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Recent California Water Transfers: Implications For Water Management

ABSTRACT

The 1991 and 1992 California Drought Emergency Water Banks were the first large water transfer programs in the nation in which the state served as the predominant broker for water trades. Although the state-sponsored Water Banks have drawn widespread attention, there have been a great number of water transfers and exchanges taking place in California independently of the state. These transfers illustrate well the widespread applicability of transfers in managing water resource systems, as well as the multiple mechanisms available for effecting water transfers. This article focuses on California's recent experiences with water transfers, and offers a series of potential lessons for federal, state, and local managers for integrating water transfers in regional water resource systems.

INTRODUCTION

Economists have long endorsed the idea of using markets to foster the efficient allocation of water.[1] Over the years there has been much discussion on the legal implications,[2] the institutional forums,[3] and the potential third-party impacts of water transfers.[4] Although

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1. *See generally* Jerome W. Milliman, *Water Law and Private Decision-Making: A Critique*, 2 J. L. & ECON. 41-63 (1959); LOYAL M. HARTMAN & DON SEASTONE, WATER TRANSFERS: ECONOMIC EFFICIENCY AND ALTERNATIVE INSTITUTIONS (1970); Charles W. Howe et al., *Innovative Approaches to Water Allocation: The Potential for Water Markets*, 22 WATER RESOURCES RES. 439-45 (1986); BONNIE C. SALIBA & DAVID B. BUSH, WATER MARKETS IN THEORY AND PRACTICE: MARKET TRANSFERS, WATER VALUES, AND PUBLIC POLICY (Stud. in Water Pol'y & Mgmt. No. 12, 1987). A brief introduction to the water market literature appears in Norman J. Dudley, *Water Allocation by Markets, Common Property and Capacity Sharing: Companions or Competitors?*, 32 NAT. RESOURCES J. 757 (1992).

2. *See generally* Brian E. Gray, *A Primer on California Water Transfer Law*, 31 ARIZ. L. REV. 745 (1989); Kevin M. O'Brien, *Water Marketing in California*, 19 PAC. L.J. 1165 (1988).

3. *See generally* HARTMAN & SEASTONE, *supra* note 1; R. Maria Saleth et al., *Bargaining Rules for a Thin Spot Water Market*, 67 LAND ECON. 326 (1991); Susan C. Nunn & Helen M. Ingram, *Information, the Decision Forum, and Third-Party Effects in Water Transfers*, 24 WATER RESOURCES RES. 473 (1988).

4. *See generally* NAT'L RES. COUNCIL, WATER TRANSFERS IN THE WEST: EFFICIENCY, EQUITY, AND THE ENVIRONMENT (1992); Charles W. Howe et al., *The Economic Impacts of Agriculture--*

implementation of water transfers and water markets has lagged theoretical development, water transfers are a common component of many regional water systems and are increasingly considered for meeting growing water demands and for water management during drought. This paper demonstrates that water transfers can take many forms and can serve several purposes in the management of a water resource system.[5]

The study of actual water transfers can be very insightful for the design of new transfers as well as for transfer theory. The constraints actually encountered in applying water transfers confirm the need to account for transaction costs, operational requirements, third-party impacts, and multi-party coordination of water movement in the development of water transfers. Moreover, just as practice often reveals unanticipated constraints, study of actual water transfers reveals greater flexibility than anticipated by theory. This is due largely to the ingenuity of water managers.

The purpose of this paper is to review the recent water transfer activity in California and to draw from this experience lessons for water managers at all levels to integrate water transfers into regional water resource systems. A discussion of California water policy cannot be fully appreciated without some sense of the complexity and expanse of the California water resources system, including its physical and institutional characteristics. Thus, a brief overview of California water resources is presented first. The state-sponsored Drought Emergency Water Banks of 1991 and 1992 are discussed, followed by discussion of non-state-sponsored transfer activities. Conclusions and lessons for water managers and planners are provided.

CALIFORNIA'S WATER RESOURCE SYSTEM

California's unique hydrologic conditions form the basis of an elaborate water resource system. The state's water supplies are poorly distributed in both time and space. The principal water sources are in the northern and eastern mountains, but the greatest demands occur in the southern and western regions. Precipitation falls predominantly in the winter, while the summers, which are the periods of major agricultural and urban demands, are typically dry. As a semi-arid region, California also is prone to multi-year droughts. The water-related infrastructure, institutions, and legislation which have evolved, as well as the conflicts and antago-

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to-Urban Water Transfers on the Area of Origin: A Case Study of the Arkansas River Valley in Colorado, 72 AM. J. AGRIC. ECON. 1200 (1990); RONALD L. LITTLE & THOMAS R. GREIDER, WATER TRANSFERS FROM AGRICULTURE TO INDUSTRY: TWO UTAH EXAMPLES (Inst. for Soc. Sci. Res. on Nat. Resources Res. Monograph No. 10, 1983).

5. Jay R. Lund & Morris Israel, *Water Transfers in Engineering Water Resource Systems*, J. WATER RESOURCES PLAN & MGMT. (forthcoming).

nisms which have arisen over the years, can be traced to the imbalances of supply and demand. The physical and human infrastructure developed as part of the California State Water Project (SWP), the federal Central Valley Project (CVP), and the numerous smaller local projects has created a highly integrated and intricate water resources system. This vast system is governed by a large number of diverse water management agencies which, in turn, are governed by a complex set of laws, regulations, judicial rulings, contracts, and coordinating agreements.[6]

The state's major water facilities are located as shown in Figure 1. Together the CVP and the SWP provide approximately 30 percent of the state's surface water demands.[7] These two systems are important for water transfers in that most large transfers must employ these systems' conveyance and storage facilities. An equally important component of the California water system is the Sacramento-San Joaquin Delta. Essentially, all north-south movement of water must pass through or around the Delta. Due to environmental constraints, movement of water through the Delta can only occur when the Delta is in "balanced" conditions; that is, when releases from upstream reservoirs match Delta water quality standards, Delta outflow, and export demands. Windows of opportunity for moving water through the Delta are becoming increasingly constrained because of more stringent water quality standards and increased concern over threatened and endangered species residing in the Delta.[8]

The Federal government has a major role in managing water in California, acting primarily through the Bureau of Reclamation, which owns and operates the CVP. The U.S. Army Corps of Engineers and the Environmental Protection Agency have lesser, but still significant roles in managing the state's water resources. The California state government has three principal roles in water management: regulating water use, major developer of water resources, and protector of the natural environment. State activities in these potentially conflicting roles are split between the State Water Resources Control Board (the Board), the Department of Water Resources (DWR), and the Department of Fish and Game (DFG).[9]

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6. *See* WILLIAM L. KAHRL, CALIFORNIA WATER ATLAS 64 (1979).

7. The CVP delivers approximately 8 million acre-feet (MAF) and the SWP delivers roughly 2.3 MAF, but has contracts for up to 4.1 MAF. An acre-foot of water is equivalent to 326,000 gallons.

8. CALIFORNIA URBAN WATER AGENCIES, THE DELTA 1 (1993).

9. The State Water Resources Control Board is responsible for administering water rights and water quality programs. The Board has the authority to impose restrictions on the use of water rights and to revoke water rights if any of these restrictions are violated. The Department of Water Resources is charged with formulating coordinated statewide plans for the control, conservation, and use of the State's water resources. DWR also manages and operates the State Water Project. The Department of Fish and Game is responsible for the protection, preservation, propagation, and enhancement of the State's wildlife resources.

Figure 1: California's Major Water Infrastructure

California has roughly 3,000 water suppliers, both public and private. These water providing institutions differ widely in scale, organization, and enabling legislation, and are often driven by divergent objectives. Ownership and control of facilities varies, as does operation and maintenance responsibilities. However, overall operation of the system is finely orchestrated through a series of operating agreements, contracts, regulations, and laws. It is common for the water supplied to an individual house or farm to have been contractually or physically handled by several hierarchically layered water supply agencies. Water from a state or federal reservoir is often contracted to a regional water wholesaler which may sell the water to two or three additional water districts before final delivery to the individual water user. Historically, this hierarchical contracting has impeded transfers.

The two primary legal doctrines governing use of the state's waters are the riparian rights doctrine and the appropriative rights doctrine.[10] Other less important doctrines used in California are contract rights, pueblo rights, prescriptive rights, and ground water rights. The interaction between these doctrines results in a complex, confusing, and ambiguous water/water right transfer mechanism.

Two characteristics of riparian rights limit water transfers. First, riparian water must be used on riparian land. Second, riparian waters are not storable. These two limits prohibit the transfer of water in space (conveyance) or time (storage), so critical for California.

Appropriative rights are theoretically a transferable, marketable commodity. Transfers may involve change in ownership, type of use, and place of use. However, a general constraint on the transfer of appropriative rights is that other appropriators must not be adversely impacted by the transfer.[11] In California, the Board must approve changes in timing, place, and type of use for most water transfers. The Board also determines third-party impacts.

THE 1991 DROUGHT WATER BANK

The California Drought Emergency Water Banks did not arise without precedents or precursors. Similar water banks have existed elsewhere in the West.[12] Earlier water transfer activity in California included a successful water bank sponsored by the Bureau of Recla-

10. William R. Attwater & James Markle, *Overview of California Water Rights and Water Quality Law*, 19 PAC. L.J. 957 (1988).

11. CAL. WATER CODE § 1702 (West 1971).

12. Richard M. Rigby, *Water Banking in Idaho*, *in* PLANNING FOR WATER SHORTAGES: WATER REALLOCATIONS AND TRANSFERS DROUGHT MANAGEMENT 113 (Jerry Schaack et al. eds., 1989); NAT'L RES. COUNCIL, *supra* note 4, at 16.

mation for CVP members during the 1977 drought.[13] The Bureau of Reclamation also sponsors ongoing water pooling agreements within the CVP, and several other water transfers.[14] Establishment of the 1991 Drought Water Bank was greatly facilitated by a series of legislative items and technical studies conducted since the 1977 drought.

The 1991 Drought Water Bank was conceived as California entered a fifth year of drought conditions. Stringent urban water rationing, severe cutbacks in agricultural water availability, and critical conditions for fish and wildlife were widespread.[15] The responsibility for organizing and implementing the 1991 Drought Water Bank was assigned to the DWR and was to be managed separately from the SWP and other state contracts. A summary of the 1991 Water Bank is presented below.[16]

1991 Water Purchase Contracts

A Water Purchase Committee was formed by DWR to negotiate the terms and conditions of a model contract for buying water for the Bank. Committee members representing public agencies that might buy water from the Bank also aided in initial negotiations and assisted in implementing water purchase contracts.

To protect the water rights of sellers and to encourage their participation, several pieces of legislation were enacted. Assembly Bill (AB) 9 gave water suppliers explicit authority to enter into contracts with DWR or other water suppliers for the transfer of water outside their service area. AB 10 stated that no temporary transfer of water for drought relief in 1991 or 1992 would affect the standing of any existing water rights. Article 29 of the *Agreement Establishing a 1991 California Emergency Drought Water Bank* further specified several water rights assurances to sellers.[17] For instance, the transfer of water was deemed to be a beneficial use of water on the lands from which it was transferred, did not constitute evidence of waste or unreasonable use, did not affect and was not a basis for any loss or forfeiture of these rights, was not evidence of

13. RICHARD W. WAHL, MARKETS FOR FEDERAL WATER: SUBSIDIES, PROPERTY RIGHTS, AND THE BUREAU OF RECLAMATION 137 (1989).

14. Brian E. Gray, *Water Transfers in California: 1981-1989*, *in* THE WATER TRANSFER PROCESS AS A MANAGEMENT OPTION FOR MEETING CHANGING WATER DEMANDS 24 (Lawrence J. MacDonnell, principal investigator, volume 2, 1990).

15. CALIFORNIA DEP'T OF WATER RES., THE 1991 DROUGHT WATER BANK 1 (1992) [hereinafter *DWR*].

16. JAY R. LUND ET AL., RECENT CALIFORNIA WATER TRANSFERS: EMERGING OPTIONS IN WATER MANAGEMENT (Center for Envtl. & Water Resource Engineering Report 91-2, 1992).

17. RICHARD HOWITT ET AL., A RETROSPECTIVE ON CALIFORNIA'S 1991 EMERGENCY DROUGHT WATER BANK 10 (1992).

the availability of surplus water or ground water beyond the terms of the agreement, and the transfer of water was in furtherance of state policies favoring voluntary transfers of water on an intermittent basis to help alleviate water shortages.

To further motivate early seller participation in the Water Bank, purchase contracts contained a price escalator clause. The price escalator clause provided that if, by a specified date, the average price extended to a similarly situated seller exceeded the price in the contract by 10 percent, the seller would receive the higher of the two prices.

Sellers made water available to the Bank by: (1) fallowing farmland (i.e., not planting or irrigating a crop) and transferring the conserved irrigation water to the Bank, (2) using ground water in lieu of surface water, or (3) transferring water stored from local reservoirs. After analyzing farm budgets, talking to potential sellers and buyers, and consulting with agricultural economists, the acquisition price was set at $125/ac-ft, regardless of the source of the water or the crop not planted. The intent was to offer a price that would yield a net farmer income similar to farming plus an additional amount to encourage participation in the Water Bank.

The 1991 Water Bank acquired 820,665 ac-ft of water through 348 contracts.[18] Fifty percent of the acquired water came from 325 fallowing contracts (414,743 ac-ft); thirty-two percent from 19 ground water substitution contracts (258,590 ac-ft); and eighteen percent from 4 surface water contracts (147,332 ac-ft).

Fallowing Contracts

Roughly half the Water Bank supplies came from fallowing farmland. To be eligible for fallowing, land had to have been farmed in the previous year, or set aside under the Federal Farm Commodity program with farming anticipated for 1991. Eligibility was verified based on Agricultural Stabilization and Conservation Service reports. Shallow ground water levels on Delta farmland required additional vegetation control to reduce water losses from subsurface seepage. Sellers breaching a contract by irrigating with surface water were liable for liquidated damages of twice the price paid for the purchased water.[19]

The amount of water conserved by fallowing land was estimated as the net amount of applied water consumed by the crop. A survey of crop water use conducted after the 1976-77 drought was used to calculate

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18. DWR, *supra* note 15, at 2. Final figures for the quantity of water acquired and the number of contracts were provided by Steve Macaulay, Manager of the State Drought Water Bank, in a personal communication on March 8, 1993.

19. HOWITT ET AL., *supra* note 17, at 11.

the water conserved by fallowing different types of crops. Crop consumptive use was estimated to equal estimated crop evapotranspiration assuming similar rainfall patterns for the 1991 and 1977 growing seasons.[20] A crop fallowing payment schedule identified the amount of water per acre that would be consumed by specific crops.[21] Estimates of crop water use were adjusted as the 1991 rainfall surpassed the 1977 levels.

Table 1
1991 Drought Water Bank Fallowing Payments for Selected Crops

Irrigated Crop	Sacramento Valley and Delta Upland		Delta Lowland (1)		Comments
	Crop Water Use, Acre-foot per Acre (2)	$/Acre	Crop Water Use, Acre-foot per Acre (2)	$/Acre	
Alfalfa	3.5	450	3.2	400	rounded amount
Dry Beans	2.1	263	1.7	213	rounded amount
Field Corn	2.5	325	2.0	250	rounded amount
Pasture	3.5	450	3.2	400	rounded amount
Rice	3.5	450	-	-	rounded amount
Sugar Beets	3.0	375	2.5	325	rounded amount
Tomatoes	2.5	325	2.1	263	rounded amount
Wheat, Barley (3)	2.0	250	2.0	250	prior to 3/1/91
	1.5	190	1.5	190	3/1/91 - 3/13/91
	1.0	125	1.0	125	after 3/13/91

(1) Slightly lower values were used for crops grown in lower elevations of the Sacramento-San Joaquin Delta due to the influence of seepage from surrounding channels.
(2) The crop water use numbers in acre-feet are the estimated consumptive crop water needs that were expected to be met by applied irrigation water. These amounts assumed minimum rainfall in 1991, similar to rainfall in 1977.
(3) Water savings for these crops depend to a large extent on rainfall. The initial value of 2.0 ac-ft per acre was progressively reduced over time due to the record rainfall throughout March 1991.
Source: DWR 1992

The crop acreage fallowed through the 166,094 acres participating in the land fallowing program included corn (35.7 percent by acreage), wheat (26.2 percent), pasture (9.7 percent), alfalfa (6.2 percent), rice (4.9 percent), and others (17.3 percent).[22] The acreage fallowed for the Water Bank was about ten percent of the field and vegetable acreage of the major counties participating in the program and was within the acreage fluctuations of the previous four years, with the exception of corn in all

20. *Id.* at 12.
21. See Table 1.
22. DWR, *supra* note 15, at 4.

counties and wheat and alfalfa in Sacramento and Contra Costa counties.[23]

Ground Water Substitution Contracts

Land owners entering into ground water substitution contracts would irrigate crops with ground water and transfer their surface water entitlements to the Water Bank for the season. A few contracts provided pumped ground water for direct transfer to the Bank.

Ground water contracts involved the complex task of determining whether the pumped ground water was "new" non-surface water. Water was considered "new" if it had been made available to the state's supply system only because of actions undertaken as part of the Water Bank program. Well logs for each well in the program were reviewed to assure that the Bank received only new water and that the wells were not hydraulically connect to a near-by surface water source.[24]

In many areas, the ground water basin is the major regional source of agricultural and urban water supply. Local interests in the ground water exporting regions were concerned that ground water would be pumped for use outside the basin, potentially harming local areas. To address these concerns, the ground water contracts required that sellers meter ground water use. The local water district then released an equal amount of surface water to the Bank. The pumped ground water was used only on lands overlying its source. To ensure that pumping did not harm local ground water basins, monitoring programs were established in Yuba, Butte, and Yolo Counties. Yolo and Butte Counties also received a two percent payment on selected contracts to fund county water plans.

Reservoir Withdrawal Contracts

Withdrawals from reservoirs for the 1991 Water Bank totaled 147,332 ac-ft. Yuba County Water Agency (YCWA) agreed to transfer 99,200 ac-ft from its New Bullards Bar Reservoir. An additional 30,000 ac-ft would be stored in the reservoir on behalf of DWR for release in 1992. Separately, DWR acquired 28,000 ac-ft for the DFG for instream flow releases and wildlife refuges in the San Joaquin Valley. In sum YCWA sold 157,200 ac-ft of water to DWR. Water for DFG was pur-

23. HOWITT ET AL., *supra* note 17, at 18. *See also* AGRICULTURAL ISSUES CENTER, UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA WATER TRANSFERS: GAINERS AND LOSERS IN TWO NORTHERN COUNTIES 16 (1993) (providing analytical results of direct and third-party impacts of water transfers on Yolo and Solano counties).

24. Linton Brown, Sorting Out New Water, Real Water, and Paper Water (Nov. 12, 1992) (presented at UCLA Conference, Buying and Selling Water in California).

chased at a discounted price of $50/ac-ft. Water for the Water Bank was bought at the usual $125/ac-ft.

Selling Price

The selling price of Water Bank water was $175/ac-ft for water delivered at the SWP's Delta pumping plant at the entrance to the California Aqueduct. The price included all acquisition and administrative costs borne by DWR, as well as costs incurred to satisfy outflow requirements for moving water through the Sacramento-San Joaquin Delta. A deposit equal to 50 percent of the purchase price was required within seven days of enlisting in the Bank. Within fifteen days, 75 percent of the cost had to be deposited. The balance was due prior to water delivery.

Most Bank water was delivered through SWP facilities. The costs for using these facilities were negotiated in separate conveyance contracts. The SWP contractors purchasing Bank water paid primarily for the energy to pump water to the contractor's area. Non-SWP contractors were charged an additional use-of-facilities fee, a proportional share of the capital and annual operation and maintenance costs of SWP facilities involved in the transfer. Final delivery costs often were several times the original purchase price. A typical conveyance contract would stipulate points and rates of water delivery, as well as costs for using SWP facilities for conveyance and storage. Some costs were tied to the quantity of water transferred or stored, others were lump sum payments.

Allocations from the 1991 Drought Water Bank

Allocation of Bank water by DWR was prioritized based on 'Critical Needs' to assure participants that the most urgent demands were satisfied first. Allocations were made according to the following priorities. First,

> water to meet identified emergency needs, such as health and safety;
> second, water for areas with critical needs, defined as: urban water users with less than a 75 percent supply, agricultural users who need water to assure the survival of permanent or high value crops, and fish and wildlife resources;
> third, water for entities previously receiving allocations for critical needs and who need additional supplies to reduce substantial economic impacts resulting from reduced water supplies

fourth, carryover storage for the SWP.[25]

Before purchasing water, buyers had to demonstrate maximum use of current available water supplies, implementation of a satisfactory water conservation programs, and ability to provide fund their purchases from the Bank. Additional criteria depended on the intended use of the purchased water.[26]

A total of 389,970 ac-ft was purchased from the 1991 Water Bank by 12 entities, compared to 348 entities selling water. Three jurisdictions, Metropolitan Water District of Southern California (MWD), Kern County Water Agency and the San Francisco Water District accounted for over 80 percent of the purchases. MWD alone purchased 55 percent. Roughly 80 percent of 1991 Water Bank sales were for municipal and industrial uses.[27]

Table 2
1991 Drought Water Bank Allocations

Location	Amount Allocated	Percent of Total
Alameda Co. Flood Control & Water Con. District	500	0.1
Alameda Co. Water District	14,800	3.8
American Canyon Co. Water District	370	0.1
City of San Francisco	50,000	12.8
Contra Costa Water District	6,717	1.7
Crestline-Lake Arrowhead Water Agency	236	0.1
Dudley Ridge Water District	13,805	3.5
Kern County Water Agency	53,997	13.8
Oak Flat Water District	975	0.3
Santa Clara Valley Water District	19,750	5.1
Metropolitan Water District of Southern Ca.	215,000	55.2
Westlands Water District	13,820	3.5
TOTAL	389,970	100.0

Source: DWR 1992

The difference between total Water Bank purchases (820,665 ac-ft) and total allocations (389,970 ac-ft) has two explanations. First, to satisfy Delta water quality requirements, DWR must release between 20 to 30 percent more water into the Delta than it pumps from the Delta. These carriage water requirements for Delta water quality account for 165,137 ac-ft of the difference. Second, DWR purchased all unallocated Water Bank supplies providing a financial backstop for the program. This 265,558 ac-ft was used for carryover storage.

Drought Bank Operations

Enabling legislation for the 1991 Water Bank required that use of SWP facilities by the Water Bank not conflict with operations needed to

25. DWR, *supra* note 15, at 9.
26. LUND ET AL., *supra* note 16, at 49.
27. Buyers and quantities purchased from the 1991 Water Bank are shown in Table 2.

provide water to SWP contractors or to meet other state obligations. Thus, transferred water received lowest conveyance and storage priority in state facilities. This low transfer priority in operations required substantial coordination to match storage and delivery operations with the availability of Water Bank supplies. Both the SWP and CVP adjusted reservoir operations and Delta export pumping schedules to the greatest extent possible to accommodate deliveries of Bank water as well as to protect fisheries.

As noted by Howitt *et al.*, "(p)erhaps the most innovative operations of the SWP and CVP systems involved the acquisitions of water from holders of riparian rights who fallowed their lands."[28] By law, riparian rights cannot be transferred, and yet the Bank was able to acquire water from holders of these rights. To meet Delta environmental standards, the SWP and CVP must frequently release water from upstream reservoirs. Riparian water right holders participating in the fallowing contracts do not exercise their water rights, allowing the water to stay in the rivers and channels. In doing so, the additional water retained in the Delta channels enables the SWP and CVP to decrease releases from upstream storage, making more available for other water demands.

EVALUATION OF THE 1991 DROUGHT WATER BANK

Numerous parties from diverse sectors expressed concerns about the effects of transferring water to the Water Bank. The most pressing issues involved effects on local agriculture-based economies, ground water basins, and the environment. However, the Water Bank was instituted in the midst of a severe drought and during an economic recession, making it more difficult to estimate Water Bank impacts directly and independently of other events.

The impact of fallowing on the agricultural economy for selected counties was measured in terms of acreage or the value of output.[29] Examination of the pattern of fallowing by crop and by county revealed that 1991 fallowing was well within the normal fluctuations of agricultural activity. The effects of the Bank on the local economies of selling counties were relatively small, estimated at less than one percent of 1989 county personal income and 1989 county employment, even though all estimates neglected Water Bank revenues on the county's local economy. Members of the agricultural communities argued that many businesses could survive one year of loss, but not consecutive or frequent losses.

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28. HOWITT ET AL., *supra* note 17, at 15.
29. *Id.* at 17.

Overall, trading water through the Water Bank created substantial economic gains for both California agriculture and the statewide economy, although there were localized regions which suffered economically.[30]

The potential impacts on ground water extraction included lowered ground water levels, increased pumping costs or costs for deepening wells, subsidence, and decreased ground water quality. Ground water monitoring programs were established in Yuba, Yolo, and Butte Counties. Where ground water levels were of particular concern, data loggers were installed on a few wells to record well levels on an hourly basis. Additional elements of the monitoring program included collection of water quality data and aquifer testing. The Yolo County program also included provisions for monitoring ground subsidence due to ground water pumping. However, it is difficult to separate the effects of increased ground water pumping due to the drought and due to the Water Bank.

The effects of the drought on fish and wildlife habitat were of particular concern to environmental groups. Modifications to SWP operations, including Water Bank transfers, were made to reduce impacts on Delta fisheries. Although Water Bank operations were designed to have reduced impacts on fisheries and wildlife, not all impacts could be eliminated. The fallowing of agricultural land stripped some waterfowl of temporary habitat and refuges. To mitigate the indirect and cumulative impacts of water transfers on striped bass, DWR purchased an additional 300,000 yearling striped bass for release into the Delta and purchased additional water for instream flow use.[31]

Some Water Bank operations provided benefits to fish and wildlife that would not have existed without the Bank. Capture of juvenile fish in unscreened pumps and diversions in the Delta and Sacramento River was reduced since water diversions to farmland were reduced under the fallowing contracts. Fallowing lands also provided the opportunity to retain more water in reservoirs until later in the season. This helped cool autumn river temperatures to benefit the fall run salmon. Reduction of irrigated acreage also reduced salts and chemical loading in return flows to the Delta.

In addition to the direct impacts of Water Bank operations, third parties not directly involved in the water transfers and environmental interests raised concerns pertaining to management of the Bank. In particular, they argued that there was little opportunity to comment on or participate in Water Bank operations or negotiations. Representatives

30. *Id.* at 20. *See generally* AGRICULTURAL ISSUES CENTER, *supra* note 23.

31. DWR, *supra* note 15, at 18.

of local communities further criticized the secrecy of water negotiations and felt that workers and owners of farm-related businesses should have been informed quickly of decreases in agricultural production. Some water appropriators also claimed that insufficient information was available to make informed decisions about selling water to the Bank.

Recommendations Incorporated in 1992 Water Bank

In response to the above criticisms, recommendations for future bank operations were presented,[32] several of which were incorporated into the 1992 Water Bank: early notice, contracting guidelines, and a dual-class system of contracts.

Early Notice—To improve participation of potential sellers, DWR should announce the formation of a water bank early enough so growers could consider the opportunity as they plan for an upcoming irrigation season. Notice should include the planned scope of Water Bank acquisitions, terms and conditions of contracts, and the nature of Bank operations.

Contracting Guidelines—To implement more complex contracting strategies, DWR should develop and publish formal contracting guidelines. This would improve the administrative efficiency of the water bank and avoid criticism concerning equal contract opportunities for all sellers. The contract guideline document should explain:

(1) the various types of contracts available to sellers;
(2) what a seller should expect to receive from each type of contract;
(3) the documentation needed under each type of contract; and
(4) how the Water Bank will administer each type of contract.

Dual-Class System of Contracts—A dual-class system of contracts consisting of early and late commitment contracts would offer a mechanism for rewarding sellers and buyers who enter into early Bank commitments. The price escalation clause provided an important incentive for sellers to participate in the 1991 Water Bank. However, no rewards were given to buyers for early commitment.

The dual-class system would consist of early contracts or option-agreements arranged before some cut-off date (e.g. January 1), and late contracts, consisting of non-option agreements arranged after the cut-off date. Under the early contracts, the Water Bank would assure sellers a reservation fee to purchase the right to decide by a trigger date (e.g. February 15) whether to buy the amount of water under the terms and conditions specified in the contract. The sellers receive the reserva-

32. HOWITT ET AL., *supra* note 17.

tion fee whether or not DWR exercises its option to purchase water for the Bank. In addition, if DWR acted on the option, it would pay the sellers a *water purchase price* based on the amount of water purchased by the trigger date. Therefore, the dual-class system of contracts rewards sellers and buyers that commit early and would enable the price escalation clause to be dropped from water purchase contracts.

Additional Recommendations—Additional recommendations dealt with land fallowing, including the need to develop accurate and defensible crop water use patterns, the need to structure acquisition prices to reflect differences in yield, and the need to establish limits on the amount of fallowed acreage permitted per region.

THE 1992 DROUGHT WATER BANK

Hydrologic conditions in California had not improved by spring of 1992 and a similar, but smaller Drought Water Bank was established by DWR. The DWR water purchase price for the 1992 Bank was $50/ac-ft. The selling price was $72/ac-ft. Again, separate contracts were drawn between the state and buyers for use of state facilities.

Allocations from the 1992 Bank totaled 158,715 ac-ft.[33] Agricultural purchases constituted roughly 60 percent of all Bank allocations. Twelve agricultural water districts participated in the 1992 Water Bank, but two, Tulare Lake Basin Water Service District and Westlands Water District, accounted for roughly 87 percent of all agricultural purchases. Purchases by DFG accounted for roughly 15 percent and municipal and industrial demands represented approximately 25 percent of total purchases (39,000 ac-ft).

Ground water substitution accounted for 161,593 ac-ft of the water purchased by the Water Bank. The balance, 31,600 ac-ft, came from direct surface water contracts. Out of a total of 193,193 ac-ft, 34,478 ac-ft were set aside to meet Delta water quality requirements.

Participants in the 1992 Water Bank were permitted to carry over undelivered Bank water for final delivery before December 31, 1995. However, carryover water receives the lowest priority in facilities owned and operated by the state and is subject to substantial storage costs. Carryover Bank water can be lost by spillage if reservoir storage capacity is required for SWP purposes or other state needs.

33. Buyers and quantities purchased from the 1992 Water Bank are shown in Table 3.

Table 3
1992 Drought Water Bank Allocations

Purchaser	Amount Allocated	Percent of Total
ALLOCATION TO AGRICULTURAL DEMANDS		
Broadview Water District	255	0.1
Del Puerto Water District	300	0.2
Foothill Water District	900	0.6
Hospital Water District	200	0.1
Kern County Water Agency	8,170	5.1
Orestimba Water District	75	0.05
Panoche Water District	2,000	1.3
Quinto Water District	100	0.06
Solado Water District	300	0.2
Sunflower Water District	400	0.3
Tulare Lake Basin Water Service District	31,550	19.9
Westlands Water District	51,000	32.1
TOTAL AGRICULTURAL USES	95,250	60.0
ALLOCATION TO FISH AND WILDLIFE DEMANDS		
Department of Fish and Game	24,465	15.4
ALLOCATION TO URBAN DEMANDS		
City and County of San Francisco	19,000	12.0
Contra Costa Water District	10,000	6.3
Metropolitan Water District of Southern California	10,000	6.3
TOTAL URBAN USES	39,000	24.6
TOTAL ALLOCATIONS FOR ALL USES	158,715	100

Source: DWR 1992

COMPARISON OF THE 1991 AND 1992 DROUGHT WATER BANKS

Although conceived for the same general purposes, the 1992 Water Bank was modified based on experiences from the 1991 Water Bank. While 1992 was a drought year, the somewhat improved hydrologic conditions influenced the scale, structure, and operations of the 1992 Bank. A comparison of the 1991 and 1992 Water Banks is presented below.[34]

A Smaller 1992 Water Bank

The 1992 Bank was smaller than the 1991 Bank both in the quantity of water transferred and in number of participants. Although the number of purchasers increased from twelve in 1991 to sixteen in the

34. LUND ET AL., *supra* note 16, at 62.

1992 Bank, the number of sellers dropped considerably from 348 to eleven. The amount of water purchased by DWR decreased from 820,665 ac-ft in 1991 to 193,193 ac-ft in 1992. Two factors account for these differences between the 1991 and 1992 Water Banks. First, heavy precipitation in the early months of 1992 reduced water demand from 1991 levels. Requests for water from the 1992 Bank totaled only 158,715 ac-ft. Second, the reduced water demands in 1992 required lowering the price of water, which may have kept prospective sellers from participating in the 1992 Water Bank.

The 1992 Agricultural Water Bank

The 1992 Bank primarily facilitated the transfer of water between agricultural parties. Twelve of the sixteen water purchasers were agricultural users, and their purchases accounted for about 60 percent of water allocated by the Bank. The large urban users which dominated the 1991 Water Bank, MWD, San Francisco WD, Santa Clara Valley WD and Contra Costa WD, did not request significant amounts of water from the 1992 Water Bank. Rainfall in February 1992 replenished urban water supply reservoirs along the central and southern coast areas, reducing urban demand for imported water. Agricultural areas which depend on ground water for irrigation benefited less from the February 1992 rainfall. Also, lower prices made water purchase for agriculture more economical.

1992 Water Bank Underwritten by Buyers

In 1992, the state assumed less financial responsibility for the Water Bank than it did in 1991. A criticism of the 1991 Bank was that water was purchased based on early demands, many of which were not followed with signed contracts. The 1991 Water Bank ended with a surplus of 265,558 ac-ft as carryover storage at a cost of about $45 million. This situation led Howitt *et al.* to conclude that "the over-acquisition of water was an unavoidable consequence of the lack of negotiated agreements before the drought emergency and an understandable lack of knowledge about the supply and demand for Bank water."[35] To ensure against repeating this behavior, no water purchases were made by DWR for the 1992 Bank unless there was a willing buyer who had previously entered into a contractual agreement. In this sense, DWR behaved as a true broker, matching supply to real demands.

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35. HOWITT ET AL., *supra* note 17.

Land Fallowing Not Permitted

Many criticisms of the 1991 Water Bank resulted from the land fallowing program. To avoid these criticisms, the 1992 Water Bank did not purchase water conserved through the fallowing of agricultural lands. DWR only acquired water through ground water exchange and stored surface water contracts. This helped procedurally, environmentally, and politically. However, had demands been higher in 1992, it is likely that a land fallowing program would have been needed to provide additional water to the Bank.

System of Pools

The 1992 Water Bank used a system of "pools" to record purchases and sales of water to and from the Bank. A "pool" was defined as a portion of Bank water sold to Members (contractors) at a single melded rate. The Pool Melded Rate was the total cost incurred by DWR to acquire water, including amounts paid to sellers of water; legal, administrative and financing costs; the impact of carriage water and other losses; refill impacts; and the costs of monitoring the impacts of water loss in the counties of origin, all divided by the amount of Bank water in that pool available for delivery.[36] Each pool represented a specified demand to be met by the Bank. A new pool was created when supply and demand conditions changed; for example, when a contractor requested increased allocation, when new contracts for water were executed, or when the critical needs of a pool were satisfied. Although, the price for water from each pool was uniquely established for that pool, it did not necessarily have to change as a new pool was created. The 1992 Water Bank operated six pools, each at the same rate.

Option and Purchase Deposits and Contracts

DWR developed several standard contracts to purchase water from different parts of the state under different circumstances, including contracts for the option to buy water. Along with a request for water, contractors were required to submit a deposit for either the purchase or the option to purchase a quantity of water not to exceed their estimate of critical needs. Option deposits were $20/ac-ft ($10/ac-ft for sellers, $5/ac-ft for Delta carriage losses, and $5/ac-ft administrative charge). Contractors requesting options to buy had to specify the month they

36. CALIFORNIA DEP'T OF WATER RES., CONTRACT FOR WATER SERVICE FROM A 1992 CALIFORNIA DROUGHT EMERGENCY WATER BANK (1992).

would exercise their option. Once an option was exercised, the contractos had to pay the prevailing Pool Melded Rate for water.

Wildlife Concerns

Fish and Wildlife water demands during the drought were a primary concern of the 1992 Water Bank. DFG purchased 24,465 ac-ft of water for preserving fish and wildlife habitat. This represented a significant change from the 1991 Water Bank, in which no direct Water Bank purchases were made for fish and wildlife habitat preservation.

Federal Involvement

The Bureau of Reclamation assumed an active role in coordinating 1992 Water Bank operations. Specifically, the Reclamation States Emergency Drought Relief Act of 1991 permitted use of Federal facilities to convey non-CVP water. Also, acreage limitations for use of Federal water were waived, making it easier to transfer Federal water to both Federal and non-Federal entities.

LESSONS FROM THE STATE-OPERATED WATER BANKS

The experiences of the Drought Water Banks of 1991 and 1992 provide water managers and planners with numerous lessons for the operation of large-scale water banks and for the long-term management of water resources in general. A few of these lessons are discussed below.

State-operated Water Banks have several advantages

The 1991 and 1992 Water Banks demonstrated that centralized water banks can succeed even where non-bank transfers are allowed and are active. Centralized water banks have four advantages:

1) They provided a greater chance for successfully completing a transfer for buyers and sellers dealing directly with the Bank.[37] This is due to the relatively straight-forward nature of Water Bank contracting and negotiations, but also due to the reduced likelihood of third-party interference in Bank transfers supported by State legislation waiving environmental impact review of transfers during 1991 and 1992.

37. Jay R. Lund, *Transaction Risk Versus Transaction Costs in Water Transfers*, 29 WATER RESOURCES RES. 3103-07 (1993).

2) A centralized water bank, particularly a State-sponsored bank, can substantialmy reduce the transaction costs of water transfers. Most of the terms of the 1991 and 1992 Water Banks transfers were standardized and the transfer process was clear.
3) State funds provide initial working capital for a bank program.
4) The State facilitates coordination of transfers with other water movements in the state.

All sectors are interested in purchasing water

The Drought Water Banks demonstrated that parties in all major water-using sectors, agricultural, urban, and environmental are interested in buying water. Some agricultural users are willing to pay high prices for water during drought years. During 1991, significant amounts of water were purchased at $175/ac-ft by agricultural users, primarily those with high-valued and perennial crops. However, most agricultural users can not afford these prices, and it is doubtful if any agricultural users would purchase water at $175/ac-ft on a continual basis.

There is a substantial interest in selling water in drought years

The 1991 and 1992 Water Banks revealed that many agricultural water users are interested in selling water, at least during drought years. Most of the water purchased in both years came from agricultural water users. However, seller participation is price-sensitive. With high price expectations created by the 1991 Water Bank, fewer sellers agreed to the lower price offered by the 1992 Bank.

Special legislation may be required

The 1991 and 1992 Water Banks were successful, in part, because many legislative and institutional constraints which hamper water transfers under normal conditions, were waived by the State. No Environmental Impact Reports were required by the regulatory agencies and the Board provided almost blanket approval of transfers involving the Water Bank. Such special conditions greatly reduced the transaction costs and transaction uncertainty of Water Bank transfers, relative to other forms of transfers and water transfers in non-drought years.

Transfers can occur between water years

Excess purchases in 1991 of 265,558 ac-ft increased carryover storage for the SWP in 1992. Water Bank purchases may usefully function for either recouping or maintaining overyear storage as a hedge against

potentially worse drought impacts in future years of multi-year droughts. Advance purchases, however, should be made only at a reduced price compared to purchases made for use in the same year.

NON-STATE SPONSORED WATER TRANSFERS AND EXCHANGES IN CALIFORNIA

Although the state-administered Water Banks discussed above have drawn widespread attention, many water transfers and exchanges have occurred independently of state programs. This section presents examples of non-state water transfer activity to provide the reader with a flavor for the types of water management strategies to which water transfers can be applied, the diversity of forms that water transfers can take, and the flexibility that these transfers can add to individual and regional water systems. For the most part, the following discussion is organized according the major sponsoring agency.

Transfers Involving the Metropolitan Water District of Southern California

Almost two-thirds of the water used within the MWD is imported water. The balance is provided by local surface and ground water sources. The volume of water supplied by external sources varies substantially over time and is currently insufficient to meet the MWD's long-term water demands. To increase the reliability and yield of its water supply, MWD has long pursued alternative sources of water, including water transfers, exchanges, and innovative wheeling arrangements. Some notable examples are noted below.

Imperial Irrigation District-MWD Transfers

To respond to directives from the Board that the Imperial Irrigation District (IID) conserve water, MWD attempted to establish an agreement with IID to fund water conservation measures within the District in exchange for the conserved water. The water transfer agreement involves a 35-year contract for MWD payments for canal lining and other system improvements in IID's irrigation infrastructure in exchange for the water saved by these improvements. The savings are estimated at 100,000 ac-ft/yr of water from IID's Colorado River water supplies. The settlement, endorsed by the Board, helped preserve IID's original water rights at little cost. Under the agreement, MWD will pay approximately $92 million for the capital costs of irrigation system

improvements, over $3 million/year in operation and maintenance expenses, and up to $23 million in liability for indirect costs.[38]

Coachella Valley Water District and Desert Water Agency Exchanges

In 1967, MWD entered into long-term water exchange agreements with Coachella Valley Water District (CVWD) and Desert Water Agency (DWA). The mutual benefit of these agreements derives from several factors. First, CVWD and DWA have entitlements to water from the SWP but have no direct access to this water. By exchanging their SWP entitlements for a portion of MWD's Colorado River entitlements, both water agencies realize their SWP entitlements. Second, CVWD and DWA typically use ground water and are concerned with over-pumping their aquifers. Use of Colorado River water should alleviate these concerns. Finally, MWD can improve overall water quality and reduce treatment costs because SWP water acquired from CVWD and DWA is less saline than Colorado River water.

The CVWD-MWD exchange is for up to 61,000 ac-ft annually. The DWA-MWD exchange varies with DWA's SWP entitlements, which increase to a maximum of 38,100 ac-ft by the year 2035. Because they involve Colorado River water, these water exchanges are not regulated by the Board.

A 1984 supplemental agreement allowing MWD to make advance deliveries of Colorado River entitlements to the water agencies for ground water storage (up to 600,000 ac-ft). This allows MWD to take full delivery of both Colorado River and SWP entitlements during droughts so that CVWD and DWA could use stored ground water.[39]

Arvin-Edison Exchange Agreement

MWD and the Arvin-Edison Water Storage District (AEWSD) have filed a request with the Board for a long-term water exchange contract. During wet years up to 135,000 ac-ft per year of MWD's SWP entitlements would be used in AEWSD for aquifer recharging or irrigation. In dry years AEWSD would use ground water, making their surface water entitlements to the CVP (128,300 ac-ft) available to MWD.[40]

SWP facilities would deliver CVP water to MWD and SWP deliveries to AEWSD would use SWP and locally-owned facilities. The proposed exchange requires that diversion location for Bureau of Reclamation

38. Gray, *supra* note 14, at 36.
39. *Id.* at 33.
40. *Id.* at 22.

federal water rights be amended by the Board and that MWD be added to the Bureau of Reclamation's service area.

Transfers within the Federal Central Valley Project

The transfer of water between contractors of the Bureau of Reclamation's Central Valley Project has been an integral part of CVP operations since its inception. The vast network of storage, pumping, and conveyance facilities has been used to transfer surface and ground water to increase CVP supplies, reduce costs, and to improve the timing and efficiency of deliveries to CVP contractors.

Since the Bureau of Reclamation's water rights for the CVP specify the entire Central Valley as the source and place of use, these water transfers are typically not subject to regulation by the Board. The only transfers which must be reported are those proposing to change the type of water use, for example, from agriculture to urban uses. Most transfers occur between agricultural users, and most of these transfers have occurred by ad hoc agreements between individual contractors.

In addition to over 1,200 routine water transfers between individual CVP contractors, other Bureau of Reclamation transfer arrangements include special pooling arrangements between groups of contractors, Bureau of Reclamation transfers involving the SWP, and the Federal water bank that operated during the 1977 drought.[41] The recently passed CVP Improvement Act (PL 102-575) permits individual CVP contractors to transfer water outside of the Project. This increased flexibility should bolster water transfer activity.

East Bay Municipal Utility District's Experiences

The East Bay Municipal Utility District (EBMUD) made several water transfer attempts during the 1987 to 1992 drought.[42] While some transfers have given EBMUD greater flexibility in managing drought conditions, the agency's transfer experiences have not been altogether positive. The first transfer attempt was an innovative effort to pump low-quality water from the Delta roughly 200 feet to the Comanche Reservoir, where it would be used to satisfy downstream flow requirements. This would make an equivalent amount of high-quality water available for EBMUD's urban uses; about 58 million gallons per day (mgd), or roughly twenty-five percent of normal EBMUD water demand. However, the application to change the point of use for this water was

41. WAHL, *supra* note 13, at 136.
42. LUND ET AL., *supra* note 16, at 71.

rejected by the Board primarily due to the potential for introducing new species and diseases from Delta waters into the mountain-fed Comanche Reservoir and the Mokelumne River. The exchange was also strongly opposed by downstream users.[43]

In a second attempted transfer, EBMUD sought to purchase water from users downstream of its reservoirs to make more water available for EBMUD's demands. Offers of roughly $50/ac-ft were made, but no purchases were completed.[44] Finally, in February 1989, EBMUD purchased 60,000 ac-ft of water at $45/ac-ft.[45] However, heavy March rains eliminated need for this water, and it was later re-sold to the DFG at substantially lower prices.

EBMUD's water quality exchange and downstream water purchase proposals were highly innovative ideas. Their failure highlights the still-formidable barriers to transfers, even during drought.

Transfers in Solano County

In 1991, Solano County established a county-wide water bank to facilitate local water transfers. Transfers and exchanges within Solano County were not new. There have been numerous small transfer arrangements between irrigators and cities and among cities for almost 20 years.[46] However, the 1991 shortages threatened a major portion of SWP's urban water supplies. At the same time, farmers relying on an independent Bureau of Reclamation project benefited from relatively abundant water supplies, creating incentives for transfers within the region. The total amount of farm to city bank transfers were 13,400 ac-ft. Cities paid $200/ac-ft, of which $170/ac-ft went to farmers in exchange for the fallowing of fields. The remaining $30/ac-ft paid administrative costs. A constant 3 ac-ft of water per acre fallowed was assumed as the amount of water saved due to field fallowing.

The Solano County example illustrates that having previous, small-scale experience with water transfers can facilitate larger-scale drought transfers and increase the ability of local regional water agencies to foster transfers with little state or federal involvement.[47]

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43. Gray, *supra* note 14, at 18.

44. NAT'L RES. Council, *supra* note 4, at 33.

45. P. Melton, *EBMUD Makes $2.7 Million Water Purchase*, LODI NEWS-SENTINEL, Feb. 22, 1989, at 1.

46. LUND ET AL., *supra* note 16, at 72.

47. *Id.*

Transfers Involving the San Francisco Water Department

The San Francisco Water Department (SFWD) purchased water from several agencies and their experiences draw attention to the numerous technical impediments facing water transfers. In 1990 SFWD purchased 15,000 ac-ft from Placer County.[48] Final delivery to SFWD required construction of an emergency turnout from the SWP's South Bay Aqueduct. The implementation of this physical transfer of water was further complicated by environmental constraints in the Delta and Sacramento River. These factors, combined with a thirty percent carriage water requirement for all flows through the Delta reduced final SFWD deliveries to about 7,600 ac-ft, slightly more than fifty percent of the original purchase. The purchase price was about $45/ac-ft. However, wheeling charges through federal and state facilities were between $250-350/ac-ft.

In 1991 SFWD purchased 50,000 ac-ft from the Water Bank, an amount that exceeded the capacity of SFWD's South Bay Aqueduct turnout and surpassed the ability of SFWD's treatment plants to blend low-quality Delta water from the Water Bank with its own high-quality waters from the Hetch Hetchy system. SFWD contracted with the SWP to store some purchased water in State facilities. However, under the storage contract, transferred water is the first to be spilled from storage as the reservoir fills. As a result, of the original 50,000 ac-ft purchased, approximately seventy-eight percent arrived at SFWD's system.[49]

The SFWD transfers demonstrate the importance of coordinated movement of transferred water through conveyance and storage systems operated by third-party agencies and constrained by environmental, contractual, and physical limitations.[50]

Yuba County Water Agency Sales

The Yuba County Water Agency (YCWA) was the largest seller of water throughout the recent drought. This occurred because YCWA constructed almost 1.0 million ac-ft (MAF) of storage capacity well in advance of irrigation demands in its service area. This situation provided YCWA with substantial amounts of surplus water in most years. Until the drought, transfers from the YCWA remained at a level of a few

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48. Norman H. Lougee, *Uncertainties in Planning Inter-Agency Water Supply Transfers, in* WATER RESOURCES PLANNING AND MANAGEMENT AND URBAN WATER RESOURCES 601 (Jerry L. Anderson ed., 1991).

49. *Id.*

50. LUND ET AL., *supra* note 16, at 73.

thousand acre-feet per year.[51] However, during the first four years of the 1987 to 1992 drought, YCWA sold roughly 290,000 ac-ft of water to other water users (exclusive of carriage water). YCWA then sold 157,200 ac-ft to the Water Bank in 1991. Water sales to the 1991 Water Bank included provisions for sales to DWR in 1992.

After years of permitting these sales, the Board in 1991 called into question the quantity of Yuba County's water rights. This was due to the Board's feeling that Yuba County's rights should be curtailed due to lack of diligence in putting this water to use within the agency's designated place of use, a requirement for beneficial use under the State Water Code.

YCWA's transfers illustrates the potential benefits and risks to water supply developers of developing supplies prior to the expansion of water demands within their service area, if a market can be found for the temporary excess in water supply yield.

TYPES OF WATER TRANSFERS AND EXCHANGES

The following discussion focuses on different types of transfers and exchanges employed by various water institutions throughout the State.

Interagency Storage Projects

A number of interagency storage projects have been planned recently that improve the yield and reliability of California's water systems and facilitate water transfers. Interagency storage projects require the type of conveyance and storage facilities and coordination required for water transfers.

Kern Water Bank

The Kern Water Bank is a SWP conjunctive use project in the San Joaquin Valley. The intent is to store surplus water in wet years as ground water and to deplete this storage during dry years. The effective storage capacity of this site might be as high as 1.0 MAF, increasing the yield of the SWP by as much as 0.14 MAF/yr.[52] An additional advantage of this site is that it lies south of the Sacramento-San Joaquin Delta, avoiding much of the environmental constraints on operations associated with this estuary.

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51. Gray, *supra* note 14, at 12.

52. Elizabeth S. Andrews, Simulation of Kern County, California's Conveyance System, Including Groundwater Recharge (1989) (unpublished Masters thesis, Dep't of Civil Engineering, University of California (Davis)).

Sacramento Regional Cooperation

A similar conjunctive use scheme has been proposed for part of the Sacramento metropolitan region. The City of Sacramento has excess water entitlements to surface water from the American River. However, neighboring suburban districts, using ground water, are faced with declining ground water tables and occasional ground water quality problems. One strategy for overcoming this problem is to use surplus surface water entitlements to supply selected suburban areas during wet years. During dry years, when surface water would be less available, these suburban areas would revert to ground water supplies, improving the reliability of all systems and reducing ground water depletion.[53]

Pumped Storage

A number of large off-stream pumped storage reservoirs are currently being planned south of the Delta. In some cases, the reservoirs might be jointly operated by several agencies. Adding large amounts of off-stream storage south of the Delta would enhance the ability of water users in this region to participate in water transfers, as it would facilitate increased pumping of water through the Delta in wet periods and allow storage of this water until the water is needed.

Transfers of Conserved Urban Water

The City of Morro Bay, in southern California, adopted an innovative twist on the transfer of conserved water. Since 1985, new real estate developments have been required to install water conservation measures in existing structures to more than match the water use of the new development. Water conserved by retrofitting existing development is applied to new development, with developers paying the costs of water conservation. For an urban system, it encourages water conservation in new development, accelerates water conservation in existing structures, and finances these activities.[54] The program is an interesting analogy to the trading of conserved water for the conservation costs seen in the IID-MWD water transfer.

A somewhat different form of transfer of conserved urban water is the unofficial, unmanaged, and uncompensated transfer of conserved urban water to agricultural uses in some agricultural regions of Cali-

53. METCALF & EDDY, SACRAMENTO AREA WATER RESOURCES MANAGEMENT PLAN (1985).

54. Robert U. Reed, Transferable Allocations in Urban Water Management: Short- and Long-Term (1990) (unpublished Masters thesis, Dep't of Civil Engineering, University of California (Davis)).

fornia. In Yolo County, for instance, urban users reduced ground water consumption by over ten percent in most drought years through water conservation. This water is available to supply nearby agricultural ground water use and reduce agricultural pumping heads. However, the impact of these relatively small unmanaged transfers would be imperceptible in many cases.

Payments for Water Conservation

Several California water utilities offer payments to customers for specific measures to reduce water demand. The most common offer is payment to install low-flow toilets (1.6 gallons/flush), high pressure shower heads, and other water saving fixtures. The cities of Santa Barbara, Santa Monica, and Los Angeles offer rebates between $80 and $100 per toilet. EBMUD has considered offers of up to $300 per single family household and $5,000/multifamily unit to install water-saving landscaping meeting district-set criteria.[55] North Marin Water District has developed a "Cash for Grass" program where residents are paid to reduce the their yard area kept as lawn, with maximum payments of $310 per house.

Payments for Alternative Water Supplies

In some cases agencies or firms have been paid to use alternative water sources during drought. This is common downstream of the Delta when SWP operations can reduce the availability of sufficient quality water at some of the diversion locations. Under these conditions the City of Antioch and the Contra Costa Water District are paid by the SWP for use of substitute water supplies. As additional SWP releases to the ocean through the Delta would be needed to reduce salinity levels at these locations, paying to replace these diversions, which have relatively senior water rights, increases the SWP's ability to withdraw water from the Delta.[56]

Innovative Wheeling

The legal, institutional, and economic will to effect water transfers and exchanges is not always enough. Successful transfers also require tremendous amounts of cooperation and coordination among numerous agencies. Many of the transfers discussed above succeeded because of

55. EAST BAY MUNICIPAL UTILITY DISTRICT, OAKLAND, CA, URBAN WATER MANAGEMENT PLAN (1991).

56. LUND ET AL., *supra* note 16, at 76.

innovative schemes to wheel the water from its place of origin to its place of use. Wheeling arrangements can be crucial in emergency situations, but they are also very important for helping meet water supply needs under normal conditions in a timely and cost-efficient manner. Santa Barbara provides an example of one type of wheeling arrangement.

The Santa Barbara region is normally considered hydraulically isolated from the rest of the state's water resources. The region was severely affected by drought in 1991 and sought forty-five percent reductions in water demand. However, Santa Barbara County was able to take delivery of 3,600 ac-ft of SWP water through a complex series of wheeling and exchange agreements with neighboring coastal counties.

CONCLUSIONS

Water transfers in California have occurred in a bewildering variety of ways. Each transfer has stemmed from substantial advantage to each side, even though money might not be exchanged and the prices paid might be arguably below market values. While the motivations for many trades have been financial, there have been other important motivations for participating in water transfers or exchanges.

The 1991 and 1992 Drought Emergency Water Banks have provided the opportunity "to learn by doing" and "to learn from mistakes". Lessons learned from the 1991 Water Bank were applied in the 1992 Water Bank. Lessons from both these experiences are valuable both for future State Drought Water Banks and for non-State entities interested in establishing Water Banks or other types of water transfers.[57] Taken together with the numerous non-state transfers, California's recent experiences with water transfers suggest several potential lessons for federal, state, and local water managers:[58]

57. DWR did not establish a State-administered Water Bank in 1993, but there were numerous water transfers from individual SWP contractors to the Westlands Water District. A Water Bank that is very similar to the 1992 Water Bank has been established for 1994. The purchase price for the 1994 Water Bank is $50/ac-ft and the melded selling rate is $72/ac-ft. As in the 1992 Water Bank, DWR will not purchase water conserved through the fallowing of agricultural lands, nor will the State make purchases unless a willing buyer has entered into a contractual agreement to buy the water. Anticipated purchases are approximately 225,000 ac-ft.

58. LUND ET AL., *supra* note 16, at 93.

1. Water transfers can enhance the performance and flexibility of existing water systems

These benefits can include: increasing beneficial use of existing supplies, favorable net economic and employment impacts, additional flexibility in drought management, avoidance or reduction of capacity costs, reduced operating costs, and a better match of waters of different qualities with different water demands.

2. Water transfers must be integrated with traditional supply and demand management approaches

Water transfers alone will rarely resolve a region's water supply problems in an economical manner. Typically, a more integrated management approach, employing traditional supply and demand management measures, integrated with water transfers, will provide better results in terms of cost, technical performance, and institutional feasibility.

3. Modification and expansion of infrastructure is often required to take best advantage of water transfers

The operation of existing conveyance, storage, and treatment facilities is likely to require significant changes to facilitate water transfers. In many California cases, transferred water can only be employed if it is stored for dry periods, necessitating new surface water reservoirs or additional use of ground water storage. Conveyance restrictions, both from physical aqueduct capacities and environmental limitations, are common. Although there are considerable physical restrictions, it must be remembered that many of the transfers discussed above could not have been even contemplated were it not for the vast California "plumbing" system.

4. Water transfers can take many forms, each serving a different operational purpose in a water resources system

The California case illustrates the many forms that water transfers can take and the diverse uses for different types of transfer arrangements. Each form of transfer, when utilized for an individual system, can fulfill a different operational purpose and accommodate different legal or third-party considerations.

5. Appropriate use of water transfers will likely vary between systems, reflecting local conditions

Each system is somewhat unique in its supplies, water demands, costs, and alternatives. Different water supply systems will have somewhat different uses for water transfers. Some water systems will not need or be able economically to employ water transfers. This variation in individual system needs helps explain the diverse ways and degrees that water transfers have been employed in California.

6. Water transfers require a broader scope and scale of thinking about water resources management

The use of water transfers in water management implies a regional and inter-regional integration of different water users and supplies. The differences between the demands of urban water systems and irrigation systems are the reason why transfers can be successful to both parties. Implementation of this broader perspective on water planning will require significant changes in water agencies at the local, State, and Federal levels.

7. Environmental, legal, and third-party considerations are important political, planning, and operational considerations in developing and implementing water transfers

Although not the focus of this paper, actual water transfers in California and elsewhere demonstrate the importance of environmental, legal, and third-party impact issues in the successful development and implementation of water transfers. While these issues are formidable, they are not insurmountable. Numerous approaches exist for accommodating, compensating, or mitigating real and potential third-party impacts.

8. Government sponsorship is often required for significant water transfers to begin

State and perhaps Federal governments have an important, and perhaps vital, role in the adoption and acceptance of water transfers in water management. Government has an essential role in accelerating use of water transfers, reducing risk and uncertainty involved in water transfers, reducing costs of completing transfer transactions, and demonstrating leadership in the legal, technical, and conceptual transitions required for agencies to implement water transfers.

9. Drought motivates change

Historically, major changes in water management philosophy have been motivated and incorporated as a result of experiences during droughts. Recent water transfers in California are an example of how drought motivates exploration of new alternatives in water management.

10. Transfers cannot be avoided only delayed

As increasing demands for water make shortages and droughts more frequent and severe, calls for water transfers are likely to become louder and more forceful. After the 1977 drought, California was able to delay significant water transfers for 14 years, until the next major drought. With the recent drought, water transfers are now a significant and permanent feature of water resources planning and management in California.

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