Protecting Instream Flows: An Economic Benefits Summary

Prepared by George William Sherk, D.Sc., J.D.

Prepared for the Upper Chattahoochee Riverkeeper

Executive Summary

The concept of "instream flows" has a variety of meanings, including streamflows required for swimming, floating a canoe, supporting fisheries, sustaining waterfowl habitat, providing downstream water supplies, assimilating wastes or generating hydroelectric power. These uses require different quantities of water at different times and at different levels of water quality. While some of these uses complement one another, others increasingly compete as populations grow and droughts limit resources. Each of these uses produces economic benefits. The extent of these benefits and the costs associated with them have been the subject of numerous studies over the past two decades. These studies have focused on the actual economic benefits produced by the protection of instream flows, on the public's willingness to pay to protect instream flows, and on the adverse economic impacts resulting from a failure to protect such flows.

This white paper presents a summary of many of the studies that have addressed the economic benefits that have been (or could be) derived from the protection of instream flows. To facilitate this summary, the studies were divided into four groups focusing on recreation, water supply, water quality and hydropower. Three conclusions can be drawn from the studies discussed in this white paper.

First, results from the studies discussed herein strongly suggest that protection of instream flows have the potential to produce significant economic benefits. This conclusion appears to be valid irrespective of whether the instream flows provide recreational benefits, water supply benefits, water quality benefits or hydropower benefits.

Second, though cost determinations are always location-specific, the costs of providing water to fulfill instream flow requirements are relatively insignificant given the benefits produced. For example, restoration of the Trinity River in 1998 would have produced annual benefits of $406 million at a cost of between $17 million and $42 million. Use of federal reservoir water in 1987 to provide flows in the Rio Chama would have provided benefits ranging between $868 and $1,040 per acre foot. Instead, this water was sold by the federal government for $40.00 per acre foot. Also in 1987, Californians expressed a willingness to pay between $42.00 and $94.00 per household in order to restore Mono Lake, a restoration that could have been accomplished at an estimated cost of $2.64 per household.

Third, a failure to protect instream flows could have devastating impacts on any rural economy dependent on water-oriented recreation and tourism. Two studies addressing this question concluded that willingness to pay declined between 80% and 93% when adequate streamflows were not provided. A third study concluded that willingness to pay "declined significantly" when streamflows were inadequate but did not quantify the extent of the decline. One study also concluded that water-based recreation was a key element in diversifying and developing rural economies.

Finally, the four categories of uses described in this white paper tend to be complementary, not mutually exclusive. When managed prudently, providing instream flows to meet the needs of any one category of uses (recreational, water supply, water quality or hydropower) can have the complimentary effect of providing flows for all of the uses.

The need, therefore, is not to identify the economic benefits associated with each of the use categories. Those benefits have been determined. The need is to implement a watershed or basin-wide approach to the management of shared water resources that maximizes the present value of the net benefits that can be derived from all of the instream uses of water.

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The Upper Chattahoochee Riverkeeper**

The concept of "instream flows" means different things to different people. To some, it is the streamflow required to swim or float a canoe. To others, it is the streamflow necessary to support fisheries or sustain waterfowl habitat. To still others, it is the streamflow needed to provide downstream water supplies, assimilate wastes or generate hydroelectric power.

These uses require different quantities of water at different times and at different levels of water quality. While some of these uses complement one another, others increasingly compete as populations grow and droughts limit resources.

Each of these uses produces economic benefits. The extent of these benefits as well as the costs associated with them (both implicit and explicit) have been the subject of numerous studies over the past two decades.[1] These studies have focused on the actual economic benefits produced by the protection of instream flows, on the public's willingness to pay to protect instream flows and on the adverse economic impacts resulting from a failure to protect such flows. In general, the "willingness to pay" studies have utilized either a travel cost methodology[2] or a contingent valuation methodology.[3]

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[1] Most of these studies discussed herein included economic benefits expressed as of the date of the study (e.g., $200 million in annual benefits, 1987 dollars). These benefits have been converted to current dollar values utilizing the Consumer Price Index. In essence, all of the economic benefits discussed herein are expressed in 2002 dollars.

[2] The travel cost methodology is used to measure values associated with the on-site use of the resource. In essence, "[t]he travel cost method is based on assessing travel expenditures to and from a recreational resource as a measure

The purpose of this white paper is to present a summary of many of the studies that have addressed the economic benefits that have been (or could be) derived from the protection of instream flows. To facilitate this summary, the studies have been divided into four groups: Recreational Benefits, Water Supply Benefits, Water Quality Benefits and Hydropower Benefits.

Recreational Benefits

The "business" of recreation was summarized by the U.S. Environmental Protection Agency in 1996 as follows:[4]

> In 1993, recreation and tourism was the second largest employer in the nation behind only the health care industry. It provided jobs for over 6 million people, and generated sales of over $380 billion, nearly three times the amount of farm products. The industry has a $22 billion trade surplus, the largest of any sector in the U.S. economy.
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> A significant portion of recreational spending is tied to fish and wildlife, both of which require high quality water and habitat, such as wetlands, for survival. Nearly 49 million American anglers spend $24 billion a year pursuing their sport, ultimately generating $69 billion for our economy. *If sportfishing were incorporated as a single business, it would rank 27th on the Fortune 500 List of top sales producers, surpassing such giants as Coca-Cola, GTE, and Dow Chemical.*
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> Ducks and other birds that depend on clean water also generate economic activity for the recreation and tourism industry. In 1991, nearly 3 million people spent about $544 million hunting migratory waterfowl. And even more Americans

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of recreational benefit. The underlying assumption of this approach is the number of trips to a recreation site will decrease as the monetary and time costs of travel increase. This is an appropriate approach when trying to estimate the demand by the current population of users. This method involves creation of demand curves to estimate how many trips would be taken as one-way travel distance to the recreation destination increases." Rivers, Trails and Conservation Assistance Program, "Chapter 9: Benefit Estimation" in *Economic Impacts of Protecting Rivers, Trails, and Greenway Corridors A Resource Book*. Washington, DC: National Park Service, U.S. Department of the Interior (1995).

[3] The contingent valuation methodology, which is used to measure both use and nonuse values, utilizes "a bidding approach to determine values of recreation resources via hypothetical market transactions. It can be used to evaluate the benefit of resources to the general population (users and non-users) and can also be used to evaluate the impacts from potential changes in resource availability, or quality." *Id.* With regard to nonuse values, see Harpman, Welsh and Bishop, "Nonuse Economic Value: Emerging Policy Analysis Tool," 4 *Rivers: Studies in the Science, Environmental Policy and Law of Instream Flow* 280 (1993).

[4] Office of Water, U.S. Environmental Protection Agency, *Liquid Assets: A Summertime Perspective on the Importance of Clean Water to the Nation's Economy*. Washington, DC: U.S. Environmental Protection Agency (1996, emphasis added). Bates reached similar conclusions, noting that (a) outdoor recreation "exploded" in the 1960s and 1970s and (b) growth in this sector of the economy has continued since then. Bates, "Whitewater Dilemma: Allocating Boating Permits on Limited-entry Rivers," 3 *Rivers: Studies in the Science, Environmental Policy and Law of Instream Flow* 266 (1992).

> watch and photograph them. Over 19 million people participate every year, spending over $3 billion, and generating nearly $10 billion in total economic activity. When all birds, not just waterfowl, are factored in, the impact is even more significant. The U.S. Fish & wildlife Service estimates that nearly 30 million people participate, and the total economic impact is nearly $20 billion.

Simply stated, all of these activities require the protection of instream flows. Fishing is perhaps the most obvious but, in many areas of the country, hunting in the riparian corridor is of equal importance. Floating rivers in canoes or rubber rafts has emerged as a major recreational activity in those areas of the country with sufficient streamflows. These flows and the riparian corridors that they support are used for nature study, picnicking, hiking, camping and birdwatching.[5] In fact, the hiking of trails located along rivers is an activity that is growing in popularity.[6] Along the Chattahoochee River in metropolitan Atlanta, over 2.5 million people a year use the trails, picnic areas, and other amenities in the Chattahoochee River National Recreation Area. The economic impacts of most of these activities have been addressed in both economic benefit studies and willingness to pay studies.

Economic benefit studies

Canyon Lake in Comal County, Texas operates dam releases to provide flows downstream in the Guadalupe River. The economic benefits of this operating plan, which provides recreational opportunities on both Canyon Lake and the Guadalupe River, results in expenditures of between $7 and $8 per person per visitor day. This results in economic benefits to Comal County of approximately $500 million per year.[7]

The Natural Resources Council of Maine addressed the economic benefits derived from the protection of instream flows, concluding that inland fishing alone produced $292.7 million[8] in annual economic benefits and supported at least 5,320 full and part-time jobs.[9] In addition, the Council noted that "millions of dollars are spent annually by birdwatchers and other recreational pursuits that are supported at least in part by adequate flow conditions."[10]

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[5] "Birdwatching, in particular, is a high growth sport. In just the past 5 years, the American Birding Association has seen its membership nearly triple." Office of Water, U.S. Environmental Protection Agency, *supra* note 4.
[6] For example, *see* Moore, *Riverwalking: Reflections on Moving Water*. New York, NY: The Lyons Press (1995).
[7] Texas Center for Policy Studies, *Community and Economic Benefits of Texas Rivers, Springs and Bays*. Austin, TX: Texas Center for Policy Studies (2002).
[8] 1996 dollars; present value would be $336.5 million.
[9] Testimony of Laura Rose Day, Watershed Project Director, Natural Resources Council of Maine in Support of LD 12488, An Act of Require Public Information Regarding Water Use by Major Water Users, before the Natural Resources Committee (4 April 2001).
[10] *Id.*

Willingness to pay studies

In 1988, Walsh, Johnson and McKean reviewed a number of studies that addressed public willingness to pay for recreational activities.[11] The results of their review are summarized in the following table:

Average Willingness to Pay by Activity

Activity:	**Average Value, per activity day:**		**Number of studies evaluated:**
	1987 dollars	**2002 dollars**	
Camping	19.50	30.95	18
Picnicking	17.33	27.51	7
Swimming	22.97	36.46	11
Hiking	29.08	46.16	6
Non-motorized boating	48.68	77.27	11
Cold water fishing	30.62	48.60	35
Anadromous fishing	54.01	85.73	9
Warm water fishing	23.55	37.38	16
Non-consumptive wildlife	22.20	35.24	7

The results summarized above have been confirmed in numerous studies documenting a public willingness to pay in order to preserve instream flows and the activities associated with those flows. Daubert and Young, for example, utilized the contingent valuation methodology to analyze public willingness to pay for recreational opportunities on the Cache la Poudre River in northern Colorado.[12] With regard to use of the resource for fishing, their studies indicated that willingness to pay peaked at $30.35 per angler day[13] when flows were maintained at 500 cubic feet per second. It is interesting to note that this willingness to pay declined significantly when (a) these flows were not maintained or (b) flows were excessive.[14]

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[11] Walsh, Johnson and McKean, *Review of Outdoor Recreation Economic Demand Studies with Nonmarket Benefit Estimates, 1968-1988*. Fort Collins, CO: U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station (1988).

[12] Daubert and Young, "Recreational Demands for Maintaining Instream Flows: A Contingent Valuation Approach," 63 *Journal of Agricultural Economics* 666 (1981).

[13] 1981 dollars; present value of $60.22 per angler day.

[14] Similar results were obtained by Loomis and Cooper in a study of the Feather River in California. Utilizing the travel cost methodology, this study concluded that additional flows (up to a certain optimum flow) produced angler benefits of $72.90 per cubic foot per second (1990 dollars; present value would be $100.55 per cubic foot per

González-Cabán and Loomis utilized a contingent valuation methodology to measure the economic benefits derived from protecting instream flows in the Río Mameyes in Puerto Rico.[15] The study was triggered by a proposed withdrawal of 10 million gallons per day from the Río Mameyes by the Puerto Rico Aqueduct and Sewer Authority. The study determined that individuals using the Río Mameyes were willing to pay $21.00 per year[16] in order to continue to receive those benefits. Over the five year period of the study, this would produce annual benefits of $110 million per year.[17] Of perhaps greater importance was the recognition that expenditures would decline sharply if instream flows were not protected. The study concluded that use of the Río Mameyes would decline 93% if 10 million gallons were withdrawn from the resource. This would translate into an annual loss of $250,000 per year[18] in recreational benefits alone.

A similar study of the Hassayampa River Preserve in Arizona was conducted by Crandall, Colby and Rait.[19] Again using the contingent valuation methodology, this study indicated a public willingness to pay $65.00 per year[20] in order to restore streamflow from intermittent to perennial. Of particular note was the conclusion that public willingness to pay would be reduced by 80% if instream flows were not maintained. The authors also concluded that water-based recreation was a key element in diversifying and developing rural economies.[21]

Mono Lake in California was the subject of a 1987 study by Loomis. In this survey of California households, it was determined that the public was willing to pay between $42.00 and $94.00 annually[22] in order to maintain lake levels in Mono Lake. At the time of the survey, the waters of Mono Lake were being used for hydropower generation and water supply purposes. If Mono Lake was to be preserved, alternative sources of energy and water supply would have to

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second). Loomis and Cooper, "Economic Benefits of Instream Flow to Fisheries: A Case Study of California's Feather River," 1 *Rivers: Studies in the Science, Environmental Policy and Law of Instream Flow* 23 (1990).

[15] González-Cabán and Loomis, *Measuring the Economic Benefit of Maintaining the Ecological Integrity of the Río Mameyes in Puerto Rico.* Albany, CA: Pacific Southwest Research Station, U.S. Forest Service, U.S. Department of Agriculture (research paper PSW-RP-240, 1999).

[16] 1999 dollars; present value would be $22.73 per year.

[17] 1999 dollars; present value would be $119 million per year.

[18] 1999 dollars; present value would be $270,563 per year.

[19] Crandall, Colby and Rait, "Valuing Riparian Areas: A Southwestern Case Study," 3 *Rivers: Studies in the Science, Environmental Policy and Law of Instream Flow* 88 (1992).

[20] 1992 dollars; present value would be $83.55 per year.

[21] Recreation and tourism play a significant role in rural economic development. "Many state governments are beginning to recognize the economic payoffs of helping attract more fishers and increasing good fishing opportunities. By investing in boat ramps, fishing piers, aquatic habitat, angler education, fish stocking, and similar programs, communities are helping their economy by attracting more anglers." Tony Feldman, *Fisheries Magazine*, *quoted in* Office of Water, U.S. Environmental Protection Agency, *supra* note 4.

[22] 1987 dollars; present values would be $66.67 and $149.21 annually, respectively.

be acquired. It was estimated that the cost of these alternative sources of energy and would be only $2.64 per household per year.[23]

Similar results were obtained by Ward in a study of the use of water impounded in a Bureau of Reclamation reservoir in New Mexico.[24] Utilizing the travel cost methodology, this study concluded that the release of water to provide recreational opportunities on the Rio Chama would produce benefits of between $868 and $1,028 per acre foot[25] of water released during normal water years. During low water years,[26] these releases would produce benefits of between $909 and $1,040 per acre foot.[27] By way of comparison, at the time of the study the City of Albuquerque had a contract with the Bureau of Reclamation to utilize the water contained in the reservoir. The contract price was $40.00 per acre foot.

Similar results were also obtained by Douglas and Taylor in studies of the Trinity River in California.[28] Construction of the Central Valley Project in California and subsequent transbasin diversions reduced flows in the Trinity River by approximately 90%. Utilizing the travel cost methodology, Douglas and Taylor concluded that restoration of the Trinity River as a recreational resource would produce benefits of $406 million per year.[29] Depending on flow requirements, the cost of providing the necessary streamflows to restore the recreational potential of the Trinity River ranged between $17 million and $42 million per year.

<u>Water Supply Benefits</u>

Protection of instream flows in upstream areas provides water supplies for areas downstream. These water supplies may be used by the downstream areas for a wide variety of purposes, including meeting municipal and industrial supply needs. The economic benefits associated with these sources of water supply, especially the value of reduced uncertainty regarding municipal and industrial supplies, have been addressed in the literature.

Economic impact studies

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[23] 1987 dollars; present value would be $4.19 per household per year.

[24] Ward, "Economics of Water Allocation to Instream Uses in a Fully Appropriated River Basin Evidence from a New Mexico Wild River," 23 *Water Resources Research* 381 (1987).

[25] 1987 dollars; present values would be $1,379 and $1,632 per acre foot, respectively.

[26] Low water years were defined as years during which flows were 50% of normal.

[27] 1987 dollars; present values would be $1,443 and $1,651 per acre foot, respectively.

[28] Douglas and Taylor, "Riverine Based Eco-tourism: Trinity River Non-market Benefits Estimates," 5 *Journal of Sustainable Development and World Ecology* 136 (1998).

[29] 1998 dollars; present value would be $449.1 million per year. Under a restoration scenario that returned the most water to the Trinity River, annual benefits could increase to $803 million per year (1999 dollars; present value

One aspect that has been addressed focuses on instream flows as needed to protect coastal and estuarine areas. Adequate flows of fresh water into these areas are critical to protection of coastal and estuarine resources as well as all of the economic activities associates with these resources. As noted in *Community and Economic Benefits of Texas Rivers, Springs and Bays*, at some point in its lifecycle, approximately 95% of marine life "depends on the wide range of salinities and abundant food and shelter provided by bays and estuaries. [T]he health of our bays and marine life in our oceans is intrinsically linked to adequate freshwater flowing from our rivers to the bays."[30] Disrupting freshwater flows into bays and estuaries could have Draconian impacts on the coastal economy:[31]

would be $869 million per year). Douglas and Taylor, "The Economic Value of Trinity River Water," 15 *International Journal of Water Resources Development* 309 (1999).

[30] Texas Center for Policy Studies, *supra* note 7.

[31] *Id.*

> Commercial fisheries in Texas account for an estimated 87 million pounds of shrimp, blue crab, fish, and oysters each year. The dockside value – or the amount of money commercial receive at the dock – is about $175 million each year. The total economic impact of the Texas seafood industry is about $330 million each year (including dockside transactions, supplies and great, trucking expenses, etc.) and supports an estimated 30,000 full-time jobs (fishermen, bait dealers, suppliers, boat builders, processors, wholesalers, retailers, etc.). As far as sport fishing is concerned, approximately 1 million anglers take 10 million trips on the Gulf Coast a year, spending $890 million a year on items such as ice chests, boats, etc., introducing $2 billion into the economy (from fishing trips, motels, restaurants, etc.), and supporting 25,000 full-time jobs in Texas.

In Georgia, the Center for a Sustainable Coast has argued that reduced streamflows into coastal and estuarine areas could have significant adverse impacts on "fisheries and nature-based tourism activities, worth at least $1 billion annually, and supporting some 40,000 jobs."[32] Similar adverse impacts, particularly with regard to the production of oysters, could occur in Apalachicola Bay if freshwater inflows are reduced.[33]

Water Quality Benefits

Adequate streamflows are also important to the maintenance of water quality. The Clean Water Act requires point sources of pollutants to obtain a National Pollutant Discharge Elimination System (NPDES) permit before such pollutants may be discharged into waters of the United States. In part, the requirements of individual NPDES permits are based on streamflow, specifically the assimilative capacity of the stream receiving the pollutants.

The pollution control requirements of the NPDES permit are usually based on the 7Q10 flow of the stream receiving the pollutant to be discharged. This flow is the lowest flow occurring for seven consecutive days in ten year period. If streamflows fall below this level, then the 7Q10 flow would have to be recalculated. If the 7Q10 flow has to be recalculated, then the requirements of the NPDES permit must be recalculated. In essence, if the assimilative capacity of the stream is reduced, then the stringency of treatment requirements must be increased.

Any recalculation of the treatment requirements contained in the NPDES permit could increase treatment costs significantly. As noted by Bailey, "[e]ven a small increase in pollutant

[32] Letter of 9 February 2001 from David Kyler, Executive Director, Center for a Sustainable Coast to the Honorable Roy Barnes, Governor, State of Georgia.

removal requirements can result in a large expense in control technology if existing systems cannot be modified."[34]

<u>Hydropower Benefits</u>

Instream flows also provide the "fuel" for hydroelectric generation. Any reduction in streamflows has the potential to reduce hydroelectric production. Assuming that energy demands remain constant, any reduction in hydroelectric generating capacity could result in increased generation using fuel sources that are significantly more expensive than hydropower.

For example, hydropower is generated at numerous public and private facilities to meet peak power demands. This type of generation is known as "peaking power" and is intended to meet peak electricity demands during a typical 24-hour period. Hydroelectric generating is particularly useful in meeting such demands because it can be brought online quickly and has low marginal costs.

An alternative source of peaking power is thermal electric generating facilities powered by natural gas. Like hydroelectric generating facilities, natural gas-fired generating facilities can be brought online quickly. Both systems are well suited to meet peak power demands.

The critical difference is the price of the power generated. The cost of hydroelectric power purchased from the Southeastern Power Administration is approximately $10.00 per megawatt hour. The cost of natural gas-fired generation, however, is approximately $70.00 per megawatt hour.

Assuming that demand remains constant, these additional costs will be borne by consumers both directly (through increased residential energy costs) and indirectly (through increased costs of goods requiring energy in the production process). Such increases in energy costs are likely to have disproportionate adverse impacts on individuals living on fixed incomes[35] or living in rural areas.[36]

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[33] Christensen, Monaco, Livingston, Woodsum, Battista, Klein, Galeprin and Huang, *Potential Impacts of Reduced Freshwater Inflow on Apalachicola Bay, FL Oyster* (Crassostrea virginica) *Populations: Coupling Hydrologic and Biological Models*. Silver spring, MD: National Oceanic and Atmospheric Administration (1998).

[34] Bailey, *Minimum Instream Flow Legislation and the Section 404 Permitting Process: The Impact of State Water Quality Laws*. Washington, DC: Environmental Defense Fund (undated).

[35] Individuals living on fixed incomes, such as retirees, seldom have the ability to absorb additional costs without reducing other expenditures.

[36] Particularly affected would be individuals living in areas not served by private utilities having a more diversified fuel mix that would allow cost increases to be minimized.

In essence, a failure to protect instream flows could have the result of reducing hydroelectric generation. As a result, the cost of both energy and consumer goods is likely to increase. The extent of the increase in consumer costs is not known because the price of natural gas has been quite volatile. The reality of an increase in consumer costs, however, is virtually a certainty.

Conclusions

Three conclusions can be drawn from the studies discussed in this white paper. First, results from the studies discussed herein strongly suggest that protection of instream flows have the potential to produce significant economic benefits. This conclusion appears to be valid irrespective of whether the instream flows provide recreational benefits, water supply benefits, water quality benefits or hydropower benefits.

Second, though cost determinations are always location-specific, the costs of providing water to fulfill instream flow requirements are relatively insignificant given the benefits produced. For example, restoration of the Trinity River in 1998 would have produced annual benefits of $406 million at a cost of between $17 million and $42 million. Use of federal reservoir water in 1987 to provide flows in the Rio Chama would have provided benefits ranging between $868 and $1,040 per acre foot at a cost of $40.00 per acre foot. Also in 1987, Californians expressed a willingness to pay between $42.00 and $94.00 per household in order to restore Mono Lake, a restoration that could have been accomplished at an estimated cost of $2.64 per household.

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