flexibility. The Administration should take steps to ensure that agencies coordinate allocating and expending funds on restoration activities, as well as establishing priorities for spending funds. The Commission strongly believes that interagency budget coordination is necessary to maximize the effective expenditure of shrinking federal funds, to eliminate duplication, and to ensure the funds are spent on the high priority activities.
- (b) Lift restrictions on use of federal funds on nonfederal lands as appropriate.
- (c) Grant agencies carryover authority to enable spending on long-term projects and/or

provide for multiyear funding of activities.¹⁰ When a fund fueled by user-based and/or congressional appropriations is established to facilitate a basin program, we recommend passage of waivers or exemptions which will permit retention of funds in an interest-bearing reserve account or trust to facilitate carryover management of the funds on a sustained multiyear basis.

- (d) Authorize federal agencies to spend money on nontraditional ways to encourage sustainable water development and management, including buying water for instream flows, buying conservation easements, and funding aquifer storage, reuse, and conservation projects, as well as other methods to achieve restoration and water supply goals.
- (e) Apply the principle of "user pays" by charging the true costs of extractive uses of renewable and nonrenewable resources.
- (f) The Administration should actively explore other innovative funding mechanisms, such as trust funds, private-partnership arrangements, and foundations, to create opportunities to raise and direct nonfederal dollars to restoration projects.
- (g) Authorize federal loan and grant programs to assist states and others in carrying out ecosystem restoration projects.
- (h) Amend the Land and Water Conservation Fund to permit both state and local grant recipients and federal agency participants to use fund money to acquire water for environmental protection and mitigation.

⁹ The Commission recognizes that water management agencies have research arms. It is the Commission's expectation that this research will be coordinated with USGS work and not be duplicative. The Administration should specify a lead agency to coordinate research activities within a watershed to ensure that a comprehensive, rather than piecemeal, approach is used to gain a better understanding of how aquatic and other ecosystems work. The present approach of each agency appears to the Commission to be fragmented and not conducive to ecosystem management.

¹⁰ In its report to the Commission, Reclamation notes that the lack of multiyear funding for planning and monitoring inhibits its ability to develop and implement plans to protect and enhance aquatic ecosystems.

Water Quality

The federal government has, for well over 30 years, taken the policy lead in water pollution control, largely because the issue is national and even international in scope and bears heavily on the national economy and society. Implementation of federal clean water laws has been remarkably successful in many areas, particularly in reduction and control of point source pollutants. The federal government should continue to provide strong leadership in water quality protection for the same reasons which led the Congress to enact the CWA in 1972. A sufficient supply of clean water is necessary for the health and well-being of people and of ecosystems. It is essential for our economic security and the sustainability of agricultural and municipal systems.

However, the leading objective of the CWA—"to restore and maintain the chemical, physical, and biological integrity of the nation's waters"—remains unfulfilled. Despite progress in many important areas, significant problems remain to be addressed. These include: (a) nonpoint source runoff and discharges; (b) poor integration of land and water management; (c) inadequate management of some specific sources of water quality impairment; (d) inadequate water quality standards for some aspects of water quality; (e) poor integration of groundwater and surface water pollution control programs; (f) poor coordination of water quality and water use programs; and (g) insufficient attention to more holistic and integrated approaches to water quality protection and improvement.

When actions of federal agencies have led to deterioration of water quality or water-dependent ecosystems, the agencies should assume the affirmative obligation of restoration.

Water Quality Standards.—

1. The water quality of western rivers presents issues that are often different from those in the eastern United States. There is little recognition of this in CWA or in the programs of EPA. EPA should, within the parameters of its statutory authority, be an active player in protecting and restoring western waters. Water quality standards, which are established by the states, should reflect the ecological attributes of rivers, as well as their chemical composition.

2. EPA and USGS should broaden their water quality monitoring to enable the agencies to knowledgeably assess the condition of western ecosystems.

3. Western ephemeral streams in arid areas, dry many months of the year, with aquatic ecosystems that can be vastly different from year-round water bodies, present a unique challenge under CWA. The Commission supports EPA's effort to find ways to treat these aquatic ecosystems as a separate type of water use and to develop a more appropriate, though equally protective, set of water quality criteria that states may use to adopt water quality standards that protect these ecosystems and their species and habitats. EPA and the states should be responsive to the growing pressure in the West to move toward land application of effluent, rather than costly treatment. In the West, the ecological value of water in streams is often higher than no discharge of effluent. The Commission also supports EPA's efforts to encourage states to develop biological criteria to help define the biological integrity of state waters.

4. Hydrologic modification activities are increasingly a source of concern in western aquatic ecosystems and rank third nationally as a source of water quality impairment for rivers. Water quality criteria and best management practices should be aggressively developed that allow states to pursue

instream flow and other standards for protecting physical and biological aspects of instream water quality.

Nonpoint Sources of Pollution.—

1. Pollution from diffuse sources reaches surface water and groundwater through overland runoff, washout from the atmosphere, leaching into groundwater, and other means, and is particularly difficult to control. A comprehensive collection of statistics, surveys, and studies examined by the Commission supports a conclusion that the West will not achieve water quality objectives—let alone sustainability of watersheds—unless there is a substantial new commitment to, and improvement in, policies and programs to reduce and control water pollution from surface runoff and other nonpoint sources. Nonpoint source agricultural pollution consistently stands out as a major source of water quality impairment throughout much of the West (EPA, 1995; USGS, 1993; National Water Summary, 1990-91).

Despite extensive program efforts and expenditures under the voluntary programs of CWA and the farm bills, and establishment of soil loss limits by the Natural Resources Conservation Service (NRCS), the problem of nonpoint source degradation continues and threatens to undermine the considerable national success in addressing point sources of water pollution (Reetz, 1997). Clearly, efforts to date have been inadequate to achieve fully the fundamental objectives of CWA.

2. Federal policy and law should continue to address nonpoint sources of water quality degradation through nationally consistent programs and by establishing national benchmarks for water quality and for best management practices. Federal programs must be reassessed, given the limited success to date in reducing many categories of nonpoint sources that contribute to water quality impairment. Programs must also be implemented

more aggressively by states with active support and cooperation of the federal government.

3. Programs addressing nonpoint sources should, wherever feasible, emphasize incentives to adopt best land management practices and be designed to be implemented flexibly at the watershed level. Many nonpoint source problems are site specific, and proposed solutions must be sufficiently flexible to reflect local physical and economic circumstances in a given watershed. Innovation should be encouraged as local and watershed solutions are proposed.

Examples of incentive-based programs include the Conservation Reserve Program and the Emergency Watershed Program, with its emphasis on flood plain easements and similar devices. Cost sharing of the type once used in the Great Plains Conservation Program should be made available westwide.

Nonpoint source programs should, wherever possible, be implemented through local watershed organizations. In developing local solutions, close attention should be given to the views of individuals who know the particular land well, such as long-term residents and those who farm, ranch, and fish.

4. The Congress should consider modifying or changing the CWA approach to nonpoint sources found in Sections 208 and 319 to that of the Coastal Zone Management Act (16 U.S.C. § 1451 et. seq.) reauthorization amendments.

5. The EPA and the states should more actively pursue cooperative implementation of the watershed-based total maximum daily load (TMDL) process. The states and the federal government have moved slowly to implement this potentially effective tool. The TMDL process also provides a vehicle for working closely with local interests such as watershed councils. Since the TMDL process

primarily is a tool for identifying the pollution load a receiving body can assimilate, it requires a successful implementing program to actually reduce pollution from nonpoint sources. Two promising areas are a reformed system of nonpoint source best management practices, described above, and pollutant trading systems developed on a watershed basis.

Integrating Land and Water Quality Management.—Many nonpoint and diffuse sources of pollution are the result of land management practices undertaken for a variety of purposes. The federal government is a substantial land and water manager in the West, and therefore has important obligations in this area.

1. The mission and authority of each federal water and land management agency, including the Corps, Reclamation, Forest Service, BLM, Fish and Wildlife Service (Service), and National Park Service (NPS) should explicitly include land management to improve water quality, particularly from nonpoint sources. The federal government should consider how it can best meet its water quality obligations under CWA and implement CWA "federal consistency" provisions. Federal agencies should be held to the same water quality standards as others. However, the absence of state controls on nonpoint source pollution has allowed federal managers to avoid complying with these standards. The Congress should mandate, for example, that the Forest Service and BLM implement best land management practices on public land to meet water quality standards.

2. In some river basins, irrigation of marginal agricultural lands results in excessive salts, as well as selenium and other toxic constituents, in return flows from some types of soils. In such situations, restoration and pollutant reduction options should be aggressively implemented. These options can range from more efficient water use and other irrigation management techniques, as documented in studies done in the Central Valley of California, to

considering retirement of marginal lands as cost-effective approaches to meeting water quality standards in particular situations.

3. The Commission observes that there is frequently a direct and significant correlation between nonpoint source pollution, wetland drainage, and flooding: each is often the result of shortsighted land management practices. On these subjects, the finding of the National Water Commission again continues to have force: flooding and water pollution are closely connected to land use and management; federal water policy must focus, inevitably, where land meets water. Protecting and restoring natural flood plains and wetlands should be promoted as a critical component for managing water quality on a watershed basis as well as for the other public and private benefits flood plains and wetlands can provide.

Specific Sources of Water Quality Impairment.—

1. A historic pattern of general growth, urbanization, and population concentration is accelerating at an unparalleled rate in the West. It is, and will continue to be, a serious threat to water quality. It has also been regarded as somehow an uncontrollable source of water quality degradation. Yet mechanisms may exist that could be more fully employed to help reach water quality goals.

For example, discharges from publicly owned wastewater treatment works that are utilized beyond their capacity are a potential cause of water quality impairment in specific western water bodies. The states and EPA should carefully monitor the water quality impacts of growth in the West and assure, for example, that growth does not outstrip current and future waste treatment capacity and adversely affect receiving waters.

2. The CWA exempts several important point sources from effluent limitations and regulation

under the point source National Pollution Discharge Elimination System (NPDES) permit system. As a result, some significant sources of water quality degradation need to be addressed and are not.

Among the most serious unregulated forms of water pollution is that generated by irrigated agriculture through irrigation and drainage districts. Irrigation return flows can, in certain situations, contain toxic constituents as well as salts, pesticides, and fertilizers. Some of these discharges enter waterways through discrete and specific points—pipes and ditches—after being collected in carefully engineered systems. These discharges, which are point source in nature, were exempted by the Congress through an amendment to the Clean Water Act; that exemption should be reconsidered. Other irrigated agricultural return flows are much more diffuse in nature. Often, the two are found together on one field, complicating their management.

Still, there is a well-known and broadly understood science and technology for control of both point and diffuse water pollution from such sources. More rigorous control of these sources should be tied to best land and water management practices—careful definition of effluent and instream water quality standards, soil loss limits, water efficiency measures, and preparation of whole-farm conservation plans as defined by NRCS. The interaction of point discharges with overland runoff and underground seepage should be considered in developing and implementing a combination of point source requirements, enforceable nonpoint source requirements, and instream standards.

3. The large and growing number of sizeable confined animal feeding operations will continue to represent an ever-increasing threat to surface and groundwater quality. Under CWA, most such lots are point sources in the technical sense only but are largely treated as exempt from regulation in the practical sense. CWA authorities should be applied

to require that confined animal feeding operations operate under NPDES permits that are enforced.

Groundwater-Surface Water

Linkage.—Increasingly, empirical studies have documented that groundwater and surface water are not separate and distinct hydrologic regimes in terms of water quality or water quantity.

The CWA and other federal and state laws needlessly perpetuate this fictional division, resulting in inefficient pollution control.

Because of the hydrologic link between surface and groundwater, the discharge of pollutants into groundwater from a wide range of sources should be subject to some rigorous system of management under CWA, through NPDES, nonpoint source best management practices, or watershed management approaches. Safe Drinking Water Act protections for groundwater as a source of human drinking water do not currently assure water quality protection.

Water Use and Water Quality

Linkage.—

1. The Commission joins with many other voices in noting that water quality and water use systems are not integrated or effectively coordinated at the federal, state, or local level. Fulfilling the mandate of CWA to protect physical and biological, as well as chemical, water quality is difficult if not impossible without this coordination. Even though it presents challenges in accommodating water quality goals and water quantity needs, the relationships between water use (water allocation and water rights) decisions and water quality management should be recognized at all levels of government decisionmaking.

2. Federal agencies with water management responsibilities should recognize that storage and offstream diversions for water use can have a locally

significant adverse effect on instream water quality in western states. Federal agencies with responsibility for dam and reservoir operation and control should include water quality protection as one of their principal management goals. Also, the contribution of such cost-effective water management tools as improved water use efficiency into water quality improvement efforts deserves more attention. The refocusing of the Colorado Salinity Control Program on nonstructural solutions is just one example of this.

3. Monitoring of water quality and water quantity should be given the highest priority. The principal recommendations of the Intergovernmental Task Force on Monitoring Water Quality should be implemented. These call for the establishment of a National Water Quality Monitoring Council, use of collaborative monitoring teams, and linking national ambient water-quality assessment programs.

Irrigation Drainage and Retirement of Lands Unsuitable for Irrigation.—Reclamation should document, on a project-by-project basis, the water quality effects of each of its projects providing irrigation water service. Reclamation should then prepare a plan for each project for addressing water quality impacts on a long-term basis, meeting applicable state and federal water quality standards and restoring aquatic resources that have been damaged or degraded by contaminated irrigation drainage. Such plans should consider a range of remediation approaches including treatment, source reduction, and land retirement.

The Congress should prohibit Reclamation from conveying certain new benefits from the Reclamation program (e.g., new contracts, contract renewals, or extensions; early payouts; rehabilitation of project facilities; loans, etc.) for any project that has not taken steps to address the impacts of agricultural drainage water.

Integrated Watershed Solutions.—In conclusion, to further the goals of CWA to promote the physical, chemical, and biological integrity of our nation's waters, and to meet the national goals of fishable and swimmable waters, integrated solutions beyond the bounds of the current CWA programs are needed. The Commission endorses more widespread adoption of watershed-based efforts to achieve improved water quality and urges the cooperation of federal, state, tribal, and other entities in achieving these goals. The Commission also points to the importance of overall water quality improvement, not just reduction of specific pollutants, as a key factor in restoration of western aquatic ecosystems and endorses the recommendations of the National Research Council 1992 report on aquatic ecosystems (NRC, 1992a).

4. Management of Water and Water Facilities

Modifying Operation of Existing Federal Projects to Better Address Current and Future Needs

The growing population of the West and the increasing demands for instream uses suggest that we must continue to look for ways to expand the managed water supply.

New Storage.—Water supplies in the West will need to be augmented by new storage in some areas to address tribal water rights, instream needs, and out-of-stream uses. Strategic storage augmentation should focus on a range of new approaches that have fewer environmental impacts and are cost effective, including smaller and offstream storage facilities, pumped storage, and groundwater recharge. It appears that most new storage in the West is being undertaken by states and local water utilities. (See report to the Commission by the Western States Water Council, *Water in the West Today: A States' Perspective*,

July 1997). However, as part of the review of operations of federal dams, consideration should be given to the need for additional supplies and opportunities for improving project yield, such as through changes in dam operating criteria, expansion of storage, and the like.

One new water supply strategy presented to the Commission is headwater storage. This entails development of smaller offstream storage facilities high in a watershed to augment existing demands and to meet new demands. This strategy provides several advantages over large basin storage facilities. Being high in the system, it allows greater operational flexibility and less evaporation loss. Since it is offstream, it may have less adverse impact on the stream. As with all new storage, it is relatively expensive and has some unavoidable environmental effects.

The emerging trend is for state and private agencies to take the lead in developing new storage for municipal supplies. For example, the Metropolitan Water District (MWD) of Southern California is completing the \$1.9 billion Eastside Reservoir Project, including the 800,000-acre-foot Eastside Reservoir, which will provide a 6-month emergency supply to MWD's service area and a regulated supply to help meet an additional 1.2-million-acre-foot demand in southern California by the year 2030 (MWD, 1997). The Contra Costa Water District's Los Vaqueros Project, which includes the 100,000-acre-foot Los Vaqueros Reservoir, is being constructed at a cost of nearly \$450 million and will principally improve water supply reliability and quality from the Sacramento-San Joaquin Delta (State of California, 1994).

For federal projects, the trend appears to be toward augmenting supplies for multiple purposes, but usually with the core purpose of addressing endangered species issues or tribal water rights. Current examples are the Animas-La Plata Project in southwestern Colorado, which would implement a

tribal water right settlement; the storage options being considered as part of the Bay-Delta program to augment supplies to replace waters recently dedicated to environmental purposes; and the enlargement of Pathfinder Reservoir in Wyoming, in part, to provide additional water for meeting endangered species needs along the Platte River in Nebraska.

Water Reuse and Recycling.—

Throughout the West, interest in water recycling, reclamation, and reuse as a way to stretch available water supplies is strong and increasing. In conjunction with more efficient water use, in many areas, this may be the only available source of "new" water.

The Commission recommends that the federal government undertake a role of strong support for local water recycling projects. This would include:

- Demonstration, technology development, and research.
- Definition of water quality parameters.
- Technical and financial assistance for particular projects.
- Efforts to reduce the institutional and regulatory barriers to water recycling. In particular, the Congress should provide funds for Interior to develop a westwide program to promote water recycling where it is environmentally and economically appropriate and to identify on a regional basis the feasibility of water recycling to meet water supply needs.

At the same time, recognizing that there are many worthwhile projects from a local point of view and a diminishing source of federal funds, the Commission urges the federal government to invest only in those projects that assist the federal government in

meeting its own water resources management mission including environmental mitigation and restoration. Federal agencies should work closely together and with individual states to coordinate financial assistance programs to leverage federal dollars.

Optimization of River Systems.—

Agencies should continue to study approaches to optimize yield from operation of reservoirs and systems of reservoirs. Conjunctive use of ground and surface supplies, and keeping more water stored at higher elevations, can improve yield.

Risk Sharing and Management.—

Especially as the capacities of current storage systems are reached, mechanisms for sharing risk of shortages can allow critical needs to be met from existing supplies. Urban rationing plans and agricultural water banks are two such approaches that should be further used.

Groundwater Management.—State law should recognize and take account of the substantial interrelationship of surface water and groundwater. Rights in both sources of supply should be integrated, and uses should be administered and managed conjunctively. The Congress should require state management of groundwater and regulation of withdrawals as a condition of federal financial assistance for construction of new water storage projects.

All federal agencies conducting water planning should include in studies and proposals a description of associated groundwater resources and their current management, including estimates of the rates of depletion of such resources. The Congress should scrutinize proposals for water projects in areas with groundwater mining, especially noting the presence or absence of groundwater regulation and management.

Drought Management.—Drought is one of the most costly western water problems. It also has one of the most predictable patterns of occurrence of all natural disasters. Unfortunately, drought management remains too often on a crisis-management rather than a risk-management basis. The Commission adopts the following recommendations based upon the review of drought management and drought policy conducted for the Commission (Wilhite, 1997). These recommendations are similar to those recently adopted by the Western Governors' Association in 1996, which the Commission endorses (Western Governors' Association, 1996a).

1. An interagency task force should be established to develop an integrated national drought policy and plan that emphasize a preventive, anticipatory, risk management approach to drought management and promotes self-reliance. An effort to better coordinate existing programs and mitigation activities has been initiated for the western United States by a memorandum of understanding among the U.S. Department of Agriculture (USDA), Interior, the Federal Emergency Management Agency (FEMA), the Department of the Army, the Department of Commerce, three tribal councils, the National Association of Counties, and the Western Governors' Association.

2. Drought management should be incorporated into FEMA's National Mitigation Strategy.

3. An improved system should be developed for national climate monitoring that builds upon the various drought monitoring systems developed by states. The goal is to provide early warning of emerging drought conditions.

4. Most, but not all, western states have developed drought mitigation plans. The federal government should provide technical assistance and financial incentives to develop or revise existing plans.

5. All federal and state drought management should emphasize programs that encourage long-range planning and mitigation for drought and that provide more timely and reliable information to decisionmakers.

Rural Domestic Water Supplies.—It should be a goal of the federal government to ensure that all residents of tribal reservations have safe and modern water supply, treatment, and sanitation facilities. Further, state and federal agencies should continue efforts to assist rural communities to develop or upgrade their water supply and treatment systems to meet drinking water standards and to make operation of these systems more cost effective. For both of these purposes, reallocation of water supplies from existing federal water projects should be considered if appropriate.

Promoting Efficiency and Flexibility of Water Use

Water Conservation and Efficiency.—Water conservation, or improved efficiency of use, can have many benefits and should be the first approach considered for extending or augmenting available supplies. Under the right conditions, it can help reduce stream diversions, reduce costs for water and wastewater treatment, reduce the need for new storage and delivery systems, and save costs for water users. However, the Commission recognizes that improving water use efficiency must always be viewed as a means to an end. Efficiency improvement programs must always have clearly defined purposes and must be structured to ensure that those purposes are achieved.

Water conservation programs in the municipal and industrial sector, where costs of water and treatment are high, have been successful at reducing use, sometimes dramatically. Ongoing programs have reduced water use by 15 percent, and emergency programs during drought have cut use by up to

50 percent. Sustaining large reductions is more difficult, and water utilities have limited incentives to significantly reduce customer demand in the long term (Natural Resources Law Center, 1997).

In the agricultural sector, numerous potential benefits come from improving water use efficiency. Benefits include reduced operating costs, onfarm costs, drought impacts, soil erosion, drainage problems, groundwater overdraft, and improved crop yields and quality and water supply reliability, as well as improved water quality and aquatic habitat.

Some of the constraints on water conservation in the agricultural sector are the low cost of water, the cost of conservation technologies, uncertainties about both the ownership of conserved water and the effects of conservation on individual water rights, and legal constraints on marketing conserved waters. Further, the relationship between improved water use efficiency by individual farmers and the resulting changes in river diversions for an irrigation project or watershed are complex and indirect, affected by both the specific nature of local water rights and basin hydrology. To be effective in meeting program goals, water efficiency improvements must be carefully planned and implemented with full understanding of the institutional and physical environment (Allen et al., 1996).

Estimating potential benefits to be gained from agricultural water conservation is difficult. Data on the effectiveness of efficiency programs are scarce, and specific sites can vary substantially in their potential for water conservation. Two studies of water conservation in Colorado and California from a decade ago estimated that somewhat less than 5 percent of total water use can be saved through practical agricultural conservation methods (Jenson, 1984; Davenport and Hagan, 1982). The National Research Council explains that, while increasing irrigation efficiency can reduce the amount of water diverted, the return flows will be decreased because

"conserved" water is often used elsewhere on the farm or by other water users. Thus, the actual volume of water made available to other uses can be small (NRC, 1996a).

Evidence does exist, however, that there are significant opportunities to increase efficiency. Also, the NRC has pointed out that irrigation efficiencies vary significantly and has itemized numerous opportunities for implementing efficient practices and measures (NRC, 1996). Further, an examination of Reclamation's *Summary Statistics* reveals a diverse range of water application rates between water districts, suggesting a corresponding diversity of irrigation efficiencies (after accounting for differences due to climate, crops, and supplemental versus full service irrigation) (Reclamation, 1992). Thus, while the potential for improved efficiency in a given district is uncertain without a specific evaluation, the potential improvement over the 10 million acres in 1,000 Reclamation irrigation districts is substantial (Reclamation, 1992).

The Commission therefore recommends that the Secretaries of the Interior, Defense, and Agriculture actively encourage and work with users of federal project water to improve project water use efficiency and onfarm water use efficiencies wherever there is reasonable expectation that public purposes might be served. In these cases, the Administration should provide incentives and technical and educational assistance for contracting agencies and water users. Many Reclamation irrigation districts have very limited information on water deliveries and use, making basic calculation of system efficiency difficult. Such data are prerequisite to assessing feasible options for improving water management.

Federal agencies investing in efficiency improvements should take full advantage of existing federal and state programs designed to protect conserved water as instream flows (such as the state of Washington's trust water rights program). In addition, the Administration should encourage states to adopt

laws and regulations that allow water users to benefit from conservation efforts and that allow a portion of conserved water to be applied to instream flows and other environmental purposes including groundwater protection.

The Congress and affected agencies should consider requests for new water storage or modifications to existing projects to augment supply only after the efficiency of the existing project or water use has been evaluated and opportunities for improved efficiency examined and implemented where cost effective.

Pricing.—Federal agencies providing water-related services, such as storage, delivery, or flood control, must re-evaluate the subsidies they provide to users of the services to determine whether such subsidies serve current and future needs. The Congress and the federal agencies should recognize the signals that such subsidies send to users regarding the efficient use of water. Subsidies can create significant disincentives to use water efficiently. Therefore, in new or renewed water contracts, agencies should seriously consider pricing their services closer to the full taxpayer's cost of providing the service, thereby promoting water rate structures that encourage efficient water use. The Commission believes that, in many cases, more realistic prices will lead to improved water use, without sacrificing the other social values supported by existing subsidies.

Operation of Dams and Water Delivery Systems.—The operations of many of the large federal dams in the West are currently under review. In most cases, these reviews are focused upon endangered species issues.¹¹ Further,

¹¹ Some changes in project operations have been formalized by statute, such as in the Grand Canyon Protection Act, Public Law 102-575, Title 18, 106 Stat. 4669, or the Central Valley Project Improvement Act, Public Law 102-575, Title 34, 106 Stat. 4706.

many dams are now providing benefits to a much broader range of interests than was originally envisioned when authorized. Therefore, the time seems right for a more systematic review of operations that could lead to adjustments in project purposes, operations, and even cost allocation.

The Commission recommends that the Secretaries of the Interior and Defense and the Chairman of the Federal Energy Regulatory Commission be directed first to prepare and submit to the Congress, for each of the dams they manage, a brief assessment of the value of undertaking a systematic review of the dam's purposes, authorities, and operations. Public scoping should be part of this process. The agencies should then be authorized and directed to undertake such reviews, prioritized based on scoping results.

In these reviews, the agencies should assess project operations in light of current and future needs for water storage and delivery, hydroelectric power generation, flood control, transportation, recreation, and other authorized purposes, as well as for purposes that may not currently be explicitly authorized, including environmental purposes such as watershed and aquatic habitat restoration. Wherever possible, these reviews should be undertaken on a watershed or river basin basis. The reviews should actively seek involvement and participation by the states, tribes, local watershed groups, and other stakeholders.

Any need for modifying a facility's structure, project authorities and purposes, cost allocation, or operations should be identified through a public planning process and reported to the Congress if statutory changes are required. The Congress should provide funding and authority for those changes which appear to improve the way water projects serve public needs while addressing

equitably the rights, as well as the financial obligations, of current water users.¹²

Water Marketing and Transfers

The Commission has found that water transfers are an essential part of any discussion of the future of the West and its water. Voluntary water transfers are occurring throughout the West and can help meet the demand for new urban supplies and for environmental flows in a manner that is both fair and efficient. However, water transfers that occur without attention to their potentially damaging effects on local communities, economies, and environment can be harmful to ecosystems and

¹² Reoperation of federal projects must take place within the framework of existing compacts, water rights and contracts, and state water law. In some cases, state law restricts the types of changes that can be accomplished. In its report to the Commission, Reclamation identified some of these limitations:

Some state water laws do not recognize the interconnection and interaction of ground and surface water, making conjunctive management of water resources problematic.

Definitions of 'highest and best use'; may not recognize instream flow as a 'beneficial use,' and, in some cases, state laws limit which entities may apply for and hold instream flow rights.

Under some existing state laws, public environmental values for water use are unrecognized, which makes the environmental communities' desire to maintain and increase aquatic environmental amenities difficult to address.

Existing laws may penalize water conservation or the environmental uses of water (use-it-or-lose-it stipulations), making efforts to encourage environmentally beneficial management practices difficult to implement.

Differing provisions of water laws of bordering states may complicate efforts in dealing with basinwide ecosystem issues (Reclamation, 1997a).

social systems that depend on irrigation economies. Governing institutions are therefore faced with a difficult balancing act—to facilitate transfers on the one hand, recognizing the benefits they may produce, and to scrutinize transfers on the other hand, understanding their potential costs to society.

The authority to approve a transfer or lease of water rights or changes in location and type of use rests for the most part with the states and tribes, and varies significantly between states and between federal projects. In some cases, the United States has a direct role in approving transfers; in other cases its role is more indirect, sometimes limited to compliance with the National Environmental Policy Act (NEPA) requirements to evaluate the effects of a significant federal action. However, because the United States oversees storage and distribution of substantial water in the West, its policy toward water transfers is fundamental. The principles for voluntary water transfers adopted by the U.S. Department of the Interior in 1988 (Interior, 1988) have encouraged the transfer of both Reclamation and non-Reclamation project water.

The Commission, in general, was persuaded by the recent detailed report of the NRC, *Water Transfers in The West: Efficiency, Equity and the Environment* (1992b), and endorses that report in general. Several of the following are findings and recommendations from the NRC report.

1. *Benefits From Voluntary Transfers.*

Voluntary water transfers, if thoughtfully managed, can promote efficiency in water use while protecting other water-dependent values recognized by society. Voluntary transfers also represent a growing source of water for instream flows and other environmental purposes.

2. *Federal Role.* The United States should recognize the potential usefulness of voluntary water transfers as a means of responding to changing demands for use of water resources and should facilitate voluntary water transfers as a component of policies for overall water management, subject to

processes designed to protect well-defined, third-party interests. The Congress and federal agencies should review existing water resources law and policy in order to ensure that it does not stand as an impediment to voluntary water transfers.

3. *State and Tribal Approval of Transfers.*

State and tribal governments have primary authority and responsibility for enabling and regulating water transfers, including identification and appropriate mitigation of third party effects. State and tribal administrators should develop and publish clear criteria and guidelines for evaluating water transfer proposals and addressing potential third-party effects. State and tribal administrative processes should provide for public and broad, third-party representation in the review of water transfer proposals. In addition to normal actions such as notices of proceedings, public hearings, and protest opportunities, programs should include affirmative review of potential third-party effects in cases likely to involve significant effects. States should provide leadership in exercising their water administration and planning responsibilities to identify opportunities for water transfers that might serve as instruments for achieving a wide range of water management objectives.

4. *Addressing Third-Party and Environmental Impacts.* Public interest considerations—especially environmental consequences and impacts on Native American assets and Hispanic and other rural communities with the potential to maintain environmentally sustainable ranching and irrigation economies—should be included among the third-party issues and legal provisions for permitting and denying water transfers. To the extent that public trust concepts and values cannot be represented dependably under existing laws and policies, states should develop new laws, institutions, and administrative tools to represent these concepts and values.

The costs of mitigating third-party effects should be internalized as a cost of the transfer—that is, the beneficiaries or proponents of the transfer should bear the mitigation costs as a matter of law and

equity. Therefore, the cost of the transfer should include sufficient funds—in the form of water, money, or other compensation—to help mitigate third-party effects.

Water transfer processes should formally recognize interests within basins of origin that are of statewide and regional importance, and these interests should be weighed when transbasin exports are being considered. States should revise laws that now exempt water facilities from taxation by the county of origin, either because the exporter is a public entity or because of provisions that make such facilities taxable only in the county where the water is used. Mechanisms to compensate communities for transfer-related losses of tax base, such as an annual payment in lieu of taxes, may be needed.

5. *Costs of Transfers.* The cost of water transfers should be kept as low as possible. This provides the greatest incentive for transfers. It is then up to the responsible district and local officials, states, Indian tribes or nations, and federal agencies to actively determine whether any given transfer is in the public interest and should be allowed to proceed. The greatest social benefits from transfers occur when the transaction costs of transfers are low, but active oversight is provided.

To help reduce costs, policies might be designed so that, in general, transfers of acquired rights are limited to the amount of water that the seller consumptively uses. This may entail setting state, river basin, or regional standards for the consumptive use of water per irrigated acre based on crop type, historic water availability, and other local variables. Such standards should be flexible enough to account for variations in water availability and local conditions. Third parties should not have to develop data on the transferable quantity; data should be developed by the buyer or seller.

Regulatory requirements should be designed to encourage negotiated resolutions of conflicts. Consid-

eration should be given to processes other than judicial proceedings (e.g., a state water court) to provide the initial evaluation of transfer proposals.

6. *Opportunities for Environmental Enhancement.* When water is marketed, there may be an opportunity to dedicate some of the newly available supply to public uses such as environmental protection. Some have proposed that the federal government take some of the money from the marketing of federal project water and use those funds to mitigate a project's environmental impacts. Others have suggested that transaction costs are already too high and that further "profit sharing" may unnecessarily impede transfers, which often are undertaken for environmental purposes. The Congress should set clear policy for the distribution of monies from the resale of federal project water. The issue is complex, but, on balance, the Commission concludes that the federal government should not try to recapture the subsidies involved in federal project water (beyond the repayment of all contractual obligations by the project beneficiary). The transaction costs of subsidy recapture would discourage desirable transfers and would represent a sharp break with past Reclamation policy. However, this recommendation would not preclude a restoration tax on transfers to help restore degraded aquatic ecosystems.

7. *Appropriate Revision of Regulations.* The Secretaries of the Interior, Agriculture, and Defense should revise their regulations as needed to facilitate and encourage marketing of water from federal projects and water banking to promote efficient water uses to the extent consistent with the ecological integrity of affected streams and the economic vitality of communities in the area of origin.

Enforcement of Reclamation Law.—

Reclamation should also take steps to ensure that water use from Reclamation projects is in compliance with project authorities and federal

Reclamation law. Regulations should be promulgated providing for the resolution of the range of circumstances under which water has been put to unauthorized uses. Any water returned to the project as a result of eliminating such unauthorized use should be made available for other authorized project purposes, or for instream uses, if appropriate.

Flood Plain Management

Need for Overarching Flood Management Policy.—The 1997 floods in California, Nevada, and the upper Midwest, along with the 1993 Midwest/Mississippi floods, demonstrate the need for an overarching flood plain management policy to consistently achieve the nation's policies of flood control, disaster prevention and mitigation, disaster relief, and environmental restoration.

The Commission recognizes that the appropriate flood protection measures vary by location, density of population, land use, and other factors. The Commission notes that structural measures to protect against floods have produced substantial benefits over the years, and the repair of those structures following a flood event may be the most appropriate response depending on the ground circumstances. However, the Commission has concluded there is a need for strong preflood preparedness and planning to more thoroughly explore nontraditional¹³ options and to ensure that agencies are capable of utilizing such options, as appropriate.

¹³ The Commission intends the term "nontraditional," as used in this section, to be defined broadly and to include, among other measures, use of easements and the Conservation Reserve Program, setback and redesign of levees, elevation of critical infrastructure located in the flood plains, and buyouts, as well as the range of other nontraditional options set forth in the Galloway Report and in the February 18, 1997, Memorandum to Federal Agencies from Franklin Raines, Director of the Office of Management and Budget and Kathleen McGinty, Chair of the Council on Environmental Quality.

Recommendations.—

1. Recommendations of the 1994 Galloway Report should be adopted and implemented.¹⁴

The Galloway Report reflects four key themes:

- (a) The responsibility for flood plain damage reduction through flood plain management should be shared among all levels of government and by those at risk of flooding.
- (b) Enhanced organization and consistency of government activities would further flood plain management, and further the federal response to floods and flood recovery, in a manner that promotes future flood damage reduction.
- (c) The analysis of flood risk and means to avoid, minimize, and mitigate flood risk should be pursued in a comprehensive manner that integrates hydraulic, hydrologic, and ecosystems management within a watershed.

¹⁴ The Commission recognizes the specific concerns the Corps raised with the report and recommends that those concerns be taken into account as the recommendations and action items are implemented. Such concerns include possible major budgetary, manpower, and resource implications of implementing some of the concepts in the report such as the use of the Standard Project Flood level of protection as a minimum level of protection for urban areas. The Corps also expressed concerns that the Galloway Report went beyond recommendations for flood control and protection and extended into other areas, such as land acquisition activities. The Commission has made similar recommendations to those in the Galloway Report concerning interagency coordination, watershed and riparian restoration and restoration, land acquisition, and ecosystems management and, therefore, endorses the substance and approach taken by the Galloway Report.

The Commission also notes that the Galloway Report contained a number of recommendations directed at state and local governments which are outside the purview and scope of this Commission.

- (d) The reduction of vulnerability to flood damages should be pursued by giving full consideration to all possible alternatives including permanent evacuation of the flood-prone areas, flood warning, floodproofing of structures remaining in the flood plain, creation of additional natural and artificial storage, and adequately sized and maintained levees and other structures.

2. Development of flood plains should not be subsidized by the federal government, in part to minimize growing losses of life and property as a result of flooding events, and in part to provide the flood storage, conveyance, and environmental benefits associated with healthy riparian and riverine ecosystems.

3. All federal expenditures for flood plain management and disaster relief should consistently encourage responsible behavior and discourage behavior likely to lead to future loss of life and property.¹⁵

- (a) The Administration and the Congress should establish a policy that communities and individuals who are eligible to purchase flood insurance and have failed to do so are not eligible for major federal disaster assistance, except for such assistance as needed to provide for immediate health, safety, and welfare, and to provide a safety net for low-income flood victims. The Administration should step up its

educational efforts concerning hazards, hazard mitigation, the availability of flood insurance, buyout opportunities, and other measures to reduce exposure to risk.

- (b) The Administration should increase incentives for communities who participate in flood plain management planning through FEMA's National Flood Insurance Program Community Rating Systems. Participants with high ratings should be eligible for a higher proportion of flood relief funds than nonparticipants.
- (c) Federal flood insurance underwriting should be modified to resemble the private insurance industry so that flood insurance premiums increase with repetitive losses.
- (d) Communities should be encouraged to procure private flood insurance to insure public structures.
- (e) The Corps' Floodplain Management Program should be aggressively promoted and funded in order to advise communities of best management practices and to prioritize public and individual assistance grants for recovery from flood events. It should be integrated with the Corps' emergency response/recovery operations, using the Corps' new authority under the Water Resources Development Act of 1996 to implement nonstructural flood plain management measures in lieu of structural repairs.
- (f) The Administration should pursue, and the Congress should accept, a change in law to require 50/50 cost sharing among federal and local governments for funding future structural flood control projects. For nonstructural approaches to flood mitigation, the federal government should fund up to 75 percent.

¹⁵ A number of specific action items for implementing this recommendation can be found in the Galloway Report and should be implemented by the Administration. Such items include requiring actuarial-based flood insurance for properties behind levees which provide less than standard flood protection and reducing losses to repetitively damaged insured properties through surcharges and increased deductibles. The Commission notes that the waiting period for flood insurance has been increased to 30 days by the Flood Insurance Act of 1994 and believes that this interval should not be decreased.

4. The federal government should place greater emphasis on, and the Congress should provide funding for, the disaster relief programs for nontraditional approaches to recovery from disasters. The Congress should provide funds from outside of the disaster relief programs for planning and preparedness programs to enable federal and nonfederal agencies to use nontraditional responses to flood events, including relocation before and after such events, purchase of easements, and so forth.

- (a) The Administration should streamline procedures for federal assistance to states for land purchase and relocation and establish consistent procedures to permit preflood sales (to permit and encourage relocation out of key flood plains) as well as postflood sales and relocation.
- (b) The federal government should more aggressively engage in alternative nontraditional solutions including purchasing flood plain lands or flood easements, setting back levees, restoring wetlands and natural storage areas, floodproofing structures on the flood plain, and allowing for natural pooling of rivers in lightly populated areas.
- (c) The federal government, through financial and other incentives, should encourage relocation of structures away from flood-prone areas.
- (d) The Congress should provide generic authority to the water management agencies to engage in developing and implementing nontraditional options to lessen the loss of life and property following a disaster and to engage in environmental restoration activities in riparian and riverine areas to lessen the severity of floods. A lead agency to coordinate these activities should be named.

5. The federal agencies should explicitly recognize that periodic flood plain inundation benefits the ecosystem by restoring conditions for wetlands and riparian areas, reducing salt and sedimentary accumulations, re-establishing fish and wildlife habitat, enhancing agricultural lands, improving water quality, and recharging groundwater. A key strategy for minimizing flood losses includes protecting and restoring riparian and riverine areas. The Commission has made a number of recommendations concerning aquatic ecosystem restoration ("Resource Management and Restoration," above). As noted, the Congress should authorize and fund the federal agencies to engage in aquatic restoration activities.

6. The federal government should encourage adoption of an integrated flood plain management and ecosystem management strategy on a basin level to meet dual objectives of flood loss mitigation and environmental restoration. Permanent basin level interagency organizations should be established to implement a flood plain management strategy. The interagency organization should be interdisciplinary, engage in alternative solutions before and in response to flood events, develop rapid interagency/intergovernmental response, and engage in efforts to inform communities and individuals of programs and relief options.¹⁶

¹⁶ The Galloway Report recommends a similar effort: the Administration should establish an interagency task force to formulate a coordinated approach to multiple objective watershed management; Interior, USDA, and EPA should coordinate and support federal riverine/riparian area restoration activities; the Administration should set up a lead agency for coordinating the acquisition of title and easements to lands acquired for environmental purposes; the Department of Transportation should focus land acquisition efforts on river reaches and areas with significant habitat values or resource impacts; agencies should be required to cofund ecosystem management using operation and maintenance (O&M) funds; funds for mitigation lands should be allocated in concert with and at the same pace as project construction.

Maintaining the Water Infrastructure

A tremendous investment has been made in water infrastructure across the western United States by many federal agencies, states, and private entities. Many of these structures are getting older and must necessarily be the focus of significant maintenance decisions. The issue of facilities maintenance is critical, given the declining federal budget and the broader purpose projects are serving today.¹⁷ The Commission recommends that the Congress and the agencies:

1. Appreciate the importance of sufficient funding for O&M of significant federal facilities upon which the public relies for water supply.
2. Recognize the fiscal desirability of preventive maintenance—that deferred maintenance may require eventual capital expenditures far exceeding preventive maintenance costs.
3. Place greater importance on maintaining and rehabilitating key existing federal water infrastructure than on funding for new projects.
4. Develop a long-range approach to maintenance, considering other means of supporting maintenance through expanded use of user fees and other cost-sharing approaches.
5. Explore further application of revolving funds and the like, which allow needed maintenance to be accomplished in a more timely and efficient fashion. These approaches, in many instances, can enable agencies to delay some kinds of expensive rehabilitation because they know that when monitoring indicates a need for rehabilitation, the funds will be immediately available.

¹⁷ Reclamation has 631 major facilities in the West. Responsibility for O&M has been transferred (usually to irrigation districts) for 398 of those facilities. For those cases, the operating partners are reimbursed for the facility O&M.

6. Continue to vigorously pursue means to become more efficient and effective to reduce costs of operation.

The Commission concurs that the goal of privatizing certain federal assets—making government work better at less cost—is laudable and encourages the Administration to proceed with this initiative. The Commission concurs that it is desirable to transfer assets out of federal ownership in those situations in which the new owner can manage those assets as well as or better than, and at less cost than, the federal government. The Commission, while concerned about the slow pace of actual transfers in Reclamation's program, concurs with the Administration's insistence that transfers be in compliance with environmental laws, that the public be involved in the transfer process, and that taxpayers' interests be protected. At this time, the Commission concludes that the transfer of multipurpose projects should be approached carefully, with special attention to how various purposes, along with environmental protection and restoration efforts, will be met.

Similarly, the Commission is wary of privatization of federal hydropower assets. These assets are usually one component of multipurpose facilities that serve irrigation, municipal, recreational, and fish and wildlife purposes as well as power. It is not clear to the Commission how these other needs might be met after privatization, especially when the new owner will likely be a power provider interested in maximizing the value of the power output of the facility.

While an analysis of the advantages and disadvantages of a deregulated power industry and privatized federal hydropower facilities is beyond the scope of this Commission, the potential impacts such actions might have on the aquatic environment are not. To one degree or another, dams have contributed to changes—all significant and some adverse—on aquatic ecosystems. Privatizing the dams and the

power facilities has the potential to reduce environmental mitigation, protection, and restoration efforts and to further degrade the aquatic ecosystems. The Commission believes the federal government, because it is such a large producer of hydropower in the western United States, should adopt a wait-and-see approach to the transfer of mainstem dams and power generating facilities, given the uncertainties in the new energy marketplace and the importance of ensuring that environmental protection and restoration efforts are continued and fully protected by the new owners as part of any future transfer.¹⁸

The Commission offers the following recommendations concerning the transfer of federal assets:

1. The Commission notes the Reclamation criteria for the transfer of title. We are not aware that other agencies with water and power management responsibilities have established similar criteria. We recommend that agencies contemplating facility transfers establish criteria for the transfer of title and that such criteria be consistent among the agencies. The agencies should consider the following in their criteria:

- (a) Statements of types and sizes of projects which are or are not subject to transfer or sale.
- (b) Definition of the financial advantages to the federal government which shall be a precondition to any sale or transfer.
- (c) Methodology for determining a price which adequately reflects both fair market value and the government's investment.

- (d) Scrutiny of all near term and potential effects of the transfer on water allocation and prices.
- (e) Determination of a level of maintenance needed to protect the public interest.
- (f) Opportunity for public input to the terms and conditions of the transfer.
- (g) Development of a facility-specific transfer plan, reflecting public input.
- (h) Description of the transferee's exact responsibility for maintenance, the transferee's fiscal responsibility, and the transferee's financial ability to fund maintenance indefinitely.

2. The Commission recommends the President task the Office of Management and Budget (OMB) with responsibility to ensure consistency among the policies and programs of the various federal agencies which might transfer water and power assets. A key responsibility of OMB would be to ensure that such transfers (of water and/or power facilities) will not result in further environmental degradation, that mitigation responsibilities are met by the new owners, and that the environmental and other objectives set forth in the basin governance plan are met.

3. The Commission notes that Reclamation gives preference to existing beneficiaries to take title to its projects. We recommend that the federal government consider whether the range of potential transferees should be broadened to include states or other nonfederal entities with the financial and technical capabilities to own and manage such facilities or projects.

4. The Commission recommends that the federal government continue to retain ownership and control over large systems of federal water facilities.

¹⁸ For a description of federal hydropower in the western United States, as well as a discussion of the pending issues which may have an impact on the power facilities and aquatic ecosystems, see Driver, July 1997.

It is important to recognize that these projects have critical functions important to multiple users, stakeholders, beneficiaries, and the public which should be protected. Few, if any, owners outside the federal government can provide adequate protection to these multiple, conflicting, and often interstate interests.

5. The Commission recommends generally against the transfer of title to federal hydropower and transmission system assets which are used by the federal power marketing administrations. At this time, we do not see how transfer of these assets out of federal ownership can be done in a manner to meet project purposes beyond power production. This is not opposition, per se, to such transfers; only an expression of our concern that, at this stage, they can be carried out in a way that protects the broad public interest.

5. Protecting Productive Agricultural Communities

Over the last century, the farm population in the United States has declined steadily and dramatically, while the value of food production has increased. In addition to the decline in the number of farms and ranches, those remaining are increasingly very large, often corporate, operations or small hobby or specialty farms. In the last several years, federal supports for agricultural production have been reduced, reflecting two goals—making production more market driven and reducing the environmental costs associated with greater agricultural production. For the better part of this century, substantial assistance to agricultural production—in the form of price supports, low-cost energy, and low-cost water—encouraged the expansion of low-priced food production for the U.S. and for export to the rest of the world. Some of the expansion occurred in areas which were economically marginal or which damaged important natural

resources. As federal supports are reduced, further contraction and restructuring of agriculture is likely, and the family farm and ranch are at risk.

At the same time, urban growth, suburban sprawl, and the growth of ranchette and luxury second homes in rural areas have placed pressure on farmers to sell land or water, or both, to support this growth. While this has been financially beneficial to many individual farmers; in some areas, the conversion of agricultural lands to other uses has had serious impact on traditional economies and cultures. Suppliers, implement dealers, grain operators, feed lots, and others, such as grocery stores and car dealers who depend upon a healthy agricultural economy in town, may close down and may constitute "third-party impacts." The traditional, close-knit nature of farm and ranch towns may change.

Further, there can be important environmental consequences of some types of water conversion. Aquifers and wetlands that depend on irrigation flows may dry up. Fields which lose their irrigation and are not planted to permanent cover can create mini dust bowls or become a source of noxious weeds.

Particularly in the interior West, existing ranching and farming operations are concentrated along riparian corridors, in flood plains, and on rich bottomlands. While these operations sometimes have negative environmental impacts on riparian resources, they also maintain the area as relatively undeveloped land, providing important benefits to wildlife and open space. As urban areas grow in the West, farming and ranching operations provide important open-space buffers between urban centers. Further, intact agricultural communities maintain an important part of the nation's culture and tradition.

Maintaining these important benefits from farming and ranching operations in the face of changing

national and international economies, greater concern for protecting environmental resources, and the tidal pressure of urban growth is a complicated and difficult task, requiring attention from the federal, state, and local level. National farm and public lands grazing policies, tax policies, and other laws affect the economic viability of individual operations. The federal authorities for individual water projects and state water law can affect the opportunity for individuals to sell water rights. And, most importantly, county land use plans and taxes determine whether lands can be developed or must stay in agricultural production. Local officials are seldom willing to restrict the rights of individual landowners to sell or develop property or water rights. State and national efforts to encourage land use planning have not been popular.

It is the judgment of the Commission that, in the majority of cases, federal water policy affects but does not drive these trends or changes. Nor can we envision acceptable federal water policies that can manage these trends to the satisfaction of most parties. However, the trends have significant effect on water resources, federal water projects, and related economies and environmental resources. We do recommend:

1. That federal water policy not subsidize growth and development in productive agricultural areas. For example, federal water managers should seek to ensure that those receiving water from federal projects for domestic or municipal purposes are charged an appropriate rate under project authorities, not just the basic project rate for agricultural water. Also, new urban development should pay the full costs for managing increased urban runoff, rather than relying on irrigation project drains.

2. That state and local officials give more attention to putting growth on a sustainable basis, recognizing the substantial state and local subsidies that are often given to sprawl development. The

Commission notes and supports the new initiative by the Western Governors' Association to establish an open lands conservation agenda for the West (Western Governors' Association, 1996b).

3. That federal agencies participate with and encourage local efforts to develop plans for land use that preserve the important economic, environmental, cultural, and amenity value of open agricultural and ranchlands. The Congress and federal agencies should recognize that these development pressures often unite traditional water users and conservation interests, whose joint efforts can serve important regional and national goals. Agencies should continue programs to obtain or facilitate acquisition of conservation easements or development rights in support of such local planning efforts.

4. That federal water agencies develop or continue programs that support sustainable agriculture by:

- (a) Strengthening locally led conservation partnerships by ensuring a strong base program of technical assistance and financial incentives to address the array of water resources issues stemming from private and tribal lands.

The conservation program of the NRCS should be reinvigorated under dynamic leadership. Efforts to consolidate NRC field operations have detracted from watershed efforts and have reduced the capability of local people to respond to increased resource management pressure. The technical support and cost sharing of such programs as the Great Plains Conservation Program should be restored in order to empower conservation districts, individual farmers, ranchers, and landowners. Significant incentives, more numerous technical experts, and increased accessibility of NRCS field personnel are essential.

- (b) Assisting in development of water conservation plans from districts contracting for federal water supplies.
- (c) Providing loans, grants, and other financial assistance that promote flexible water conservation on farm lands and other lands.
- (d) Conducting research to improve and promote water conservation and water quality.
- (e) Facilitating water transfers and marketing of federal water within states where state and local interests find them to benefit both water conservation and the financial viability of agricultural operations.

5. That irrigation districts, water management agencies, local and state officials, stakeholders, and affected publics work together to anticipate the demands for water conversion and develop plans for such conversion which protect the integrity of communities and the environment.

Reducing Costs of Environmental Compliance, and Increasing Certainty of Water Use for Water Users

Changing social values, demographics, economics, and environmental conditions in the West are requiring changes in water use. This has placed considerable pressure on traditional water users to meet increasing environmental regulations, obligations to Native Americans, and other pressures for changes in water use. Water users face increasing uncertainty regarding their annual water supply, the cost of their water operations, and renewal of their water contracts or permits. Given the rapidly changing conditions in the West, and given the interest on the part of the federal government in retaining the opportunity at the expiration of water contracts to revisit the appropriateness of current

agreements, it is unlikely that this uncertainty of use and operating costs can ever be fully eliminated. However, efforts should be made by all agencies to reduce or avoid costs or uncertainties placed on water users that are not fundamentally necessary. We recommend that:

1. Agency policy and intent regarding renewal of water contracts and permits be developed and clearly stated. Where possible, conditions for renewal should be stated.

2. The process for renewal of water contracts and permits be started sufficiently early for all parties to develop proposals, conduct negotiations, and carry out NEPA studies prior to expiration of existing contracts.

3. Water contracts and permits should make clear how resource users can benefit from conservation of the resource and from voluntary conversion of the resource to other desired uses.

4. Transaction costs for conversion of water to other uses should be kept as low as reasonably possible by federal agencies to allow water users the greatest incentive for conservation and conversion. Whenever possible, the costs of transactions should be specified up front, so that the benefits to users can be predicted with reasonable certainty.

5. Efforts should continue to address environmental conservation and recovery more comprehensively and, thus, provide resource users more certainty in their obligation. Examples include development of Multi-Species Habitat Conservation Plans and the associated "no surprises" policy.

6. Regulatory agencies should continue the process of improving and streamlining implementation of regulatory authorities. The Administration's initiative to reduce costs and burdens of implementing the ESA, the Council on Environmental Quality's initiative to improve

implementation of NEPA, and Federal Energy Regulatory Commission's redesigned process for considering renewal of hydropower licenses are three examples of efforts to improve and reduce the costs of governance while still meeting the fundamental goals and objectives of laws or programs.

6. Improving Decisionmaking, Reducing Conflict

In addition to recommending more integrated governance of river basins and watersheds, the Commission has identified several other areas where sound decisionmaking can be reinforced and improvements made in the way we deal with conflict over resource use.

Coordinating Federal Water Management

One difficulty with water resource management in the West is that there are multiple interests represented within any given department, with no merging of these interests below the Secretary. Perhaps the most important example related to water resources is that of the Department of the Interior with the extremely divergent congressional mandates carried out by BLM under the Assistant Secretary for Land and Minerals Management; Reclamation under the Assistant Secretary for Water and Science; Service and NPS under the Assistant Secretary for Fish, Wildlife, and Parks; and BIA under the Assistant Secretary for Indian Affairs.

The same problem exists between the various federal Departments; e.g., Interior water agencies versus the National Marine Fisheries Service in the Department of Commerce, with line supervision merging only at the President or Vice President.

In both instances, only issues of major political or national significance can hope to get the attention of the Secretary or the President necessary to resolve the interdepartmental or intradepartmental conflict.

The vast majority of the issues, although not rising to this standard, are extremely important and require authoritative and informed policy leadership for resolution. This usually requires a degree of attention, including the commitment of time, beyond the means of any Secretary or Assistant Secretary, let alone the White House. Compounding this problem is the fact that the typical resource issue has a real and political lifespan that far exceeds the tenure of any political leadership. This creates a leadership void. At best, informal structures and concerned individuals fill this leadership void, but they are most often unempowered, misunderstood, and inefficient. Line management in the involved federal agencies is left to work these issues out themselves. Thus, the existence of the conflicted federal presence today.

Solutions:

- A. An authoritative policymaker should be appointed who has the time and interest to shepherd the issue on behalf of the President or Secretary, as appropriate.
 1. They must be formally appointed to perform this function with clearly defined authority and responsibilities.
 2. They need to have a line of communication to the ultimate authority.
 3. They need a skilled and trusted staff advisor (recognizing the tenure of a political appointee averages under 3 years) to provide continuity.
- B. A forum should exist at the policy level to consider various program and policy issues resulting in a clearly articulated federal objective. This objective must be clearly conveyed to the field organizations and managers.

- C. A clearly designated lead organization should be established at the field level with authority and support or an appointed and empowered coordinator with direct line to the designated policymaker.
- D. A single point of contact for legal counsel should be named for the issue to coordinate and mediate all involved federal agency counsel for the line managers, the policymaker, and the Department of Justice (in the event of litigation).

eye on 'the big picture.' Thus, federal water policy lacks a unifying vision or even a set of guiding principles. . . . (Western Governors' Association, 1989)

In its report to the Commission, the Western States Water Council notes that, ". . . it seems evident that Congressional committee jurisdictions, department competition, and interest group ambition have contributed to a fragmentation in federal programs that militates against integration" (Western States Water Council, 1997).

Coordination of Federal Water Policy

The most recent institution charged with coordinating federal water policy was the Water Resources Council, created by the 1965 Water Resources Planning Act and defunded in 1981. Since then, coordination of federal water programs, when it has occurred, has come variously from the OMB, the Council on Environmental Quality at the White House, and such ad hoc bodies as the Task Force on Floodplain Management.

The major stimulus for the Water Resources Council was to establish criteria for evaluating major water projects and to attempt to rationalize the latter stages of the development of river basin storage and control systems. Of course, it was precisely the Council's efforts to bring economic, environmental, and hydrologic sense to the array of separate projects that created such animosity toward the Council on the part of states, federal agencies, and other project sponsors.

A white paper prepared for the Western Governors' Association to assess ways to improve coordination of federal water programs found that:

A principal characteristic of federal water policy is that said policies are made in an ad hoc, decentralized manner. No agency of the Executive Branch is responsible for keeping an

Today, most recognize that the world in which federal water policy functions is vastly changed from that overseen by the Water Resources Council. Large federal water projects are not being funded, nor even proposed. Today, the need for policy development and coordination stems from the many environmental and social crises affecting the nation's rivers. In the West, federal agencies are responding to tribal water claims, endangered species listing, and CWA lawsuits in nearly every river basin.

The Commission believes that functioning river basin forums can play the major role in shaping, coordinating, and implementing federal policy at the regional level. However, we believe that there remains a need for national coordination of water policy and programs, especially as federal resources decline and the need for prioritysetting becomes more acute. At a time when our water resources policies are in such rapid transition, it is remarkable that there is no regular forum for discussion of these issues by involved federal officials.¹⁹

¹⁹ A member of the Galloway Commission described how striking it was that, for the first time in many years, most of the key flood management agencies were actually in the same room talking about the government's approach to flood mitigation.

Program and Budget Coordination

The section of this report, "Integrating River Basin and Watershed Governance," describes the need for coordination of federal agency budgets on large, multiagency initiatives such as basinwide recovery and restoration programs.

We recommend the establishment of a process to coordinate and approve federal agency regional budget requests for each fiscal year and flexible budget requests for each ensuing 5-year period.

Federal agencies subject to such coordination would be determined for each basin depending on the significance of their programs to management or restoration of the basin's water resources. Typically, this would include Reclamation, the Corps, Service, EPA, and USGS, and may also include the Forest Service, National Marine Fisheries Service, BLM, BIA, the National Weather Service, and NRCS.

The coordination process should result in a reviewed and approved annual and 5-year budget plan of each agency's river basin offices in support of the annual budget requests submitted to the agency headquarters. In many instances, it should also result in a multiparty budget crosswalk similar to that developed for the Everglades initiative. To foster the achievement of coordinated programs, the agencies would be directed to coordinate actively with each other in the development of their basin water programs and budgets. In order to accomplish this, the agencies would:

1. Disclose to one another their anticipated programs and budget needs for the next fiscal year and for a projected 5-year period and their accomplishments to date.
2. Plan and execute their activities so as to assist each other in achieving consistent, measurable federal goals.

3. Submit agency budget requests pertaining to water resource management and development for mandatory review at the regional or watershed level for interagency programmatic coordination and consistency.

4. Set joint objectives for federal activities throughout the basin in such areas as water quality, water supply, ecosystem restoration, flood management, species protection, and social and economic vitality.

5. Cooperate fully to integrate enforcement of federal laws, especially when responsibility does not reside solely in one agency, such as working cooperatively to simplify, streamline, and, when possible, consolidate federal regulatory permit processes.

6. Work together to fund and develop sound scientific information including sharing with each other all important scientific results, data compilations, studies, and reports which substantially underlie their past and future program plans and budget requests.

The Federal Role in Research and Data Collection

Using Good Science.—Sound, unbiased data and findings are a prerequisite to the success, efficiency and economic prudence of many federal activities. Decisions based on slanted, scanty, or untested theories may have wasteful and disappointing consequences. The Commission recommends that when federal agencies undertake sizable projects or programs which depend on new scientific research or knowledge, the agencies should take steps to assure the validity and credibility of the science. Such projects may include major changes in river operations, major species recovery programs, or extensive monitoring and adaptive management programs.

The aim is to bring wider expert review and contribution to research and monitoring plans, data analysis, and assessment of conclusions. Options include external review panels, such as NRC review committees and publication in peer reviewed journals.²⁰ Also, joint investigations with universities and professional groups, project conferences, and symposia should be utilized.

Given the cost and time required for peer reviews, they should be used when justified by the potential impact on the project. However, when used, project planning must include sufficient time and budget to support participation by outside experts from the very start of the effort.

Even when intensive participation by outside experts is not justified, agencies should still publish or otherwise make public their data, findings, and reports so that the public may be informed and the scientific community at large may comment on or contribute to the activity.

Adaptive Management and

Monitoring.—When natural river systems and their associated biota are combined with extensive water control structures, the resulting network of interrelationships is extraordinarily complex. Today's crises of water management (e.g., decline of salmon runs) combine the complexity of the physical and biological system with the high stakes

²⁰ An example of this approach is found in the September 1996 amendment to the Northwest Power Act, directing the Power Planning Council to convene an 11-member panel of independent scientists to review the its Columbia River Fish and Wildlife Program for recovery of several threatened and endangered salmon runs. This panel evaluates projects proposed for the Program, determining whether proposals rely on sound scientific principles, benefit fish and wildlife, and have clearly defined objectives and outcomes with provisions for monitoring and evaluation of results. The panel's 1997 report to the Council contains many useful recommendations about the process of designing, implementing, and monitoring aquatic restoration programs.

of major regional economies and property rights. In these situations, it is rare that our understanding of the system will be sufficient to select remediations with complete confidence in their effectiveness. Costs of actions will be high, and certainty of outcome will be modest. Yet, because of the deteriorating situation, action must be taken.

This dilemma characterizes the management of most western river systems, nearly every one of which is involved in critical endangered species, water quality, or similar problems. Therefore, almost every river system must be operated within a framework of adaptive management.²¹ The Commission endorses and encourages the use of true adaptive management wherever long-term programs or projects are implemented or facilities operated that may have significant impact upon valued environmental, social, economic, or other resources, and where significant uncertainty exists about the best management action or its effects. Adaptive management should be implemented keeping the following two points in mind:

- (1) What gives scientific validity to adaptive management and distinguishes it from crisis management, is the deliberate setting of goals, selection of indicators for monitoring, design and implementation of a management strategy, and regular revisiting and updating of the strategy based on the monitoring data.
- (2) What gives political reality to adaptive management is an open and inclusive process

²¹As described earlier in this report, adaptive management is a process where goals for management of a resource are defined and critical resource and production indicators monitored. The best option for initial management of the resource is selected based on available information. Monitoring tracks the changes resulting in the resource, giving information on both the fundamental dynamics of the system and on the appropriateness of the current management option. Adjustments in the management of the resource can then be made and monitoring continued.

for establishing the elements of its framework. Vital to success is the agreement of stakeholders on the rules, especially the rules for revising operating plans based on the monitoring data. A strong commitment to maintain the monitoring program for the long term will not only provide good management data but will also build trust among participants in the soundness of the process.²²

Monitoring.—In its review of the first 25 years of NEPA implementation, the Council on Environmental Quality concluded that, "In most cases at present, agencies do not collect long-term data on the actual environmental impacts of their projects. Nor do agencies generally gather data on the effectiveness of mitigation measures." Therefore, in addition to supporting the increased use of adaptive management, the Commission recommends that agencies give more attention to monitoring significant environmental resources, programs, and environmental mitigation plans.

Water Research.—The Congress should acknowledge the scarce nature of western water resources and should recognize that water resources

research is a legitimate federal interest and should be supported. To address these issues, the Congress should fund a tightly structured research program. A substantial effort must be made to consult with state and other water managers to ensure that research is directed at high-priority problems and to coordinate research across the federal agencies so that limited research funds may be spent most efficiently.

Areas that seem to be a high priority include:²³

- Water treatment and reuse technologies.
- Use of impaired waters for various purposes.
- Approaches to recovery of threatened and endangered aquatic species.
- Watershed and river dynamics, with special attention to questions of adaptive management and monitoring.
- Land use trends and impacts on water and related resources.

In addition, research is needed on how water institutions should respond to changes in the way in which society is making resource decisions—the waning influence of governing bodies and the growing power of direct citizen participation and lawsuits. The history of water resources development has been the creation of coalitions

²² Among the points stressed by practitioners are:

1. Needing to focus monitoring on the most important indicators, including social and economic as well as biological.
2. Monitoring variables that are affected by management and which provide information relevant to management options.
3. Recognizing the degree of uncertainty in the knowledge and the variability of the system and match monitoring to it, in level of detail and duration.
4. Not trying to monitor everything, or things that would be just nice to know. Know how the results of the monitoring will be used.
5. Ensuring that all of the major management activities are included in the adaptive management effort. While one can't control things like annual precipitation, one should strive to include in the program, for example, every agency having significant management control over the resources.

²³ See Minckley, *A Report to the Western Water Policy Review Advisory Commission, etc.* for recommendations concerning specific research requirements identified by a number of leading scientists. Also, Reclamation, in its report to the Commission, notes that "River basin and project-specific databases vary greatly in type and amount of information, ease of access, and transferability" and that "sufficient data are generally lacking on the distribution and habitat needs of nongame, nonlisted, aquatic species and on aquatic and riparian vegetation" (Reclamation, 1997a).

around big projects which increased the water pie—all the players got more. Now the challenge is to shape institutions that can respond to signals that the carrying capacity of the resource has been exceeded and that can pull groups together to reallocate a shrinking pie—a nearly impossible task for our current institutions.

We believe that more of the research by USGS and other agencies should be driven by the information needs of managers attempting to manage water resources on a sustainable and watershed basis. We recommend that USGS work with other federal resource agencies and the states to determine highest priority policy-relevant areas for research.

National Water Data.—Water quantity and quality data are collected by many organizations at the local, state, and federal level. Many purposes are served by this data collection; among the most significant are verification of attainment of water quality standards and determination of water flow, use, and rights. As our interests in water resources become more diversified, programs to monitor the resource have also grown. Two critical needs have emerged related to these programs: (1) improving efficiency and coordination in data collection and (2) ensuring continuity and coverage in data collection.

The longstanding programs of USGS to collect and publish basic streamflow information provide very important information to a broad community of water users and water management organizations. This data collection is cost-shared by USGS and other federal, state, and local agencies. For many reasons, including high costs of data collection and tighter state and federal budgets, the number of gauging stations being maintained has declined substantially. The Commission received considerable comment about the need to maintain and ensure the continuity in this basic data collection program. As the competition and conflict over water increase, the value grows of a

nationwide, standardized, highly credible source of information. Steps should be taken to develop, among the agencies and cooperators, a plan for the future of this program that results in greater financial and programmatic stability, and this plan should be presented to the Congress for additional funding, if needed.

Similarly, the collection, analysis, and publication by USGS of water use data from the states has served as one of the few sources of information about regional or national trends in stream diversions, water supply, and use. As our focus on water management is increasingly on the river basin or watershed, often spanning multiple states, it is important to maintain this source of information for both its broad and historic view.

USGS and EPA are engaged in several water quality data collection programs, in concert with the states. The largest of these is the National Water Quality Assessment (NAWQA). To improve the coordination and efficiency of these data programs, we encourage the efforts of the Interagency Taskforce for Monitoring, which includes representatives from all levels of government, to conclude the development and implementation of a national strategy under the National Water Quality Monitoring Council.

We strongly recommend that further steps be taken to add a focus within NAQWA on critical biological indicators, in addition to the physical and chemical variables currently assessed.

While groundwater use is an area of water management that is arguably the least sustainable in many areas, given current practices, data on this resource is not systematically collected and coordinated, either by the states or USGS. Considerable useful work has been accomplished by USGS on individual aquifers, usually as conditions have become a cause for concern or economic harm. A more systematic approach by local, state, and federal agencies seems

prudent, given the increasing reliance on groundwater by agriculture in some regions and by municipal water users in many areas. USGS, in conjunction with state officials, should systematically collect data on groundwater use and publish forecasts of aquifer life, to assist decisionmakers.

Further examples of such suggestions are contained in NRC's recommendations for greater USGS focus on watershed research (NRC, 1997b).

Data Sharing.—Federal agencies should pool/share resources with state and local governments to share water data, funding, and data collection responsibilities, as well as to prioritize data collection and research. Ideally, such water data should be collected and archived on a river-basin basis, and every effort should be made to make the data easily available to all basin agencies and the public.

Public Participation.—Over the past 15 years, federal resource agencies have made great strides in seeking and incorporating public participation in resource decisions. Examples of elaborate, extensive, and lengthy consultation processes are now the norm rather than the exception for major resource decisions. The Commission recommends agencies strive to:

1. Maintain public awareness and access to information on the current operation plans for dams and other river facilities. While most facility managers hold annual briefings on river operations with water users and sometimes the general public, these important aspects of public participation are often given less emphasis than consultation on new initiatives.

2. Continue the efforts to make agency guidelines, policies, authorities, budgets, and program information available to the public. Agencies have already made substantial use of the Internet in this area.

3. Support and encourage local groups and organizations working on watershed issues. Ensure that, when these groups are a source of information or public input, the membership of the groups is taken into consideration so other perspectives can be sought as needed. When federal funds are used to support such groups, or when these groups are intended to represent the broad public, ensure that the membership is representative and fairly balanced.

4. Continue efforts to facilitate communication and negotiation among competing resource users. Increasingly, agencies are acting as conveners of interests, facilitating negotiations among interest groups that are often best able to develop creative solutions. While doing this, agencies must ensure that the process has appropriate openness and accountability to the broader public and that the national statutory responsibilities of the agencies are made clear and are protected as these negotiations proceed.

Federal Advisory Committee Act.—Federal Advisory Committees are a formal approach to citizen participation in which citizens are formally named to a committee which deliberates in open public meetings to develop recommendations to the federal government. This approach is especially useful for complex problems where participants must develop a detailed understanding of issues, where negotiations among interest groups are needed, or where the duration of activities requires sustained participation and continuity in membership. These groups provide formal advice to the federal government, meant to be given special weight in an agency's deliberations.

To ensure openness in the creation and functioning of these groups, Congress passed the Federal Advisory Committee Act (FACA) which stipulates procedures for chartering committees with a

balanced slate of members, for deliberating policy options in a public setting, and for providing public notice of meetings and careful recordkeeping. Any group of non-federal employees which is utilized by the federal government for advice must meet the requirements of FACA.

However, many federal managers perceive FACA as restricting their efforts to work informally with groups that are addressing local watershed problems, but not providing formal recommendations to the government. In some cases, FACA has been interpreted as applying to these local groups. In such cases, the membership of such groups, their meetings, agendas, and recordkeeping would be subject to FACA requirements—an imposition that is unwanted by local groups.

A recent analysis of court cases involving FACA by Rieke (1997) suggests that this interpretation is not correct, but also suggests that clarification of FACA regulations is needed. Recently, the General Services Administration, which administers FACA, has announced its intent to revise the FACA regulations.

The Commission recommends as part of their review, that the definition of groups "utilized by a Federal agency" be clarified based on recent court rulings to make clear that it is permissible for an agency, without triggering FACA requirements, to:

- (a) Participate with or on local groups in order to provide technical assistance, advice, or coordination in pursuit of activities of interest to the agency, and
- (b) Obtain input on agency activities from such local groups, as long as the group is not the sole or primary source of public input to the agency, and as long as the membership and agenda of the group are not established by the agency.

The Commission also recommends that the Administration rescind Executive Order No. 12838 which directs that no new Federal Advisory Committees be chartered except based on compelling considerations of national security, health or safety, or similar interest. Because we view Advisory Committees as useful tools for consultation, we believe that this order sets the standard for creation of an Advisory Committee too high. As Rieke states, "The FACA standard, requiring advisory committees to be in the public interest in connection with lawful duties of the agency, appropriately leaves to agency personnel the decision whether an advisory committee is needed."

Alternative Dispute Resolution.—The last two decades have seen a great increase in the use of alternative dispute resolution (ADR) methods. ADR is composed of a group of negotiation and conflict-resolving techniques for settling disputes outside of judicial proceedings, most often using a neutral facilitator or mediator to help structure and manage the process. ADR programs are widely incorporated in local and state justice systems as an alternative to trials, while the Congress and the federal government have promoted ADR within their own jurisdictions, primarily to resolve labor disputes, contract disputes, and human resources problems.

For the last 25 years, ADR has also been applied to resolve conflicts over natural resources, including water resources. Agencies such as EPA have instituted negotiated rulemaking to involve affected parties in the formulation of regulations. ADR methods have been used to resolve surface and groundwater allocation decisions; to address water quality matters including effluent standards, discharge permits, drinking water treatment, and instream habitat; and to construct projects related to port development, water storage, hydropower, and flood control (Bingham, 1997).

ADR is not a panacea, but it does provide flexibility to address and involve a wider range of people and issues than is often the case with legal proceedings. This flexibility is an asset when trying to resolve complex issues with more of a watershed or river basin focus.

The Commission offers the following recommendations to encourage the greater use of ADR in water disputes and to direct its application appropriately.

1. State legislatures should consider legislation similar to the Federal Administrative Dispute Resolution Act to provide clear authority to state agencies to use ADR and to provide proper procedures.
2. The Congress should consider changes to regulations governing the major environmental statutes to:
 - (a) Identify specific decision points at which an individual or applicable agency could initiate an ADR process to address disputes.
 - (b) Authorize agencies to allocate funds for joint fact-finding and other ways of improving resolution of technical disputes.
3. Appropriate government research institutions should consider funding more research and evaluation on the use of ADR in resource disputes and other public policy matters.
4. We recommend that the emerging river basin processes institute mechanisms by which those who are in disagreement with governmental regulatory decisions may engage in mediation or, where appropriate, stipulated binding arbitration through an independent mediator or arbitrator or a coordinated agency tribunal.

Revising the Principles and Guidelines.—The *Principles and Guidelines for Water and Related Land Resources Planning* (U.S. Water Resources Council, 1983) were developed to guide the formulation and evaluation of water projects. They set the standard for analysis of proposed projects by the Office of Management and Budget and the Congress. The Commission recommends that these standards be updated to make them a more useful guide and decision tool for today's broader range of water management activities.²⁴

²⁴ Revisions to be considered should include:

1. In cases with significantly increased local cost-sharing, allow for greater flexibility in defining local objectives. Allow for some version of the "shared vision" approach in planning and designing water projects. This would move away from strict formulation criteria toward a consensus-building and negotiation process in which agreements are reached among stakeholders on the acceptable magnitude and distribution of costs associated with achieving a given social, economic, or environmental objective.
2. For federal portions of projects, allow the nonmonetary Environmental Quality account to be treated equally with the National Economic Development account.
3. Improve the methodologies used in the benefit/cost analysis performed under the *Principles and Guidelines for Water and Related Land Resources Planning*, addressing such changes as: discontinuing the use of "avoided costs" as measure of economic benefits for municipal and industrial projects; explicitly incorporating risk and uncertainty; providing a more comprehensive treatment of methodologies for estimating non-market benefits; including a specific discussion on the proper approach to valuing environmental quality changes; providing additional guidance on the issue of benefits transfers; and addressing the extent to which water resource projects should be required to use a discount rate that differs from the discount rate used for evaluating other federal investments.