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Water Use Efficiency: The Value of Water in the West

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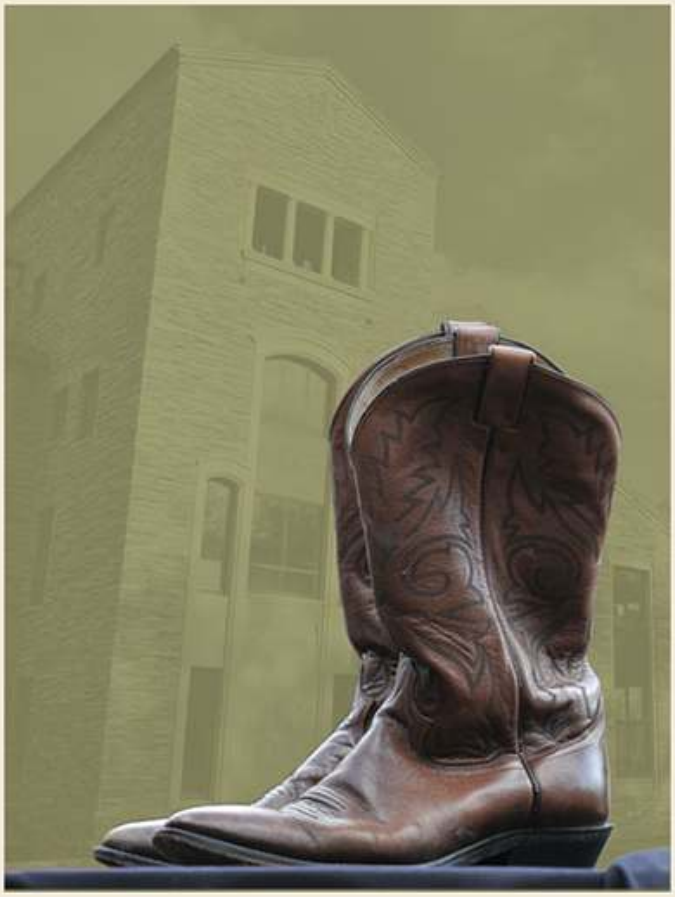

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ARTICLES

WATER USE EFFICIENCY: THE VALUE OF WATER IN THE WEST

David H. Getches*

I. INTRODUCTION

Water scarcity is part of the West's heritage. Nature gives most of the region the lowest annual rainfall in the country, making aridity the dominant western characteristic.[1] Responses to water scarcity have often been irrational: water is needed for survival but far more people have lost their lives fighting over water sought for economic gain than those that have died of thirst. Western water law has fostered selfishness instead of cooperation, allowing some users the right to waste large quantities of water, while leaving others with none.

Although state laws in the West proclaim water a public resource,[2] the public good frequently is disserved by laws and institutions allocating water rights. Today, one of the greatest challenges for western water law is to satisfy a changing array of water demands. A century of practice, bound by legal tradition, has focused on quests for new supplies, notwithstanding obvious physical limitations, rather than on making fuller use of available resources. As never before, the West is learning that efficient management and use of water resources is a less expensive, more attainable solution for meeting future water needs. It is a solution with largely positive effects, unlike the costs and damages inflicted on the public by major water

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1. The average precipitation across most of the western territory (west of the 100th meridian) ranges from 10 to 20 inches annually, compared to the national average of 30 inches. Parts of the Great Basin and Lower Colorado regions, however, receive less than 4 inches of rainfall per year. UNITED STATES WATER RESOURCES COUNCIL, THE NATION'S WATER RESOURCES, pt. 3, ch. 2, at 1-2 (1968). Much of the precipitation in this area occurs during winter in the form of snow. *Id.* at 2. The celebrated western writer Wallace Stegner has powerfully and lyrically drawn the theme of aridity from the entirety of the western experience. *E.g.*, W. STEGNER, BEYOND THE HUNDREDTH MERIDIAN (1954); W. STEGNER, THE SOUND OF MOUNTAIN WATER 15 (1980).

2. *See, e.g.*, ALASKA CONST. art. VIII, § 3; CAL. CONST. art. 10, § 5; COLO. CONST. art. XVI, § 5; IDAHO CONST. art. 15, § 1; MONT. CONST. art. IX, § 3; N.M. CONST. art. XVI, § 2; N.D. CONST. art. XI, § 3; WASH. CONST. art. XXI, § 1; WYO. CONST. art. VIII, § 1.

developments: environmental degradation, lost recreational opportunities, social and economic dislocation, and diminished wildlife habitat. The values that are lost to large-scale development are precisely the same values that the public expects to be enhanced by well-managed water resources. This is an increasingly important concern as the West becomes conscious of the value of its natural assets as cornerstones of its economy and culture. Even as cities grow, the scarcity and importance of free-flowing streams, open canyons, and vital fish and wildlife populations are more apparent. Improved water management addresses newly appreciated western water needs that are expanding in kind at least as fast as they are expanding in quantity.

A scarcity of water need not mean a shortage. Prophecy of an imminent water crisis has led to a misconception that the nation or the West has an inadequate water supply.[3] There are legitimate concerns that the destruction of some groundwater sources by overdrafts[4] or contamination may permanently eliminate sources of water supply.[5] But while growth in local demands may cause some regional shortages,[6] it is incorrect to say that water supplies are being exhausted. The amount of water moving in the earth's hydrologic cycle—in rivers, streams, lakes, the atmosphere and oceans—is constant.[7]

Although the supply of water is finite and human needs for it are growing and diversifying, most foreseeable problems of scarcity can be addressed by better water use management—management that considers and balances all of the competing demands for water. This calls for technologies that are already available for highly efficient water manage-

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3. *See, e.g.*, J. WRIGHT, THE COMING WATER FAMINE 15 (1966); W. ASHWORTH, NOR ANY DROP TO DRINK (1982); and F.I. MOSS, THE WATER CRISIS (1967). A 1975-76 study of voters and senators in Arizona, Utah, New Mexico and Colorado found that a majority of respondents perceived water shortage as a "serious" or "very serious" problem. Ingram, Laney & McGain, *Managing a Limited Resource: The Political Constraints on Water Policy in the Four Corners States*, 1979 UTAH L. REV. 719, 725.

4. An overdraft occurs when water is withdrawn at a rate greater than the rate of recharge. Major areas of groundwater overdraft have been identified in the high plains of Texas, New Mexico, Colorado, Oklahoma and Kansas, as well as in large areas of Arizona and California. Bredehoeft, *Physical Limitations of Water Resources*, in WATER SCARCITY: IMPACTS ON WESTERN AGRICULTURE 25 (E. Englebert ed. 1984). *See also* J. MATHER, WATER RESOURCES: DISTRIBUTION, USE, AND MANAGEMENT 387 (1984).

5. Water supplies in much of the country are unsafe for human consumption or use because of toxic chemicals and metals. *See generally* F. POWLEDGE, WATER: THE NATURE, USES AND FUTURE OF OUR MOST PRECIOUS AND ABUSED RESOURCE (1982). *See also* THE CONSERVATION FOUNDATION, GROUNDWATER PROTECTION 119-26 (1987).

6. *See* Scheuring, Engelbert & Hagan, *No Simple Solutions*, in WATER SCARCITY: IMPACTS ON WESTERN AGRICULTURE 12 (E. Englebert ed. 1984). *See also* J. MATHER, WATER RESOURCES: DISTRIBUTION, USE, AND MANAGEMENT 386 (1984).

7. UNITED STATES GEOLOGICAL SURVEY, NATIONAL WATER SUMMARY 8 (1983).

ment (judged by engineering standards).[8] But most of all it calls for institutional changes.[9] I believe that in the arid West there will be enough water for the indefinite future if our laws and institutions can respond to the need for more efficient water use to serve broader purposes. Because it is impossible to expand or create new water supplies, management of use is the most realistic approach. And because most of the untried schemes to move or store huge quantities of water are tremendously expensive, improving management is usually the most cost effective approach. Pursuit of development schemes can no longer forestall the need to improve management of existing resources, because those schemes conflict with other valuable uses of water, such as aesthetics, fish and wildlife, and recreation.

It has been controversial to criticize traditional quests for water supplies through construction of major reservoirs and delivery systems, but the recent demise of federal subsidies has forced a reconsideration of western water policy. The result has been a rising consciousness of the need for better water management.[10] The Western Governors' Association has

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8. *See* OFFICE OF TECHNOLOGY ASSESSMENT, WATER-RELATED TECHNOLOGIES FOR SUSTAINABLE AGRICULTURE IN UNITED STATES ARID/SEMIARID LANDS 299-330 (1983) (describing water and land management technologies, including irrigation water management, cultivation practices, and computer and information management). *See also infra* note 53 and accompanying text. "Efficiency" has a special meaning for engineers, who seek to consume as much of each unit of water that is applied to a particular use as possible, that is, to get the most "work" out of the water that is used. As used in this paper and in most policy discussions, efficient water use generally refers to getting the most *value* out of each unit of water that is used. Value includes economic productivity and a variety of benefits that are derived from water use, but that are difficult to quantify. The latter values often relate to concepts like "quality of life." Thus, engineering efficiency is relevant to the broader notion of efficiency because it can be achieved by certain uses consuming less water, thus allowing the water "saved" to be put to other important uses. But engineering efficiency is not an end in itself for western water policy because it does not account for the many and diverse values inherent in water use, let alone the cost of achieving productive use.

9. "The likelihood of the world running out of water for sustaining its life is zero; the likelihood grows of its grossly mismanaging its water resource unless the proper political and technological decisions are made." White, *Water Resource Adequacy: Illusion and Reality*, 7 NAT. RESOURCES J. 20 (1983).

10. There is a growing body of literature analyzing the need and possibilities for increased efficiency in western water use. *E.g.*, NATIONAL WATER COMM'N, WATER POLICIES FOR THE FUTURE 227-30 (1973); U.S. DEPT. OF THE INTERIOR, CRITICAL WATER PROBLEMS FACING THE ELEVEN WESTERN STATES (1975); Pring & Tomb, *License to Waste: Legal Barriers to Conservation and Efficient Use of Water in the West*, 25 ROCKY MTN. MIN. L. INST. 25-1 (1979); Shupe, *Waste in Western Water Law: A Blueprint for Change*, 62 OR. L. REV. 483 (1982); WATER AND AGRICULTURE IN THE WESTERN UNITED STATES: CONSERVATION, REALLOCATION AND MARKETS (G. Weatherford ed. 1982); Kramer & Turner, *Prevention of Waste or Unreasonable Use of Water: The California Experience*, 1 AGRIC. L.J. 519 (1980); Tarlock, *The Changing Meaning of Water Conservation in the West*, 66 NEB. L. REV. 145 (1987); Wilkinson, *Western Water Law in Transition*, 56 U. COLO. L. REV. 317 (1985); and WATER EFFICIENCY TASK FORCE, REPORT TO THE WESTERN GOVERNORS' ASS'N, WESTERN WATER: TUNING THE SYSTEM (1986) (finding that states should establish water use efficiency as a goal of water policy and encourage and implement comprehensive water transfer,

taken a major step toward recognizing that more efficient water use is the key to satisfying future water needs and responding to changing attitudes about the value of water. The Association's chairman, Colorado Governor Richard D. Lamm, appointed a special, blue ribbon Water Efficiency Task Force that studied the issue for a year, culminating in a major report.[11] The report found that water use efficiency in the West could be greatly increased through conservation measures, other management techniques and market mechanisms, and that it should become a major focus of western water management. The governors adopted the report and passed a resolution that, among other things, set up a working group to report on how to facilitate voluntary water transfers and recommend changes in water law and practices. The group's report made many far-reaching, specific recommendations that would require new laws and policies at the federal, state and local levels.[12]

II. WESTERN WATER LAW IN PERSPECTIVE

The history of western water law and policy is a history of adaptation to societal needs. The system has roots in the necessities of the 19th century West. Miners and farmers who came to settle the West often were trespassers on federally-owned lands—the public domain.[13] If they were to put waters to use on their homesteads and mining claims, and later on their private lands, it usually was necessary for them to divert the water out of streams and transport it across divides and along rocky hillsides to where it could be used. Reliance on the eastern states' riparian doctrine, which gave rights only to property owners who bordered the stream, would have relegated most enterprises to failure. Without resort to water-dependent placer and sluice methods, miners in many places—including the bonanza country around Sutter's Mill in California—would have been severely hampered. Farmers without the benefit of a stream diversion in much of the West would suffer meager, uncertain yields that reflected the vicissitudes of the West's stingy precipitation.

The early settlers conveniently rejected any riparian notions they might have brought from the East, and adopted a system of prior appropriation. The federal government had lured settlers West with promises of homesteads and of the right to extract minerals to those with

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conservation and salvage programs).

11. B. DRIVER, WESTERN WATER: TUNING THE SYSTEM (1986) (Report to the Western Governors' Association of the Water Efficiency Task Force).

12. WESTERN GOVERNORS' ASS'N WATER EFFICIENCY WORKING GROUP, WATER EFFICIENCY: OPPORTUNITIES FOR ACTION, REPORT TO THE WESTERN GOVERNORS (1987).

13. *See* R. DUNBAR, FORGING NEW RIGHTS IN WESTERN WATERS 61 (1983).

enough grit and luck to find them.[14] The settlers assumed the government must have intended to suffer the use of enough water from the public domain to give meaning and value to homestead grants and mining claims. The trespassing miners and farmers settled disputes over water, often amidst beer and blood in the saloons around Northern California mining camps, by allocating it the same way they did minerals on the public domain: first in time, first in right. Those who made the earliest beneficial uses of water were rewarded with the best water rights.[15] The prior appropriation law was embraced by the courts[16] and then given recognition in federal statutory laws.[17]

The prior appropriation doctrine subsequently evolved in a variety of ways. In its earliest applications, the doctrine only required that one post a notice and begin diverting water. Today, virtually every state has a sophisticated permit system[18] requiring that unappropriated water be available and that a number of other conditions be met and procedures followed before a valid water right will be recognized.[19] These changes give the prior appropriation system more reliability and order.

Prior appropriation law originally gave a priority to rights as of the date water was first diverted, so that established rights were superior to all

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14. The Homestead Act of 1862, 43 U.S.C. §§ 161-284 (repealed 1976), provided free land to those who met the requirements of settlement and cultivation. The General Mining Law of 1872, 30 U.S.C. § 22, opened the public domain to entry for exploration and mining. G. COGGINS & C. WILKINSON, FEDERAL PUBLIC LAND AND RESOURCES LAW 91, 420 (2d ed. 1987).

15. *Id.* at 359-60. *See generally* R. DUNBAR, *supra* note 13, at 61.

16. An early California case, Irwin v. Phillips, 5 Cal. 140 (1855), specifically recognized the rule of prior appropriation which had evolved in the mining camps as applying on California public lands. *See also* Coffin v. Left Hand Ditch Co., 6 Colo. 443 (1882) (adopting the prior appropriation doctrine in Colorado as between two agricultural users, without limitation to public lands).

17. The 1866 Mining Act, 30 U.S.C. § 551 and 43 U.S.C. § 661, "gave formal sanction of the government to appropriations of water on public lands of the United States." 1 W. HUTCHINS, WATER RIGHTS LAWS IN THE NINETEEN WESTERN STATES 172 (1971). An 1870 amendment to the Act made it clear that all patents and homestead rights were granted subject to vested water rights and rights-of-way for ditches. *Id.* at 173. The Desert Land Act of 1877, 43 U.S.C. §§ 321-329, severed the right to water from the public lands so that no riparian rights passed with a federal grant of land title. *Id.* at 174.

18. All western states except Colorado have adopted administrative procedures to acquire permits to appropriate water. WATERS AND WATER RIGHTS § 414 (R. Clark ed. 1972 & Supp. 1978). Colorado has a system of water courts whose functions are similar in many respects to those of administrative agencies. *Id.*

19. *See, e.g.*, ARIZ. REV. STAT. ANN. § 45-142 (Cum. Supp. 1986); CAL. WATER CODE § 1260 (West 1971); IDAHO CODE § 42-202 (1977); MONT. CODE ANN. § 85-2-311 (1987); NEV. REV. STAT. §§ 533.325 and 533.335 (1986); N.M. STAT. ANN. § 72-5-1 (1985); OR. REV. STAT. §§ 537.130 and 537.140 (1985); UTAH CODE ANN. § 73-3-2 (1980); WASH. REV. CODE ANN. § 90.03.260 (Cum. Supp. 1987); WYO. STAT. § 41-4-501 (1977). Many states impose a general requirement that a given diversion not be detrimental to the public interest. *See, e.g.*, ARIZ. REV. STAT. ANN. § 45-143 (Cum. Supp. 1986); CAL. WATER CODE § 1255 (West 1971); IDAHO CODE § 42-203A (Cum. Supp. 1987); NEV. REV. STAT. § 533.370; N.M. STAT. ANN. § 72-5-6 (1985); WASH. REV. CODE ANN. § 90.03.290 (Cum. Supp. 1987); WYO. STAT. § 41-4-503 (1977).

subsequent diversions.[20] Most states now recognize "conditional rights," allowing one to declare an intended use of water and obtain a right that can then be the basis of secure investments in water developments before any actual diversion of water takes place.[21] Permits are then granted subject to the condition that facilities be built and water diverted in the manner proposed. If this is done in a reasonable time, the right will have a priority date as of the date of the application, not the diversion. Conditional rights enable growing cities to plan for their future needs and allow water-dependent industries to obtain rights before they locate in a new place.

Western states have begun to recognize instream flows as beneficial uses deserving legal protection under the prior appropriation doctrine.[22] Legal protection of instream uses was impossible without statutory renovation of the doctrine, because of its fundamental requirement that water be diverted out of the stream.[23] Modifications of legal doctrine were driven by a strong popular sentiment and perceptions of the social and economic benefits from maintenance of basic streamflows for fish, wildlife and recreation.

While aspects of western water law and policy have changed significantly to conform to changing values in western society, there are indications that the law is not keeping pace with the West's social evolution. Water policy is still biased toward impractical structural solutions to water problems. Efficient use and conservation are discouraged by the priority system. The low cost of water, attributable in part to massive

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20. *See Coffin*, 6 Colo. at 447.

21. In permit system states, an inchoate water right arises upon application for a permit. Thus, one who has applied for an appropriation but has not yet put the water to beneficial use is protected against junior appropriators. HUTCHINS, *supra* note 17, at 584. That right cannot be defeated so long as the holder proceeds toward appropriation with due diligence. *E.g.*, ARIZ. REV. STAT. ANN. § 45-150 (Cum. Supp. 1986); N.M. STAT. ANN. § 72-5-8 (1985); OR. REV. STAT. § 537.230 (1985); WASH. REV. CODE ANN. § 90.03.320 (Cum. Supp. 1987). Colorado protects those in the process of appropriating water by decreeing conditional water rights. COLO. REV. STAT. § 37-92-103(6) (1973); Mooney v. Kuiper, 194 Colo. 477, 573 P.2d 538 (1978). Every four years, the holder of a conditional right must make a showing of reasonable diligence in development of that right or the right is considered abandoned. COLO. REV. STAT. § 37-92-301(4) (1973). Colorado River Water Conservation Dist. v. City and County of Denver, 640 P.2d 1139 (Colo. 1982).

22. *E.g.*, ALASKA STAT. § 46.15.145 (Supp. 1986); COLO. REV. STAT. § 37-92-102 (1973); IDAHO CODE §§ 67-4301 to -4312 (1980) (authorizing administrative filings on specific streams); IDAHO CODE § 42-1501 (Supp. 1987) (all streams); KAN. STAT. ANN. § 82a-703a-c (1984); NEB. REV. STAT. § 46-2107 to -2119 (Supp. 1985); OR. REV. STAT. § 536.325 (1985); UTAH CODE ANN. § 73-3-8 (Supp. 1987); WASH. REV. CODE ANN. §§ 90.22.010 and -.040 (Cum. Supp. 1987); WYO. STAT. §§ 41-3-1001 to -1004 (Cum. Supp. 1987).

23. *E.g.*, Colorado River Water Conservation Dist. v. Rocky Mountain Power Co., 158 Colo. 331, 406 P.2d 798 (1965) (instream flow rights unconstitutional prior to passage of instream flow law declaring such uses to be beneficial and not subject to diversion requirement). For a discussion of instream flow rights as they relate to the actual diversion and beneficial use requirements of an "appropriation," see Tarlock, *Recent Improvements in the Recognition of Instream Uses in Western Water Law*, 1975 UTAH L. REV. 871.

federal subsidies, encourages highly consumptive uses like low value agriculture and exotic suburban landscaping, apparently limiting the quantities of water available for new uses. Inefficient uses inflate future demand estimates because policy makers often assume that past patterns of demand will be perpetuated. Inhibitions on water transfers, whether explicit in law or implicit in cumbersome and expensive procedures, tend to lock water in existing uses. As the western society and economy evolve, policies and laws must be reshaped and redirected to enable the West to meet its future needs.

III. CHANGING DEMANDS FOR WESTERN WATER

New trends in water use dictate changes in how the West must deal with water. Much of the West is becoming urbanized.[24] The economic base generally is shifting from dispersed agricultural uses to pockets of urban development.[25] Growing urban centers such as the Denver metropolitan area, Salt Lake City, Boise and Billings increasingly dominate the western landscape.

A few years ago, analysts predicted that energy minerals would be the centerpiece of western economic activity.[26] Although mineral development has slowed considerably, it probably will continue to exert a moderate, rather constant demand on water resources.[27] The West also will experience occasional bursts of production to supply the nation with resources according to demands set by distant markets over which it has little control.

In many western states recreation and tourism comprise the only

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24. Between 1970 and 1980, all western states experienced growing urban populations, ranging from a 6% increase in Kansas to a 78% growth in Nevada. BUREAU OF THE CENSUS, UNITED STATES DEPT. OF COMMERCE, 1980 CENSUS OF POPULATION, GENERAL POPULATION CHARACTERISTICS (1982).

25. The vast majority of westerners live in cities. In all but Idaho, Montana, New Mexico and Wyoming, more than half the population lives in metropolitan areas. U.S. BUREAU OF THE CENSUS, STATISTICAL ABSTRACT OF THE UNITED STATES, at Table 33 (1987). In Arizona, California, Colorado, Nevada, Utah and Washington, over 75% of the population lives in such areas. *Id.* Metropolitan areas in the eight mountain states from 1970 to 1980 expanded from 62.2% to 65% of the total population, and non-metropolitan areas experienced a corresponding decline. *Id.*

26. In 1978 mineral production nationwide was predicted to increase water withdrawals by 61% by the year 2000. U.S. WATER RESOURCE COUNCIL, THE NATION'S WATER RESOURCES 1975-2000, Vol. 2, pt. III, at 95 (1978). The report projected no water supply problems for the mineral industry as a whole, but stated some localized shortages could occur in the Missouri River Basin and the Colorado River Basin. *Id.* at 100. In Colorado, water withdrawals for energy development in 1981 were 246,341 acre feet/year. At that point, it appeared they would increase by 25% to 350% by the year 2000 depending on the growth of energy industries. COLORADO ENERGY RESEARCH INSTITUTE, WATER AND ENERGY IN COLORADO'S FUTURE, Tables 26, 36 and 42 (1981). Since then, energy development has actually declined rather than increasing as predicted, casting doubt on the higher predictions.

27. *See, e.g.*, Himelspach & Spitzer, *Alternatives to Dealing with Distressed and Orphaned Mineral Properties*, 32 ROCKY MTN. MIN. L. INST. 7-1, 7-3 (1986).

growth industry, accounting for billions of dollars in new business.[28] The lure of wilderness and an unspoiled natural environment attracts a large number of tourists to the West's mountains every year. As manufacturing, high tech, mining and agriculture have recently declined and faced stagnation, the western economy increasingly looks to tourism and recreation for stability.

Agricultural demands for western water will be level or will decline. Although national and international demand for agricultural products may increase, the latent capacity of the highly productive areas of the Midwest, Southeast and West Coast can supply most of the reasonably anticipated growth in demand.[29] Although regional markets for local crops may grow somewhat, the agricultural production of the Mountain West is not and will not in the future be necessary to meet demands of export markets.[30] Agriculture, as the holder of rights to most of the West's water, thus becomes the most likely source to supply water for other, largely municipal and industrial, uses.[31]

The assertion of Indian reserved water rights is another important factor that must be considered in any speculation about the West's future. As Indian rights—declared by the United States Supreme Court to be prior and paramount to all non-Indian uses commenced after Indian reservations were established—are acknowledged in specific cases, new Indian uses may develop that conflict with existing non-Indian uses.[32] To

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28. Tourist expenditures in eight of the eleven western states grew by 87% from 1976 to 1981. C. GOELDNER & K. DUEA, TRAVEL TRENDS IN THE UNITED STATES AND CANADA, at Table 12 (1984). In 1981, travel generated employment represented 8.9% of the nonagricultural employment in the eleven western states. *Id.* at Table 24.

29. If the idle cropland in the Midwest, Southeast and West Coast were used to produce wheat it would more than equal the wheat produced in the mountain states. U.S. DEPT. OF AGRICULTURE, AGRICULTURAL STATISTICS 1985, at Tables 7 and 538. If the same land were used to produce hay, it would triple the amount produced in the mountain states. *Id.* at Tables 361 and 538. In corn, that land could yield nine times the amount produced in the mountain states. *Id.* at Tables 41 and 538.

30. The values of the various crops produced in the mountain states during fiscal year 1985 ranged from 0.16% to 1.6% of the total values of those crops produced in the United States. U.S. BUREAU OF THE CENSUS, *supra* note 25, at Table 1145.

31. *See infra* text accompanying notes 52 and 53. In Colorado, the Northern Colorado Water Conservancy District (NCWCD) facilitates transfers between agricultural and nonagricultural users in the district. *See* Howe, Schurmeier & Shaw, *Innovations in Water Management: Lessons from the Colorado-Big Thompson Project and the Northern Colorado Water Conservancy District*, in SCARCE WATER AND INSTITUTIONAL CHANGE 187 (K. Frederick ed. 1986) and discussion in *infra* note 71. When NCWCD waters were first available, 85% of the allotments belonged to irrigators; in 1982 that number had dropped to 64%. *Id.*

32. In Winters v. United States, 207 U.S. 564 (1908), the Court held that when lands were ceded from Indian tribes to the United States government, the Indians reserved water sufficient to fulfill the purpose of reserving the remaining lands for their use; this purpose was to civilize the Indian tribes and teach them to farm. In Arizona v. California, 373 U.S. 546 (1963), the Court held that Indian tribes living on reservations along the Colorado River were entitled to enough water to irrigate all the practicably irrigable acreage within the reservation. The priority date is no later than the date of the

avoid tremendous dislocations, non-Indian communities must be prepared to purchase water from the tribes, and the law must accommodate the necessary transactions.

When demand for water has grown in the past, the West has searched for new sources to be transported and stored. Engineering wonders abound in the West, and the notable public works accomplishments of the past, like Hoover Dam and its Bureau of Reclamation progeny, are sources of national pride. They have produced some economic bounties, but they have also created attitudes and institutions that assume it is government's job to prevent water scarcity at any cost.[33]

For a time, major water projects enabled the West to deny its arid character. Impractical, unwise uses of water were sanctioned, like irrigation of high altitude hay meadows and flooding lawns on the dry plains with unmetered water. More recently, however, federal deficit economics and environmental concerns have spurred a reexamination of policy, and federal water project funding has nearly ground to a halt.[34] It is now clear that attempts to continue insulating the West from the limits of water will be expensive in the short run and impossible in the long run. Investments in huge Bureau of Reclamation style water projects simply are not cost effective. Because of the withdrawal of federal funding, the burden of financing new projects will fall on state and local entities, public and private. As the recent attention of the Western Governors Association demonstrates, this sobering reality has led to a new cost consciousness. Western states that once could "afford" a project costing a billion federal dollars now find they cannot afford a project that costs a billion state dollars.

Opportunities for water development are reaching their physical as well as their economic limits. Evaporation loss from reservoir storage is so great that experts estimate more storage on the Missouri or Colorado

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reservation.

The quantity of water reserved and subject to the water right has been estimated at 2 million acre-feet per year for the Navajo Indian reservation alone. Back & Taylor, *Navajo Water Rights: Pulling the Plug on the Colorado River?*, 20 NAT. RESOURCES J. 71, 74 (1980). A report for the Western Governors' Association prepared by the Western States Water Council estimated that Indian water rights throughout the West may amount to almost 46 million acre-feet per year. WESTERN STATES WATER COUNCIL INDIAN WATER RIGHTS IN THE WEST 94 (1984). Indian water rights are certain to pre-date most water rights established by state law, potentially upsetting established uses within the priority system of western states and possibly curtailing some uses.

33. *See, e.g.*, M. REISNER, CADILLAC DESERT (1986) (tracing the history of Western water development and the Bureau of Reclamation's role in it).

34. There has been no federal water development funding for new project starts since 1976. In 1982, federal support for river basin commissions and the Water Resources Council was eliminated. R. SMITH, TROUBLED WATERS 20 (1984).

Rivers actually will reduce water available for use.[35] The best sites for major reservoirs either are already developed or their use would be highly controversial (because homes and businesses have been built there, or because the area has special environmental value).

Westerners are increasingly conscious of the fact that they could run out of pristine trout streams and undammed canyons, a matter of economic importance as well as cultural and spiritual value in today's western society. The environmental consciousness aroused in the sixties has grown steadily, and an overwhelming majority in Congress now insists on strengthening, and strict enforcement of, environmental protection statutes. Indeed, a recent Harris Poll indicated that Americans will choose environmental cleanup over economic growth and prosperity by a margin of 63-33%.[36] Considerations of water quality, riparian habitat, protection of fisheries and salinity control all militate against further major water development in an era of heightened environmental concern.[37]

Investments in water development are still necessary. Small to moderate-sized water projects, for example, can make regional or local water use more efficient by allowing better regulation and management of existing resources. In addition, many existing projects need major rehabili-

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35. Studies have shown that reservoir capacity on the Colorado River reached a theoretical optimum at 50 million acre-feet. Reservoir capacity above that level does not increase supply due to the amount of evaporation. *See* LANGBEIN, WATER YIELD AND RESERVOIR STORAGE IN THE UNITED STATES, UNITED STATES GEOLOGICAL SURVEY, CIRCULAR 409 (1959); THE COLORADO RIVER, UNITED STATES GEOLOGICAL SURVEY, CIRCULAR 409 (1959). The Colorado River currently has 60 million acre-feet of reservoir storage. THE NATION'S WATER RESOURCES 1975-2000, *supra* note 26, at 11.

36. Remarks of pollster Louis Harris of Louis Harris & Associates, Inc., to the Wildlife Management Institute (March 18, 1985). The poll also found that an 8-1 majority favors strict enforcement of the Clean Air and Clean Water Acts. *Id.*

37. Large reservoirs trap at least half the sediment that flows into them. Meade & Parker, *Sediment in Rivers of the United States*, in U.S. GEOLOGICAL SURVEY, NATIONAL WATER SUMMARY 1984, at 51. Many toxic pollutants in streams are tightly bound to the sediment. *Id.* at 55. Toxic pollutants are therefore being stored in reservoirs across the country with unknown, but likely, health effects. Channel width downstream from dams is typically much narrower than the pre-dam channel. Williams & Wolman, *Effects of Dams and Reservoirs on Surface-Water Hydrology—Changes in Rivers Downstream from Dams*, in U.S. GEOLOGICAL SURVEY, NATIONAL WATER SUMMARY 1985, at 85. When such narrowing occurs, vegetation grows in the old streambed, significantly altering the habitat along the river's banks. This alteration can disfavor wildlife species adapted to the previous environment and allow new species to move into the area. *Id.* at 88. In addition, waters released from a dam are often warmer than pre-dam flows. The temperature change could have adverse effects on species of fish which lived in the pre-dam environment. *Id.* Water development projects such as reservoirs, irrigation systems, and transbasin diversions account for more than half of the Colorado River's salinity. T. MILLER, G. WEATHERFORD & J. THORSON, THE SALTY COLORADO 5-7 (1986). Evaporation from reservoirs and irrigation ditches concentrates the salt load in the remaining water, and transbasin diversion has the same effect. Irrigation leaches salts from the soil, adding to the river's salt load. *Id.*

tation and repairs so that they can safely store their full capacity of water.[38] Some of the least expensive additional water storage therefore may be secured by an investment in dam repairs, with a collateral benefit of enhanced dam safety.

Even as water development opportunities appear more limited, the West has become painfully aware of the perils of overdrafting groundwater supplies.[39] The Ogallala Aquifer is being drawn down at an alarming rate,[40] focusing state and federal attention on means of controlling the depletion. Overpumping in parts of the West has caused land to sink and property to be destroyed.[41] Groundwater overdrafts in Arizona led to the nation's most stringent groundwater law.[42] And the nation has become galvanized by the poisoning of groundwater by above and below ground waste disposal, particularly of toxic substances.[43]

IV. OPPORTUNITIES FOR BETTER WATER USE

The nation was able to cope with the "energy crisis" of the late 1970s and reduce its dependence on oil imports largely by making more careful use of existing resources. Energy price increases, bolstered by the spirit of a national cause, moved Americans to conserve. They used automobiles less, bought more efficient cars, and installed insulation and caulking to reduce the need for heating fuel.[44] In 1983, gasoline consumption dropped 20%

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38. Economic and technological considerations in evaluating dam safety are summarized in NATIONAL RESEARCH COUNCIL, SAFETY OF EXISTING DAMS (National Academy Press 1983).

39. The High Plains, overlying the Ogallala Aquifer, accounts for 20% of the irrigated acreage in the U.S. and 40% of U.S. beef production. HIGH PLAINS ASSOCIATES, SIX-STATE HIGH PLAINS OGALLALA AQUIFER REGIONAL RESOURCES STUDY, SUMMARY REPORT 1 (1982). Without groundwater, the continued economic vitality of this region is doubtful. *Id.*

40. In Ford County, Kansas, groundwater withdrawals were three times the natural recharge in 1980, resulting in a net loss of 96,000 acre-feet from the Ogallala that year. J. SPINAZOLA & M. DEALY, HYDROLOGY OF THE OGALLALA AQUIFER IN FORD COUNTY, SOUTHWESTERN KANSAS 33 (1983).

41. B. BOLT, W. HORN, G. MACDONALD & R. SCOTT, GEOLOGICAL HAZARDS 214 (1975). As the land sinks or cracks, damage may result to bridges, roads, and buildings. C. MCCAULEY, MANAGEMENT OF SUBSIDING LANDS: AN ECONOMIC EVALUATION 13-16 (1973).

42. The 1980 Groundwater Management Code created Active Management Areas (AMAs) in which water conservation is required. Strict rules govern the use and change of use of water within AMAs. Limits are also placed on new development uses; expansion of agricultural pumping is disfavored. *See* ARIZ. REV. STAT. ANN. §§ 45-401 to -637 (Cum. Supp. 1986). For a thorough discussion of the Code's history and structure, see Higdon & Thompson, *1980 Arizona Groundwater Management Code*, 1980 ARIZ. ST. L.J. 621.

43. Toxic and hazardous wastes injected into deep wells have filtered into nearby aquifers, while there is evidence of seepage from landfills containing toxic substances. In addition, septic tanks and cesspools are sources of fecal coliform bacteria. Since 50% of the nation's population gets its drinking water from groundwater, this presents potentially serious health threats to the country. THE NATION'S WATER RESOURCES 1975-2000, *supra* note 26, pt. II, at 29-30.

44. Small car sales in the United States captured 59% of the market in 1983 compared to only 42% in 1973. American homes used 20% less energy in 1983 than in 1973. U.S. NEWS AND WORLD REP., Oct. 24, 1983, at 27-29.

from its 1978 high.[45] While experiencing population growth, the nation actually cut fuel consumption to an eleven year low.[46]

The potential for stretching water resources is even greater than it was for oil. Unlike oil, water can be repeatedly reused. Before evaporating or flowing out to sea, the same molecules of water can serve as snow on a ski slope, generate power, float a party of rafters, irrigate crops, spawn fish, quench thirst, flush a toilet, and water golf courses, perhaps doing some jobs several times. The diversity of "work" that water can do without being used up lets us redouble its efficiency as many times as our needs require.

The application of water conservation technology can reduce water demand dramatically. For example, plumbing devices can cut domestic, inhouse consumption by two-thirds,[47] and modern sewage treatment techniques allow for healthy and increasingly economical reuse of municipal effluent.[48] Most municipal water, however, is used for irrigation of lawns and other plantings; more than half of all the water diverted, pumped and treated by western cities is for use outside houses.[49] Additionally, far higher percentage of water used outdoors is actually consumed, compared with indoor water use, because treated sewage from indoor uses is usually returned to a waterway where it is available for reuse by others.[50] Denver's pioneering xeriscape education program provides information about attractive, low water demand landscaping to those who want to make significant reductions in outdoor water use.[51] Voluntary efforts are limited, however, because the low price of water makes it uneconomical for homeowners to invest in relandscaping or for housing developers to substitute less familiar indigenous plantings for familiar green lawns.

The greatest opportunities for conservation are in agricultural irriga-

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45. U.S. NEWS AND WORLD REP., Feb. 21, 1983, at 65.

46. TIME, Oct. 3, 1983, at 16. Energy use per person in 1983 was reported to be down 14% from 1973.

47. Showers and toilets account for 65% of domestic inhouse water consumption. J. FLACK, URBAN WATER CONSERVATION 7 (1982). A wide variety of fixtures have been designed to use less water than conventional shower and toilet models. *See generally* M. MILNE, RESIDENTIAL WATER CONSERVATION (1976) (describing many redesigned appliances and water saving devices).

48. *See Water Reuse and Public Health*, 10 J. FRESHWATER 10 (1986); Mills & Asano, *The Economic Benefits of Using Reclaimed Water*, 10 J. FRESHWATER 14 (1986).

49. Lawn watering accounts for 94% of total water consumption in western cities. COLORADO DEPARTMENT OF NATURAL RESOURCES, COLORADO WATER STUDY, PRELIMINARY REVIEW DRAFT, Table 1 (1981).

50. More than 40% of the United States population uses reclaimed industrial or domestic water, and 60% uses water that has been used at least once upstream. Gloyna, *Major Research Problems in Water Quality*, in WATER RESEARCH 479 (A. Kneese & S. Smith eds. 1966).

51. The program, which can result in 30% to 80% savings in landscape water use, emphasizes trees, shrubs, groundcovers and flowers that require little or no water beyond natural precipitation. The program also recommends soil improvement for increased water-holding capacity, mulching to minimize evaporation, and planting turf in limited areas. DENVER WATER DEPARTMENT, HOW TO XERISCAPE (1986) (brochure available from Denver Water Department).

tion, which accounts for 90% of the West's water consumption.[52] Agricultural consumption can be reduced through installation of gated pipes, drip irrigation systems, and use of scientific scheduling and sophisticated moisture sensing devices. Laser leveling of fields can reduce runoff. Drought resistent and salt tolerant plants can minimize the need for fresh water supplies.[53] Unfortunately many of these methods are beyond the economic reach of today's farmers.[54]

V. METHODS OF ACHIEVING WATER EFFICIENCY

A. *Salvage and Reuse*

Salvage of water that is now used inefficiently can be an important source of water to meet growing needs. Agricultural water conservation can be financed by allowing the person or entity saving the water to put it to other economic uses. An industry or municipality needing water can pay farmers for, or directly purchase, devices to reduce water consumption. The farmer then can transfer an amount of water equal to the reduction in consumptive use of water to the industry or municipality.

The largest, most celebrated proposal for a transfer of salvaged water involves the Imperial Irrigation District (IID) and Metropolitan Water District of Southern California (MWD).[55] To irrigate the Imperial Valley, IID diverts some 2.9 million acre-feet annually from the Colorado River, making it the largest single user of Colorado River water. Irrigation of the vast, fertile desert valley produces a wealth of agricultural goods.[56] But in 1984, the State Water Resources Control Board ruled that IID's water use was "unreasonable" because excessive water was being applied and allowed to go to waste, draining in to a huge and growing sink, thus enlarging the Salton Sea.[57] Metropolitan Water District began negotiating

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52. Bredehoeft, *supra* note 4, at 29.

53. INTERAGENCY TASK FORCE, DEPT. OF INTERIOR, DEPT. OF AGRICULTURE, ENVIRONMENTAL PROTECTION AGENCY, IRRIGATION WATER USE AND MANAGEMENT 20, 76-77, 79, 120 (1979).

54. The cost of fully implementing on-farm watersaving methods could be as much as $8.4 billion for the western states. *Id.* at 87.

55. *See* Wahl & Osterhoudt, *Voluntary Transfers of Water in the West,* in UNITED STATES GEOLOGICAL SURVEY, NATIONAL WATER SUMMARY 1985, at 116; Underwood, *A Case Study: Imperial Valley, California,* in WESTERN WATER: EXPANDING USES/FINITE SUPPLIES (Seventh Annual Summer Program, Natural Resources Law Center, Univ. of Colo. School of Law, June 2-4, 1986, Boulder, Colo., Loose Leaf, 1986).

56. The Imperial Valley is one of the most productive agricultural areas in the United States. T. HENDERSON, IMPERIAL VALLEY 131 (1968). *See also* D. LANTIS, CALIFORNIA: LAND OF CONTRAST 62-66 (1977).

57. California State Water Resources Control Board Decision No. 1600 (June 21, 1984). Of the 2.9 million acre feet diverted by IID, nearly a third enters the Salton Sea as return flow from irrigation. Seventy-one percent of all inflow to the Salton Sea is IID return flow. *Id.* at 7. The issue of IID's use was originally raised in 1980 by John Elmore, whose farmland adjacent to the Salton Sea was flooded with salt water. Elmore sought judicial as well as administrative remedies. Elmore v. Imperial Irrigation

with IID to finance conservation measures for IID in return for the right to use water that would be saved, a concept that had been suggested earlier by the Environmental Defense Fund.[58] The proposal could result in IID's saving 400,000 acre-feet of water a year, much of which could then be made available to MWD in return for its multi-million dollar investment.[59]

A similar approach was followed on a more modest scale in Casper, Wyoming. The city agreed to pay for rehabilitation and canal lining for the Casper-Alcova Irrigation District. The reduction in canal seepage will result in reduced diversion of water for agricultural use, without curtailing crop irrigation. In this way, Casper effectively has found an additional water supply of 7,000 acre-feet a year.[60]

The opportunities for salvaging water that is now going to waste through evaporation, evapotranspiration, and irretrievable loss as groundwater are tremendous.[61] Unfortunately, the laws of some western states

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Dist., 159 Cal. App. 3d 185, 205 Cal. Rptr. 433 (1984). After the Board's decision, IID challenged its jurisdiction to issue an essentially adjudicative order. Imperial Irrigation Dist. v. State Water Resources Control Board, No. 58706 (Superior Court, Imperial County, Calif., filed Oct. 22, 1984). In an unpublished opinion the California Court of Appeals overruled a decision on the Board's jurisdiction favoring IID. The Court of Appeals remanded the case for the Superior Court to review the Board's decision, however, noting that the judge could exercise independent judgment on the Board's record. The case is due to be heard before the Superior Court in early 1988. Telephone conversation with John Penn Carter, Attorney for IID (October 30, 1987).

58. ENVIRONMENTAL DEFENSE FUND, TRADING CONSERVATION INVESTMENTS FOR WATER (1983).

59. The California Department of Water Resources estimated that IID could conserve as much as 437,000 acre-feet by a variety of methods, including canal lining, system automation, and tailwater recovery systems. Of this amount, MWD could receive 100,000 to 250,000 acre-feet per year. Underwood, *supra* note 55, at 16-17. Annual costs of the various water saving methods could range from $8 to $115 per acre-foot. Wahl & Osterhoudt, *supra* note 55, at 116.

MWD is considering several alternatives for meeting its projected needs. These include construction of a concrete lining for the All-American Canal in exchange for water when needed by MWD; a transfer of state project water from San Joaquin Valley agricultural agencies to MWD; and a plan for MWD to store water in the Kern County Water Agency's underground basins during wet years in exchange for agency water during dry years. These and other alternatives are outlined in an MWD publication, FOCUS, No. 2, 1986. *See also* Wahl & Davis, *Satisfying Southern California's Thirst for Water: Efficient Alternatives*, in SCARCE WATER AND INSTITUTIONAL CHANGE 114-18 (K. Frederick ed. 1986).

60. Wahl & Osterhoudt, *supra* note 55, at 116. *See also* Engels, *Augmenting Municipal Water Supplies Through Agricultural Water Conservation*, in WESTERN WATER: EXPANDING USES/FINITE SUPPLIES, *supra* note 55.

61. *See* Shupe, *Wasted Water: The Problems and Promise of Improving Efficiency Under Colorado Water Law*, in TRADITION, INNOVATION AND CONFLICT (L. MacDonnell ed. 1986); WESTERN GOVERNORS' ASS'N WATER EFFICIENCY WORKING GROUP, *supra* note 12, at 62-69. The discussion of water salvage relates only to reductions in consumptive use, not in return flows. Water that historically returns to the stream and is used to supply other water rights holders is not available for salvage and reuse under western water law. Downstream users, junior or senior, are entitled to a continuation of streamflow conditions that existed when their use commenced, even if those conditions were created by return flows from upstream uses. *See* Farmers Highline Canal & Reservoir Co. v. City of Golden, 129 Colo. 575, 272 P.2d 629 (1954).

provide that salvaged water belongs to the stream and cannot be sold or used on other land by the original appropriator.[62] This removes the economic incentive for conservation measures. California made a major improvement in its law in 1983 by allowing the salvager to sell and reuse salvaged water.[63] The law recognizes conservation as a beneficial use and declares that rights to conserved water are not abandoned when they are unused.

B. *Conjunctive Use*

An important method of increasing efficient water use is to manage groundwater and surface water conjunctively.[64] At one level this means considering water pumped from the ground that is a directly connected with surface water to be part of the same management regime as surface water. At another level, it means considering groundwater supplies that are not interconnected—such as the "fossil water" deposited in "non-tributary" aquifers millions of years ago—to be a backup for regular surface supplies. Using those nonrenewable resources only as a reserve to cushion the effects of drought and peak demand periods will prolong their life, and can reduce the need for surface storage facilities.

C. *Physical Solutions*

More sophisticated and flexible management allows expanded uses of water supplies. Junior water rights holders can use innovative mechanisms such as augmentation plans and other means of providing service with substitute supplies, thereby gaining greater flexibility and benefits from using water ordinarily monopolized by seniors.[65] Seniors' needs are met with other sources, so they still get the water they need, though not necessarily as it was historically supplied. This means that seniors no longer have an absolute prerogative to demand uninterrupted flows from

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62. *E.g.*, Fuss v. Franks, 610 P.2d 17 (Wyo. 1980); Salt River Valley Water Users' Ass'n v. Kovacovich, 3 Ariz. App. 28, 411 P.2d 201 (1966).

63. CAL. WATER CODE § 1011(b) (West 1987). Oregon passed a similar law in 1987. S.B. 24, to be codified at Chapter 264, OR. REV. STAT.

64. Conjunctive use has been defined as "several different practices and processes employed to coordinate the use of ground and surface waters in order to get the maximum economic benefits from both resources." Trelease, *Conjunctive Use of Groundwater and Surface Water*, 27 ROCKY MTN. MIN. L. INST. 1853 (1982).

65. Such devices are allowed under Colorado water law. An augmentation plan is "a detailed program to increase the supply of water available in a division or portion thereof by the development of new or alternate means or points of diversion, by a pooling of water resources, by water exchange projects, by providing substituted supplies of water . . . ." COLO. REV. STAT. § 37-92-103(9) (Supp. 1986). *See* Cache La Poudre Water Users Ass'n v. Glacier View Meadows, 191 Colo. 53, 550 P.2d 288 (1976). For a discussion of such provisions in Colorado and other western states, see Dunning, *The "Physical Solution" in Western Water Law*, 57 U. COLO. L. REV. 445 (1986).

their original sources. A typical situation in which these "physical solutions" to water problems might be applied is when a housing developer wants to pump well water to supply new homes and the pumping will draw water out of the alluvium of a stream. Because pumping affects streamflow and consequently the quantity of water available to senior water rights holders downstream, it could be prohibited by absolute enforcement of the seniors' rights. To compensate for the effects of the pumping on seniors, the developer might purchase shares of irrigation water in a reservoir upstream and release it as needed to meet the seniors' call. The advantage of the system is that the quantity of water that needs to be purchased for release to the senior is usually less than the amount of water that the developer will be pumping, because there is not a one-to-one relationship between the amount of groundwater pumped and the effects on the surface stream, and because the senior agricultural rights requiring satisfaction are seasonal while the domestic use of water from the wells would be continuous.

D. *Cooperative Basin Management*

Cooperation in sharing water resources within a watershed can be a great boon to making more efficient use of water and expanding the use of limited supplies. Strict priority administration of rights often leads to inefficient use of water. For instance, water stored in several reservoirs within a basin can be jointly managed for broader benefits. Instead of every entity operating independently of the others—to the relative disadvantage of junior users—an entire system of independently owned reservoirs, wells, and ditch systems can be managed for the mutual benefit of all. If senior rights to store and use water were absolutely honored, other users might have to forgo late season irrigation and sit with empty reservoirs. Traditionally, their only hope of getting a reliable supply has been to build more and larger reservoirs, or to buy out senior rights. Under cooperative management schemes it is still possible, though less frequently necessary, to curtail junior uses in favor of seniors.[66]

Society benefits from making fuller, more productive use of water resources, not from rigorous obeisance to an awkward system that defines water rights based on historical practices. Yet seniors often oppose attempts at basin cooperation and interactive management of systems. They may be legitimately concerned that miscalculations in the course of more intensive use may leave them short of water, while strict enforcement of their "rights" under the present system gives them a large margin of safety. Furthermore, the gap in value between junior and senior rights is

66. *See generally* Grigg, *Voluntary Approaches to Basinwide Water Management*, in TRADITION, INNOVATION AND CONFLICT 207-19 (L. MacDonnell ed. 1986).

closed when seniors cooperate to relax the dominance of their rights for the greater good, and self-interest reduces seniors' enthusiasm for management schemes requiring time or trouble to implement.

The early collaboration of many landowners pooling their money, labor and ingenuity brought the irrigation water needed to open wide expanses of arid lands from distant natural streams. Today the ditch companies and special districts that are successors to many of the early cooperative efforts have become bastions of a seniority system that is inimical to the kind of cooperation needed for full, economically efficient use of water. The prior appropriation doctrine has endowed them not only with an economic edge, but enabled them to have political influence that is often used to resist changing the system or expanding the uses of "their" water resources for the benefit of junior users or of the public generally.

Entities like water districts and ditch companies are ideally situated to facilitate better water management. They have been less inclined to basinwide management schemes than to such parochial concerns as enforcement of rights and expansion of physical facilities. If districts do not act, voluntary associations of water users could be formed to pool available data and use computer modelling to arrange the most beneficial transfers and exchanges, keeping transaction costs low and eliminating risks of cooperation perceived by seniors. An alternative to the voluntary approach would be to impose state agency management responsibility for achieving optimum use of water resources in a basin. There is considerable latitude for administrative involvement in water management under the prior appropriation doctrine if private arrangements are inadequate to make the best use of a state's water resources. Judicial decisions in western states are beginning to require efficiency in management, even demanding that water rights administration lead to optimum water use rather than the traditional function of routinely protecting private rights.[67]

E. *Water Marketing*

Water marketing is a means of achieving water use efficiency by moving water rights from lower to higher valued uses.[68] Indeed, more

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67. In Colorado, the state engineer historically was assumed to have virtually no discretion in administering water rights. Recent decisions of the state supreme court have said that the state engineer may adopt rules and regulations that require efficient water management and impose requirements going well beyond simply using water in priority. The selection of what approach to take "is a policy decision to be made by the state engineer after a consideration of all relevant factors." Alamosa-La Jara Water Users Protection Ass'n v. Gould, 674 P.2d 914 (1983). The court said that: "the objective of 'maximum use' administration is 'optimum use.' Optimum use can only be achieved with proper regard for all significant factors, including environmental and economic concerns." *Id.* at 935.

68. *See* Wahl & Osterhoudt *supra* note 55; Porzak, *Innovative Transfer and Exchange Plans*, in

efficient use of water through the salvage and management techniques discussed above may depend on the availability of market transactions in water rights. Although some people object to the concept of trading water rights as a commodity,[69] economists and others argue persuasively that marketing is the most powerful means of promoting the wise use of the resource. Allowing water to be traded freely for value permits its use for the purposes that are the most important to society. The sugar beet farmer who can sell a crop for more than a wheat farmer's crop is able to bid water away from the wheat farmer, at least for the year when society's demand for sugar is greater than its demand for wheat.

Several water districts have pooled and reallocated water rights among agricultural users according to needs on an annual basis. The Arvin-Edison Water District in California's San Joaquin Valley, for example, operates a water exchange pool, in which people who have water contracts with the district may offer their rights in a pool that is available to others who need more water in a particular year. Payments for water are made by users at the usual district rates, and the proceeds are distributed pro rata to all those who offered water for sale.[70]

The Northern Colorado Water Conservancy District has one of the most successful water markets, in which agricultural rights are traded among agricultural and municipal users. There are many growing communities within the district, as well as extensive agricultural uses. About 30% of water delivered to the district by the Colorado-Big Thompson Project is available for rental or outright sale each year, at a price that fluctuates according to annual demand.[71]

The most typical, and often unpopular, case of water marketing arises when a municipality wants to buy out agricultural rights. The possibilities of shifting some water from agriculture to sustain municipal and industrial growth are great because reductions in agricultural consumption as small

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TRADITION, INNOVATION AND CONFLICT 185-206 (L. MacDonnell ed. 1986). C. MEYERS & R. POSNER, MARKET TRANSFERS OF WATER RIGHTS: TOWARD AN IMPROVED MARKET IN WATER RESOURCES (1971). *See* Shupe, *supra* note 61; DRIVER, *supra* note 11.

69. *E.g.*, Dunning, *Reflections on the Transfer of Water Rights*, 4 J. CONTEMP. LAW 109 (1977) (questioning the ability of a water market to reflect societal values); Chang, *Water: Consumer Commodity or Government Subsidy?*, in WATER VALUES AND MARKETS: EMERGING MANAGEMENT TOOLS 18-20 (Freshwater Foundation 1986) (a critique of water markets in Hawaii).

70. *See* Wahl & Osterhoudt, *supra* note 55, at 118.

71. Prospective buyers and sellers of water contact the district office which puts the various parties in touch with one another. Howe, Schurmeier & Shaw, *supra* note 31, at 189. Sales of water allotments may occur through brokers who either bring buyers and sellers together or act as speculator-sellers of agricultural waters. *Id.* at 187. The transaction costs of transfers within the district are contained because the district need not ensure deliveries of return flows to downstream users. Since the district owns the water, it need not avoid changes in use or place of use that would harm downstream third parties who depend on return flows. *Id.* at 186.

as 10% in some states could satisfy all reasonable, foreseeable municipal and industrial demands.[72] Unfortunately, such transfers may evoke unsympathetic images of a rich and powerful city taking advantage of impoverished farmers. A legacy of adverse social and economic consequences of transactions, like Los Angeles's clandestine acquisition of rights that allowed it to dry up the Owens Valley,[73] has soured many to the idea of agricultural-municipal transfers.

Water marketing need not mean the demise of farming and rural communities for the benefit of growing urban and suburban areas. On the contrary, a free market offers greater flexibility than is evidenced by unfortunate transactions in the past. For instance, farmers could enter into dry year leases with municipalities, under which the city pays each farmer an annual fee for the right to take the farmer's water in the event of drought. Under this arrangement the city effectively has an "insurance policy," but farming is not precluded. Only when the city needs the water does the farmer cease farming or turn to dryland farming for the year.

As discussed in the previous section on salvage and reuse, another marketing approach is for municipalities to pay for installation of agricultural conservation improvements in return for the right to use the water saved. For instance, if a farmer could save 20% of the water ordinarily consumed in agriculture by installing a city-financed drip irrigation system, and still produce reasonable crop yields, the water saved might be transferred to the city. Thus, water that the farm alone had consumed would now be used more efficiently, enabling both the city to expand and the farm to operate.

Indian reserved water rights could be a copious source of water to satisfy new and expanding demands, on and off Indian reservations. In the West, established and future non-Indian uses outside reservations may be threatened by the prospect of Indians using the vast quantities of water that they claim under the *Winters* doctrine.[74] Where potential on-reservation water uses promise significant cultural or economic benefits to the tribes, non-Indians dependent on the same sources may inevitably face dislocation. But if Indians must contrive low-valued uses to enjoy the benefit of their rights, it may be mutually beneficial to both Indians and non-Indians to negotiate leases or other transfers of the Indian water.

Although the standard for quantifying water rights on most Indian reservations is the amount of water needed to irrigate all the practicably

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72. One writer estimates that a 7% reduction in Arizona's agricultural water use could sustain a doubling of all other water uses. F. WELSH, HOW TO CREATE A WATER CRISIS 55 (1985).

73. *See* W. KAHRL, WATER AND POWER (1982).

74. Winters v. United States, 207 U.S. 564 (1908). *See supra* note 32 and accompanying text.

irrigable acreage,[75] many Indian reservations are capable of only marginal agricultural uses. The Supreme Court has stated that Indian tribes may use water quantified by agricultural demands in non-agricultural pursuits.[76] Tribes may choose to negotiate water sales and leases to municipalities and others if they are more profitable than returns realized from cultivation of Indian lands or from tribal industrial, recreational, and other uses. At the same time, non-Indians threatened by interruption of existing uses can achieve a greater certainty of future supplies through reasonable economic transactions.

The Fort Peck Compact between the Assiniboine and Sioux tribes and the state of Montana includes water marketing provisions. Last spring the Montana State Legislature ratified a compact resolving the reserved water rights claims of the tribes, under which the Indians are entitled to several hundred thousand acre-feet of water, of which they may market up to 50,000 acre-feet to customers off the reservation.[77] There are numerous other recent examples of Indian water marketing throughout the West.[78] By making such economic arrangements with tribes, established non-Indian economies can be maintained and Indians can be dealt with justly.

Legal and economic barriers to water marketing include some state laws that restrict the transfer of water rights. Nebraska, for example, inhibits the transfers of irrigation rights.[79] The law of Wyoming reads as if water is virtually untransferable, but in fact, tough legal limitations have been swallowed by exceptions.[80] Administrative limits on water transfers

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75. Arizona v. California, 373 U.S. 546, 600-01 (1963). This standard was adopted because the purpose of the Colorado River reservations was to enable the Indians to develop a viable agricultural economy.

76. *See* Arizona v. California, 439 U.S. 419, 422 (1979) (Indian water rights quantified according to the irrigable acreage standard are not limited to agricultural applications).

77. The compact is found at MONT. CODE ANN. § 85-20-201 (1987). The water marketing provision is at § 85-20-201, art. III, § K(5). In 1979 the Montana legislature established the Reserved Water Rights Compact Commission whose purpose is to negotiate apportionment of waters between the state and Indian tribes within the state. *Id.* § 85-2-701. The Fort Peck Compact is the first such apportionment to be ratified by the legislature. The Compact gives the tribes the right to divert 1,050,472 acre-feet of water annually with a priority date of May 1, 1888. *Id.* § 85-20-201, art. III, § A. The Tribal Water Right may not be permanently alienated, but few other restrictions apply. Off-reservation uses of marketed water must be beneficial under state law. *Id.* art. III, § D.

78. *E.g.*, The Papago Indians (now Tohono O'dam Nation) and the Ak-Chin Indian Community each received substantial "wet" water rights, entitling them to more reliable and efficient irrigation water supplies, in exchange for relinquishing their "paper" water rights under the *Winters* doctrine. *See* Southern Arizona Water Rights Settlement Act of 1982, Pub. L. No. 97-293, 96 Stat. 1261 (1982); Ak-Chin Community Water Rights Settlement Act, Pub. L. No. 95-328, 92 Stat. 409 (1978).

79. NEB. REV. STAT. § 46-294(4) (1984) limits intrabasin transfers to those in which "water will be applied to a use in the same preference category [for example, agriculture] as the present use."

80. Transfers are not to exceed the amount historically diverted or consumed or the historic rate of diversion, and they are not to decrease the historic return flow. WYO. STAT. § 41-3-104 (1977). *See* Comment, *Changing Manner and Place of Use of Water Rights in Wyoming*, 10 LAND & WATER L. REV. 455 (1975); Trelease & Lee, *Priority and Progress—Case Studies in the Transfer of Water*

exist in many states such as Nevada and South Dakota.[81]

Many laws and institutions also build high transaction costs into the prior appropriation system. Colorado, for instance, boasts free transferability in water, but has a system of water courts in which a simple water transfer can result in dozens of protesting parties coming into water court, each with a phalanx of lawyers and engineers.[82] The delays and costs of defending such challenges often are not justified by the value of the water being transferred. Other states have similar problems of fees, delays, and uncertainties encumbering the process of transferring water rights.

The market's own inadequacies give rise to further psychological and legal barriers to the use of the market to allocate water. An unregulated market does not work well to allocate water because substantial public interests are not well represented in economic transactions, so it is necessary for government to represent public values in a water allocation system. One method of integrating public values is to require that the economic importance of fish, wildlife, recreation and aesthetics be reflected in the calculus when water allocation decisions are made. For instance, developers can be required to internalize the costs of protecting wildlife and other valued resources that may be damaged by their projects. The cost of mitigating harm to public values, such as restoring a stream similar to one flooded or improving other habitat, becomes a cost of the project. Other impacts on public values are more difficult to quantify. Effects on rural areas and farmers, whose land values, tax bases and economies may be adversely affected for the sake of supplying water to other areas, may deserve compensation. Special funds could be established to compensate for such lost values, supported by contributions from developers. The amount of contributions, the losses to be compensated, and the method of administration are important political decisions that will vary for each state.

Nonmarket devices like regulation of water quality for the public benefit, have impacts on transfers of water and the value of water rights. Regulation, while not a "market mechanism," can and must be used to define the limits of the market. It is often the most efficient means of reflecting and protecting widely-held values and serving the public

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Rights, 1 LAND & WATER L. REV. 1 (1966); Gould, *Conversion of Agricultural Water Rights to Industrial Use*, 27B ROCKY MTN. MIN. L. INST. 1791 (1982).

81. Water rights transfers are not binding until they are recorded with the state engineer. NEV. REV. STAT. § 533.385 (1986); S.D. CODIFIED LAWS ANN. § 46-5-32 (1983). In addition, South Dakota prohibits the transfer of water rights separate from the land to which they are appurtenant except under prescribed conditions. *Id.* §§ 46-5-34 and 34.1 (1983).

82. *See* Martz & Raley, *Administering Colorado's Water: A Critique of the Present Approach*, in TRADITION, INNOVATION AND CONFLICT 52-57 (L. MacDonnell ed. 1986).

interest.[83]

Some laws protecting instream flows are adapted to the market system. In Colorado, instream flows are protected by state agency appropriations of rights, with quantities and priority dates administered as other rights held by prior appropriation.[84] Because the rights are permanently held, however, they are not marketable as privately held rights. Other states' instream flow laws are less compatible with the system of private rights in that they simply declare some waters unavailable for appropriation or prevent the exercise of all rights in reserved flows, senior or junior.[85]

At least two states have taken steps to participate directly in water markets. Montana, for example, must be involved in any water marketing transaction that involves over 5000 acre-feet or more of water.[86] New Mexico, motivated by a desire to prevent extensive interstate sales to the detriment of future in-state uses, developed a program for state marketing of groundwater.[87]

The theory that the market will move water to society's most important uses depends on the assumption that decisionmakers will act in their economic self-interest. Where individuals or profit-oriented entities are concerned, the assumption may be valid, but many of the entities that control water resources are insulated from the profit motive by their structure and governance. Although municipal officials are politically accountable to taxpayers, they often can hide behind the mystique of expertise that pervades the water supply area, and appeal to the chronic phobia excited by the West's cyclical droughts. Special water districts together control half of the West's irrigation water,[88] but many lack even

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83. Some commentators have recommended consideration of substituting market mechanisms for regulation in dealing with problems like water pollution. *E.g.*, Brown & Johnson, *Pollution Control by Effluent Charges: It Works in the Federal Republic of Germany, Why Not in the U.S.*, 24 NAT. RESOURCES J. 929 (1984).

84. COLO. REV. STAT. § 37-92-103(3).

85. For example, California and Oregon have legislation to protect rivers with extraordinary scenic, recreational, botanical, fishery and wildlife values. *E.g.*, CAL. PUB. RES. CODE §§ 5093.50 and -.69 (West 1984 and West Supp. 1987); OR. REV. STAT. §§ 390.805 and -.925 (1985). Both states prohibit construction of dams and reservoirs on a protected river segment. California explicitly prohibits diversion facilities on a protected river segment. The designated segments are generally so far upstream that few conflicts with senior appropriators have occurred, but designation of a river segment would seem to preclude any possibility of later appropriation and use. *See* Tarlock, *Appropriation for Instream Flow Maintenance: A Progress Report on "New" Public Western Water Rights*, 1978 UTAH L. REV. 211, 227. Expanded definitions of navigability, although not instream flow laws per se, could potentially limit private water rights by insisting on adequate stream flows for public rights such as boating, fishing and swimming. *Id.* at 230-33.

86. MONT. CODE ANN. § 85-2-141.

87. *See* STATE APPROPRIATION OF UNAPPROPRIATED GROUNDWATER: A STRATEGY FOR INSURING NEW MEXICO A WATER FUTURE, SECOND REPORT (January 1987).

88. U.S. DEPT. OF COMMERCE, 1969 CENSUS OF AGRICULTURE, IRRIGATION, Vol. 4, Table 18,

the constraints of political accountability because their boards are not democratically selected.[89]

F. *Water Pricing and Incentives*

Water pricing is a potent economic device for promoting more efficient resource use.[90] The public attention and response to the energy crisis were sparked by sharply increasing prices due to manipulation of foreign oil markets. In contrast, water is notoriously underpriced in nearly all applications: agricultural water has been heavily subsidized; municipal customers benefit from early capital investments that have long since been recovered; and all water users generally avoid paying for external effects on society or other individuals caused by the development of particular water sources.

Increasing the price of municipal water can result in a significant reduction in demand.[91] Pricing mechanisms include marginal prices, where rates are set at the cost for producing the next unit of water, rather than giving the consumer the benefit of a water supply system inexpensively developed many years ago. Another method is block pricing, under which the consumer pays a progressively higher rate for greater quantities of water used. As the price rises, residential consumers are more careful about over-watering and may consider landscaping with lower water demand plantings suited to an arid environment.

Water utilities can make investments to reduce consumer demand. Even relatively small expenditures can produce significant savings over time. For example, some municipalities and water companies encourage conservation by providing low cost plumbing appliances such as toilet dams and flow restricters for shower heads.[92] In the effort to reduce consumer demand, water utilities can learn from the innovations of electric utilities: power companies across the country have begun to make major invest-

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at 82-83.

89. *See* De Young, *Discretion Versus Accountability: The Case of Special Water Districts,* in SPECIAL WATER DISTRICTS: CHALLENGE FOR THE FUTURE (J. Corbridge ed. 1983); Ball v. James, 451 U.S. 355 (1981).

90. *See* UNITED STATES NATIONAL WATER COMM'N, WATER POLICIES FOR THE FUTURE 247-56 (1973).

91. Studies have shown that user fees are effective in reducing water use. Several studies are compared in R. SMITH, TROUBLED WATERS, Table 5-1 (1984). Industrial water use is the most responsive to pricing, showing a 6.5% to 8.5% reduction when the price is raised 10%. A corresponding price increase reduces outdoor residential use by 7% to 14% and indoor residential use by 3.5% to 6%. *Id.* at 91.

92. Los Angeles, California supplied 1.5 million free conservation kits to its customers between 1981 and 1986. The kits included a toilet tank displacement bag and a low-flow shower head. San Jose, California has achieved an 86% installation rate with a similar program for its customers. U.S. WATER NEWS, at 16 (January 1987).

ments to induce their customers to reduce consumption.[93] They make loans or grants for consumers to employ conservation measures such as insulation or energy efficient appliances. Consumers then repay the loans out of their savings—the difference between the customer's average bill before installing the efficiency measures and the amounts of monthly bills afterwards. A purveyor of electrical energy whose profits come from sales will pay consumers to buy less because it can avoid the massive capital investment required to construct a new power plant.

As the cost of new water development increases, the attractiveness of efficiency loans for water conservation measures will become more apparent to water utilities. At least two western cities have already instituted programs in which water utilities give rebates to customers who install water conservation devices or replant with low water demand landscaping.[94]

VI. Benefits of Water Efficiency

More than ever before, states are concerned with meeting their water needs in the most economical way. Efficiency measures by definition are those that impose the least costs, considering all of the effects on society of supplying water by a particular means. Cost consideration requires accounting for all costs and comparing all available alternatives. A state that pursues water efficiency policies will be able to satisfy changing water demands at a lower overall cost.

Major structural rearrangements of streams typically result in costly and disruptive construction of storage and transportation facilities. Therefore, efficient water management brings obvious environmental benefits, as it can supplant the need for intrusive facilities that flood canyons, dewater high mountain streams and wetlands, and diminish fish and wildlife habitat. Water quality is also an important benefit of efficient agricultural water use. For example, if less irrigation water is used, salt leaching and resultant salt loading of streams will be reduced.[95] More careful irrigation

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93. The Tennessee Valley Authority offers free energy audits to its customers as well as zero interest loans for taking recommended actions. Southern California Edison Company offers more than 100 programs to reduce energy demand including low and zero interest loans for conservation materials. Hemphill & Myers, *Electric Utility Conservation Programs: Progress and Problems* in Energy Conservation 140 (J. Sawhill & R. Cotton eds. 1986). A 1982 study found 105 conservation and loan management programs used by 39 utilities. Chamberlain & Camp, A Summary of Utility Incentives for Alternative Energy and Energy Conservation Programs (TVA Planning and Communications Office 1982).

94. The Goleta, California Water District offers a rebate to customers who install water-saving toilets. Santa Barbara, California, News Press, February 28, 1987 at D-2. Glendale, Arizona, in addition to toilet rebates, offers rebates to customers who install automatic sprinkler system controls or convert to low water use landscaping. Water Conservation News, December, 1986, at 6.

95. *See supra* note 37. High salinity water causes various types of damage, including dangers to

also may reduce pesticide and herbicide pollution,[96] and may curb the serious problem of topsoil loss.[97] This is not to say, however, that water efficiency is an environmental panacea. Efficient water use can also have negative environmental impacts, as true "efficiency" can mean using every drop of water in a stream, draining and drying up wetlands and destroying fish and wildlife habitat.[98] Thus, the consequences of water management decisions, like water development decisions, must be critically evaluated in advance.

The trend in Supreme Court jurisprudence indicates that states with strong water efficiency policies may gain certain advantages over those that lack such policies: larger allocations in interstate apportionments and greater control over exports. The Court's equitable apportionment doctrine calls for examining how each state uses its water; states with relatively valuable established uses have strong "equities" that militate in favor of being awarded a larger share of water.[99] The Supreme Court's most recent equitable apportionment case affirmed the superior equities of a state that makes relatively more efficient use of water than a competing state.[100]

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the health of those drinking the water, reduction of crop yields in agriculture, and increased costs to industries which require pure water. T. MILLER, G. WEATHERFORD & J. THORSON, THE SALTY COLORADO, *supra* note 37, at 8-9.

96. P. HOLDEN, PESTICIDES AND GROUNDWATER QUALITY 12 (National Academy Press 1986).

97. UNITED STATES NATIONAL WATER COMMISSION, WATER POLICIES FOR THE FUTURE 184 (1973).

98. The transaction between Casper, Wyoming and the Casper-Alcova Irrigation District, see *supra* note 60 and accompanying text, would have eliminated some 100 wetlands areas that developed from canal seepage. As a result of public concern for these areas, the canal near four of the larger areas was left unlined so that wetlands would not die. Wahl & Osterhoudt, *supra* note 55, at 116.

99. *See, e.g.*, Nebraska v. Wyoming, 325 U.S. 589 (1945). The Court stated that as between two prior appropriation states, equity might require variance from strict priority. "So far as possible those established uses should be protected though strict application of the priority rule might jeopardize them." *Id.* at 618.

100. *See* Colorado v. New Mexico, 459 U.S. 176 (1982). The Court drew on earlier cases for the proposition that "wasteful or inefficient uses will not be protected." *Id.* at 184. The decision indicated that a state's conservation efforts would be considered in determining its share of interstate waters. Colorado had alleged that in making an equitable apportionment its proposed uses should be preferred to New Mexico's long-established, but highly inefficient agricultural uses. The Court generally agreed, but remanded the case to a special master for specific findings concerning existing and proposed uses, supplies of water and reasonable conservation measures available to New Mexico. The case returned to the Supreme Court two years later on a review of the master's findings. The Court reiterated its earlier holding that New Mexico could not base its claim on existing inefficient uses of waters because "no state can use its lax administration to establish its claim to water." Colorado v. New Mexico, 467 U.S. 310, 321 (1984). The Court concluded, however, that Colorado had failed to carry its evidentiary burden of showing its own plans for water use or that New Mexico's reasonable conservation measures could compensate for Colorado's proposed uses. Thus, Colorado was not entitled to its claimed water rights. *See generally* Tarlock, *The Law of Equitable Apportionment Revisited, Updated and Restated*, 56 U. COLO. L. REV. 381, 409 (1985) ("Both to preserve supplies for internal use and to assert fair share claims against another state, states must demonstrate that they have an adequate process to attempt to maximize the use of available waters").

The Supreme Court indicated in *Sporhase v. Nebraska ex rel. Douglas*[101] that a state's attempts to restrict exports of water to another state may be constitutional if the restrictions are part of a water conservation program imposing comparable restrictions on both in-state and out-of-state water use.[102] The Court then suggested that if states do not control problems (such as the groundwater overdraft involved in that case), Congress has and may exercise its unused powers to deal with water issues of national importance.[103] The specter of federal intervention and control of water resources always has been a great threat to western states; now the Supreme Court has given fair warning that western states need to insure more efficient water use if they are to retain the ability to use and control water within their borders.

VII. Efficiency Reforms in Western Water Law

The western attitude toward water policy is changing. The Western Governors Association's recent attention to improving water use efficiency signals an evolving attitude; presumably legislative and administrative recognition of the importance of efficient water use will follow. Already several states have developed innovative laws and programs to promote efficiency, and judicial activity has encouraged further reforms. The western states, overall, have produced an impressive array of institutional improvements in water management. These measures are, however, isolated attempts within an overall system that remains flawed by disincentives to efficient water management. No state has embraced water use efficiency boldly enough to make it the focal point of state water policy. The individual state efforts nevertheless warrant consideration by every western state as potential components of an overall plan for efficient water resources management.

A. *The "Beneficial Use" Requirement*

Despite prohibitions on waste inherent in the prior appropriation system, western water law as applied often shelters wasteful practices. The

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101. 458 U.S. 941 (1982).

102. The Supreme Court held in Sporhase v. Nebraska *ex rel.* Douglas, 458 U.S. 941 (1982), that states cannot inhibit interstate commerce in water unless the inhibition is narrowly tailored to meet legitimate state goals. The Court stated that certain circumstances could justify export restrictions and that it would look with greater favor on measures that are necessary for the conservation of water. The Court concluded: "A demonstrably arid State conceivably might be able to marshal evidence to establish a close means-ends relationship between even a total ban on the exportation of water and a purpose to conserve and preserve water." *Id.* at 958. Shortages can also give rise to a state's valid preference for its own citizens. *Id.* at 956.

103. The Court noted that the Commerce Clause grants Congress the power to regulate groundwater use and to deal with groundwater overdraft on a national scale. *Id.* at 953-54.

doctrine's most potent weapon against waste is the requirement that water be put to a "beneficial use." Initially, however, the requirement was treated merely as a threshold test that asked whether a declared purpose for water use fit within one of the utilitarian "beneficial" categories such as domestic, agricultural, mining or industrial uses. Neither the quantity proposed for a particular use nor its relative benefit compared to other uses was questioned. The resulting system rewarded the first person to divert water for any use, no matter how unimportant or wasteful.[104]

Early appropriations typically were overstated, and frequently depended on crude diversion and transportation facilities. Early water rights administrators lacked both the engineering skill and the manpower to imbue the allocation process with accuracy.[105] Because an initial goal of prior appropriation was to promote all productive uses of water, neither courts nor administrators attempted to determine the most beneficial uses.

The courts first were asked to invoke the requirement that water be put to a beneficial use in order to check inefficient water use by clumsy diversion works. In 1912 the United States Supreme Court held that a water user has no right under the prior appropriation doctrine to maintain an inefficient diversion (a water wheel) that deprived others of needed water by commanding much of the streamflow just to carry water to the facility.[106] Recent cases have strengthened the requirement that one's means of diversion and transportation be reasonably efficient.[107] The trend clearly is away from allowing a vested water right to shield excessive leakage, evaporation and other wastes of water.

Besides examining delivery systems, western courts have curtailed water use practices as "unreasonable," and thus not beneficial, to defeat extreme agricultural practices.[108] For example, a well-established rule of

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104. *See* Williams, *The Requirement of Beneficial Use as a Cause of Waste in Water Resource Development*, 23 NAT. RESOURCES J. 7 (1983).

105. *See* McIntire, *The Disparity Between State Water Rights Records and Actual Water Use Patterns: "I Wonder Where the Water Went?"*, 5 LAND & WATER L. REV. 23 (1970). *See also* Battle, *Paper Clouds over the Waters: Shelf Filings and Hyperextended Permits in Wyoming*, 22 LAND & WATER L. REV. 673 (1987).

106. Schodde v. Twin Falls Land & Water Co., 224 U.S. 107 (1912).

107. *E.g.*, Glenn Dale Ranches, Inc. v. Schaub, 94 Idaho 585, 494 P.2d 1029 (1972) ("waters appropriated will be measured at the point of diversion, not at the place of use"). *See also* A-B Cattle Co. v. United States, 196 Colo. 539, 589 P.2d 57 (1978) (although "the time may not yet have arrived when all ditches can be required to be lined or placed in pipes," appropriators have no right to silt content in water to seal leaky ditches).

108. *E.g.*, Warner Valley Stock Co. v. Lynch, 215 Or. 523, 336 P.2d 884 (1959) (flood irrigation requiring entire stream to deliver lesser amount of water); People *ex rel.* State Water Resources Control Bd. v. Forni, 54 Cal. App. 3d 743, 126 Cal. Rptr. 851 (1976) (pumping from river during low water for frost protection in vineyard); Tulare Irr. Dist. v. Lindsay-Strathmore Irr. Dist., 3 Cal. 2d 489, 45 P.2d 972 (1935) (winter flooding of fields to control gophers); Fairfield Irr. Co. v. White, 18 Utah 2d 93, 416 P.2d 641 (1966) (irrigation of fields during non-growing season).

western water law limits the quantity of transferable water rights to the quantity necessary for the use to which they were put historically.[109] Though articulated as a means to protect other users, the practical effect of the historical use limitation is to screen out excessive claims embodied in old paper rights by imposing increasingly tough engineering standards as a condition of maintaining one's water rights. This translation of the beneficial use requirement into a limitation based on efficiency marks a subtle revolution in the application of the prior appropriation doctrine.

On the other hand, the promise of a more rigorous application of the beneficial use principle has been limited by judicial reluctance to force water users to modernize. Most courts have judged the beneficial use requirement's element of "reasonable efficiency" by the standards that prevailed when the use commenced.[110] While an appropriator continuously using once-reasonable methods may deserve some latitude, the equities of long-standing wasteful practice should not defeat state efforts to conserve water. Similarly, polluters whose discharges once were allowed as reasonable practices have had to change as technology became available and as society's need for clean water was recognized.[111]

Applying the beneficial use requirement to ensure efficiency in water management is an avenue by which the prior appropriation doctrine will be kept vital and consonant with the realities of a changing West. Society's varied and expanding needs for water can be reflected in a balancing process to determine whether the manner of water use is reasonable, and therefore beneficial.[112] Similarly, as technology changes new standards must be applied to define reasonably efficient water use. The Court of Appeals for the Ninth Circuit has said, "beneficial use expresses a dynamic concept, which is variable according to conditions, and therefore over time."[113]

The prior appropriation doctrine's most essential and enduring element—beneficial use—now is becoming a means of forcing the use of new technologies and reforming western water management. The idea that a right only attaches to so much water as may be used beneficially can be

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109. *E.g.*, Green v. Chaffee Ditch Co., 150 Colo. 91, 371 P.2d 775 (1962).

110. *E.g.*, State *ex rel.* Crowley v. District Court, 108 Mont. 89, 88 P.2d 23 (1939). *But see Glenn Dale Ranches, Inc.*, 94 Idaho 585, 494 P.2d 1029; *supra* note 107.

111. *E.g.*, Tanner's Council of America, Inc. v. Train, 540 F.2d 1188 (4th Cir. 1976) (tanning industry effluent limitations upheld because EPA could reasonably believe that necessary technology would be available by 1983); American Petroleum Institute v. EPA, 540 F.2d 1023 (10th Cir. 1976), *cert. denied*, 430 U.S. 922 (1977) (modification of processes can be required if they are reasonably within normal industry practice).

112. On the relationship of the concept of reasonable use to the beneficial use requirement in prior appropriation law, see Trelease, *The Concept of Reasonable Beneficial Use in the Law of Surface Streams*, 12 WYO. L.J. 24 (1956).

113. United States v. Alpine Land & Reservoir Co., 697 F.2d 851, 855 (9th Cir. 1983).

interpreted as eliminating rights in all but the quantity of water necessary to carry out the purpose of the appropriation.

B. *Recognition of Public Rights*

In order to accommodate the diverse water demands of today's American West, there must be legal recognition of uses never contemplated by those who designed the prior appropriation doctrine. The early settlers' vision, for example, did not extend to streamflow preservation. Indeed, their utilitarian conception of conservation would have considered dedication of water to such purposes wasteful.[114] Today, however, our concept of true efficiency—maximizing the value that water contributes to society—requires that the system protect instream flows. Early decisions that deemed rights to instream flows to be inconsistent with the appropriation doctrine as reflected in state constitutions were finally overcome by major state legislation.[115] States must continue to change their laws in order to accommodate rights or programs ensuring the flows necessary for streams to produce the benefits of recreation, fish and wildlife, and beauty that the West demands.

Instream flow protection has had more specific attention than other public values. Some state legislatures have responded to the perceived need to make water serve broader needs by requiring that appropriations be in the public interest.[116] Under such a broad mandate, administrative agencies must act on applications for water use without the guidance of legislative standards, considering a potpourri of factors that can vary from place to place and from time to time. Clearly, both agencies and water users would be better served by having clear standards for determining the public interest. The most effective way to reflect public values in water decisions may be to integrate them into the considerations that are made during a comprehensive water planning process.

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114. *See* Empire Water & Power Co. v. Cascade Town Co., 205 F. 123, 129 (8th Cir. 1913) (no right to maintain falls "solely for their scenic beauty").

115. *Supra* notes 22 and 23.

116. *E.g.*, ALASKA STAT. §§ 46.15.040 and -.080(a) (1984 & Supp. 1986); ARIZ. REV. STAT. ANN. §§ 45-142 and -143 (Supp. 1986); CAL. WATER CODE §§ 1225 and 2155 (West 1971 & Supp. 1987); Idaho Code §§ 42-201, -203A and -203C (Supp. 1986); KAN. STAT. ANN. §§ 82a-705 and -711 (1984); MONT. CODE ANN. §§ 85-2-302 and 311(2) (1987) (allowing permits for large appropriations only if the proposed use is "a reasonable use," which is defined in terms of typical public interest criteria); NEB. REV. STAT. §§ 46-233, -234 and -2,116 (1984); NEV. REV. STAT. §§ 533.325, -.370(3) and 534.040(1) (1985); N.M. STAT. ANN. §§ 72-5-1, -6, -7, 72-12-3 and -3.E (1985); N.D. CENT. CODE §§ 61-04-02 and -06 (1985); OR. REV. STAT. §§ 537.130 and -170(4) (1985); S.D. COMP. LAWS ANN. §§ 46-1-15, -5-10, -6-3 and -2A-9 (1983); TEX. WATER CODE ANN. §§ 11.121 and -.134(3) (Vernon Supp. 1987); UTAH CODE ANN. §§ 73-3-1 and -8(1) (1980 & Supp. 1986); WASH. REV. CODE ANN. §§ 90.03.250, -.290, -44.050 and -44.060 (1962); WYO. STAT. §§ 41-4-503, 41-3-930 to -932 (1977 & Supp. 1986).

C. *Conservation and Salvage*

Some states are seeking to achieve conservation goals by strictly regulating water demand, or by allowing innovative water salvage techniques. Probably the most extensive legal compulsions to reduce water demand found in western water law are included in the 1980 Arizona Groundwater Management Act that requires pumping from severely overdrafted aquifers to be reduced to a safe yield by 2025.[117] The law imposes strict goals for reducing usage and elaborate requirements for conservation embodied in management plans for newly-created "active management areas."

The potential for water reuse is enormous: municipalities can avoid costs of new water development by reusing treated sewage.[118] In another innovative conservation effort, California has led the way by enacting model water salvage legislation that allows a water rights holder to retain the rights in and benefit economically from conserved water,[119] and Oregon has passed a similar law.[120]

D. *Cooperative Management*

Colorado's positive experience with augmentation plans and substitute supply schemes[121] should commend the use of "physical solutions" to other states wishing to make fuller use of existing resources. Water users usually can cooperate to voluntarily effect physical solutions without any legal changes. If they are reluctant to do so, however, states should legislate to encourage rights holders to cooperate; state encouragement may be necessary to promote pooling of data, joint use of facilities, sharing of surpluses and physical solutions.

E. *Water Marketing*

While water transfers occur to some extent in every western state, there are a few outstanding examples that should be followed. The Northern Colorado Water Conservancy District's extensive program of economic transactions, the successful Casper-Alcova exchange of salvaged water and the Arvin-Edison water exchange pool, were discussed above.[122]

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117. *Supra* note 42.

118. *See generally Rethinking Reuse: A Water Supply for Our Future*, 10 J. FRESHWATER (1986/87) (discussing reuse issues such as public health and economics and explaining many reuse projects undertaken by agriculture, industry and municipalities).

119. CAL. WATER CODE § 1011(b) (West 1987).

120. Oregon S.B. 24 (to be codified at Chapter 264, OR. REV. STAT.). The law defines "conserved water" and allows its use, lease or disposal.

121. *Supra* note 65.

122. *Supra* notes 59 and 70 and accompanying text.

Additionally, Idaho's innovative state water bank for use of water from the Upper Snake River enables holders of agricultural water rights to sell their storage rights in a reservoir to a power company in years when they have excess water.[123] These and similar efforts are increasing the confidence level of those who doubt the wisdom of water marketing.

High transaction costs and limitations on marketing water from federal projects continue to inhibit freer marketability of rights. Many state law restrictions have been removed and efforts to ease transfer of salvaged water hold promise, but expensive, time-consuming proceedings often accompany attempts to transfer rights.[124] The ostensible purpose of administrative or judicial review of transfers is to ensure that other water users[125] or the public[126] are not harmed, but without a clear policy of encouraging transfers these cumbersome change proceedings can deter transactions by freighting heavy burdens of proof and presumptions upon proponents of trades.

Federal dam and reservoir projects, some brimming with uncommitted water, hold great possibilities for wider use.[127] Unfortunately, regulations, federal reclamation law, and long-standing practices militate against economically beneficial transactions.[128] Even programs like the Idaho water bank are repressed by Bureau of Reclamation restrictions on profit-making and on long-term contracts.

VIII. CONCLUSION

The promise of more efficient water management is great: the West can save money, gain greater control of water, and enjoy environmental benefits. By making fuller use of its water, the region need not despair the demise of federal financial assistance to water development. There will be sufficient water for future needs if western states can make some important legal and institutional changes.

The needs of the 21st century call for unprecedented innovation and

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123. The Idaho Water Supply Bank has legislative authority to facilitate short-term or long-term leases between individuals, corporations, irrigation districts, and cities. Leases are currently limited to one-year duration, and downstream users cannot gain rights to the return flow released by upstream users. *See* Wahl & Osterhoudt, *supra* note 55, at 118. *See also* IDAHO CODE §§ 42-1761 to-1765 (Cum. Supp. 1987).

124. *See* Martz & Raley, *supra* note 82. *See also* Wahl & Osterhoudt, *supra* note 55.

125. *E.g.*, Farmers Highline Canal & Reservoir Co. v. City of Golden, 129 Colo. 575, 272 P.2d 629 (1954).

126. *See supra* note 116.

127. *See* Wahl, *Voluntary Transfer of Federally Supplied Water: Experience of the Bureau of Reclamation* (prepared for conference "Water Marketing: Opportunities and Challenges of a New Era," sponsored by the Natural Resources Program of the University of Denver College of Law and Watershed West, Sept. 24-26, 1986).

128. *See supra* note 12, at 9-33.

ingenuity, challenging anew the adaptability of the West. Different eras and different circumstances demand different responses. If tradition inhibits sound resource allocation, the consequences will be misallocation and misuse of resources, stifled economic expansion, and abdication of state responsibility to manage western resources. Although the West has flourished, in part, by converting a desert to productive farms and cities with the help of large water storage projects funded by the federal government, building more dams is not the solution to future water problems. The challenge is to recognize that the world of western water has changed since the 19th century and to shape water policies and laws to embody the modern wisdom of better, more efficient management.