A Return to Unified River Basin Planning and Management.
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I. Introduction.

This paper presents the history and importance of the river basin as the natural unit for river administration and why it is increasingly important for water administration to get back to the river basin framework. Since there is a long history of dividing the river basin into jurisdictions that often have little to do with water, recommendations are made for moving back to the unified basin in ways that recognize the legitimate objectives of these jurisdictions. Under increasing demands and possible climate change, there will be increasing need for greater flexibility in water re-allocation. Water markets promise to provide this flexibility and, on broader geographical scales, to take planning and management back to the river basin level.

II. History of the River Basin as a Planning & Management Unit.[1]

There is a long history of recognition of the river basin as the natural unit for river development, planning and management. However, globally there has been a long history of breaking up river basins among many jurisdictions, many having nothing to do with water. At present, because of the failure to focus development, planning and management on the entire river basin, unplanned detrimental impacts (negative externalities) will increasingly appear. The question is "What politically feasible steps can be taken to move planning and management back to the river basin"?

Over past millenia, the river basin has been used as the entity for river planning and management. The origins of irrigation development in the Tigris and Euphrates Valleys go back to 6000 B.C and involved interdependent diversions from both rivers (Christensen 1993; Postel 1999). China's attempts to control the Yellow River go back to 4000 B.C. The Indus Basin was settled and managed by 2300 B.C. (Postel 1999), while the ingenious Dujianyang irrigation and flood control project on the Min River in Sezchwan Province of China was designed and built around 1600 B.C. by the still revered engineer, Li Bao (Van Slyke 1988).

In the mid-nineteenth century, the faculty of the Ecole National de Ponts et Chaussees (ENPC) in Paris was one of the most prominent promoters of the river basin approach. The "Agences de Basin" proposed by ENPC still constitute the river planning and management agencies of France (Ekrlund and Hebert 1973). In the U.S., the Inland Waterway Commission appointed by President Theodore Roosevelt in 1907 during the early era of "scientific management and the gospel of efficiency" of natural resources (Hays 1958) strongly promoted centralized control of the major rivers and multi-purpose river development.

During the depression of the 1930's, the federal government of the U.S. developed the Tennessee Valley Project- the U.S.'only attempt at basin-wide comprehensive development. (Trelease 1971). The 1965 federal Water Resources Planning Act created the Water Resources Council to coordinate federal water development and management activities (Rogers 1993) and

[1] This section draws on Howe's work as partially reported in Howe, 2005.

also authorized the establishment of new river basin commissions to coordinate federal and state efforts of basin-wide planning

During 1968–1973, the U.S. National Water Commission carried out an extensive set of studies leading to a landmark report, *Water Policies for the Future* (1973). The report strongly emphasized the importance of the basin approach. Under Commission sponsorship, a group chaired by Gary Hart produced a major study, *Institutions for Water Planning-Institutional Arrangements: River Basin Commissions, Inter-Agency Committees and Ad Hoc Coordinating Committees (Hart,1971)* that emphasized the need for a whole basin approach. More recently in 1998, the U.S. Western Water Policy Review Advisory Commission issued an incisive report, *Water in the West: Challenge for the Next Century* that emphasized the need to coordinate the numerous watershed initiatives with river basin goals[2].

In contrast to this long history of focusing on the river basin, many policies in the U.S.and elsewhere since the mid-19th century have had the effect of reducing federal control over water resources and reducing possibilities for basin-wide management (Trelease1971). In the U.S., the 1877 Desert Land Act required that settlers make water claims under state law. The 1897 National Forest Act required those using forest lands to claim water under state laws. The 1902 Reclamation Act required authorized projects to proceed in conformity with state laws for claiming water, as did the Federal Power Act of 1920. The McCarran Amendment (1988) requires all federal agencies to pursue claims for water under state laws.

Many of the institutional arrangements that stand as impediments to comprehensive river basin planning were intended to achieve valid water and non- water- related objectives including the recognition of national sovereignty in the case of international rivers, the goal of stronger roles for the states in water and natural resources management, safeguarding basins of origin and states' water supplies through prohibitions of inter-basin and/or interstate transfers and reluctance to recognize the newer, emerging uses of water. A major U.S. example is found on the Colorado River under the Compact of 1922 (Myers, 1966; Water Education Foundation 1997,1999) that divided the river's water between the four upper basin states and the three lower basin states. The rationale for the compact was to reduce the uncertainty of future water supplies for both basins that was created by the upper basin commanding the origins of the river while the lower basin was growing much faster and rapidly establishing claims to the river's flow. Thus there are trade-offs between the basin-wide benefits that might be achieved through basin-wide management and other public policy objectives..

III. Returning to "Virtual River Basins".

It seems unlikely that nations, states, and all the special districts that currently have a say in water planning and management will simply surrender their prerogatives to unified river basin initiatives. Steps towards basin-wide integration will have to involve rewards to all parties involved. Since institutional change always involves losers as well as winners, progress depends in part on devising ways of creating "win-win" opportunities and/or efficiently compensating the losers.

Several steps could take us toward what we might call "virtual river basins," i.e. not politically nor jurisdictionally unified regions but agreed upon basin-wide water allocation principles and mechanisms that can result in "win-win" improvements.

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[2] In 1982, the Reagan administration down-graded the Water Resources Council to a non-policy status and abolished the river basin commissions that had been established under the 1965 Act. This has left an uncertain, mixed picture of state versus federal water administration, especially across the western states.

A first step would be the adoption of the principle of "benefit sharing" or parallel negotiations in place of just water sharing. In his analysis of the negotiations between the United States and Canada over Columbia River development, Krutilla described the "benefit-sharing" (Krutilla 1967) incorporated in the treaty. Since the Columbia originates in the U.S.,sweeps into the canyons of British Columbia, then returns to the U.S., efficient development required reservoir storage in the canyons of British Columbia to support power generation, navigation and fisheries downstream in the U.S. The solution was to arrange monetary payments and the sharing of electric power from the lower river with British Columbia.

Similar arrangements can be envisioned on other rivers. The treaties between Mexico and the U.S. on the Colorado and Rio Grande Rivers in 1944 involved simultaneous negotiation over the two rivers, since Mexico provided a major portion of the water to the lower Rio Grande while the U.S. commanded all the water of the Colorado. This type of bargaining is referred to as an "interconnected game" (Folmer, v. Mouche and Ragland, 1993) and promises to play a role in getting back to the river basin. The potential gains may be sufficient to overcome the reluctance of nations and states to enter into more comprehensive river management arrangements.

Benefit sharing is most often accomplished through extra-market compensation. This is seen in payments to the basin of origin accompanying out-of-basin water transfers in the western U.S.. The State of Colorado requires "compensatory storage" for any project exporting water from the Colorado River Basin to other basins in the State (Grigg 2003) to provide insurance against diversion-induced shortages in the state's Colorado River Basin. The Bureau of Reclamation built Green Mountain Reservoir on the Blue River (tributary to the Colorado) as compensatory storage for the Colorado-Big Thompson Project (C-BT) that diverts water from the Upper Colorado to the eastern side of the Rocky Mountains. Naturally, compensatory storage may not always be the most efficient form of compensation.

A second step would be to take advantage of newly developed optimization and surveillance technologies that can facilitate basin-wide real time management. Technological developments have made basin-wide, real-time modes of river management practical. Tele-monitoring of streamflows is highly developed while satellite imagery of weather and flood events now makes it possible to allocate water on a basin-wide, real time basis rather than basing allocation on monthly or annual average flows. Kilgour and Dinar (2001) have shown that real time basin-wide river allocation rules are economically more efficient than administration based on periodic accounting with fixed or proportional allocations.

A third step would be to expand the geographical scope of water markets to an interstate (or even international) basis. Selling or even leasing water out-of-state has not been permitted by the western U.S. states because of fear of losing the water and foregoing future development potential. These fears can be overcome by the establishment of continuous, low transaction cost water markets extending across jurisdictional lines. Recently, the States of Arizona and Nevada have entered into an interstate agreement under which Arizona will "bank" 40,000 acre-feet per year from its currently unused portion of the Colorado River. This water will be provided to Nevada as needed in the future, with Nevada paying $23 million per year to cover Arizona's costs of groundwater recharge, plus $100 million "up front" (Arizona Daily Star 2004).

Because of pervasive externalities, water markets must be supervised to avoid third party injury, in keeping with appropriations doctrine (Howe 2002)[3]. Water markets are often limited in their ability to protect non-consumptive instream benefits such as recreation, ecosystem maintenance, and hydro-power if they are not represented by water rights. Booker (1995) and Young (1995) found that the greatest losses from extended drought on the Colorado River would be to recreation, power and environmental values.

[3] From an economic efficiency point-of-view, it may not pay to enforce "no injury" in all situatiuons. Rather, some degree of injury would be allowed to a point where marginal injury damages to other water users are offset by the benefits of a more flexible transfer.

The magnitude of transaction costs associated with transfers is crucial to the working of water markets. Transaction costs arise from the search for information about potential buyers and sellers and from the legal requirements imposed on transfers. The water court process used in Colorado guarantees orderly oversight of transfers but can be costly to buyers and sellers. Greater reliance on oversight by administrative agencies like the state engineer office can reduce these costs and expedite market transfers.

Conflict between the enforcement of priorities under appropriations doctrine and the efficient allocation of water can arise when priority dates of water rights are not correlated with marginal values in use. In the South Platte Basin of Colorado and on the Snake River in Idaho, serious economic and social losses have resulted from administering the priority system (Howe, 2008). While these cases suggest that river "calls" are likely to be economically inefficient, water markets with low transaction costs can eliminate these inconsistencies over time.

Appropriations doctrine as practiced in the western U.S. has proven to be flexible in accommodating to changing economic conditions. Water markets, too, have evolved through experience with water banks, drought relief schemes, and rotating fallow schemes that have proved to be effective in allocating water flexibly and efficiently. These water institutions will continue to evolve in response to the pressures of demand, environment and likely climate change.

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