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Economics and the Determination of Indian Reserved Water Rights

This article discusses the role of economics in the determination of Indian reserved water rights. In addition to discussing why economics is important to Indian reserved water rights, we examine some parameters of an appropriate economic analysis from a perspective which differs with other recent papers on the subject. We conclude by addressing some specific economic issues in the reserved rights inquiry.

INTRODUCTION

While Indian reserved or *Winters* doctrine¹ water rights have always been the subject of heated debate,² they are increasingly a focus of litigation as many western states seek to inventory and quantify all water rights, including those reserved for Indian use. The most common method for doing so is a general stream adjudication, a judicial proceeding in which all users of and claimants to water from a particular source (usually a river system) must appear and prove their claims or lose their rights.³ General stream adjudications involving Indian reserved water rights are pending in state courts in virtually every western state.⁴

The federal government and many tribes have also started lawsuits in an attempt to preempt the states' efforts and obtain quantification of Indian water rights by a federal, rather than state, court.⁵ As a result, the United States, many western states and Indian tribes, and countless private water

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1. So named for *Winters v. United States*, 207 U.S. 564 (1908), the first case to recognize such rights.

2. This *Journal* recently devoted an entire issue to their discussion. See generally, 20 NAT. RES. J. 1 (1980).

3. Most western states have statutes enabling an interested water user or the state to begin a general stream adjudication. See e.g., WYO. STAT. § 1-37-106 (1977).

4. For a reasonably current inventory, see J. FOLK-WILLIAMS, WHAT INDIAN WATER MEANS TO THE WEST, 29-104 (WATER IN THE WEST Vol. 1) (1982).

5. While the United States and Tribes generally perceive the federal courts to be a more favorable forum in which to determine Indian water rights, the United States Supreme Court recently reiterated that the McCarran Amendment, 43 U.S.C. § 666, vested state courts with jurisdiction to determine Indian reserved water rights as long as that determination is part of a comprehensive general stream adjudication. *Arizona v. San Carlos Apache Tribe* (No. 81-2147) and *Montana v. Northern Cheyenne Tribe* (No. 81-2188), 51 U.S.L.W. 5095 (July 1, 1983).

users are concerned with Indian water rights and how they are quantified. A brief review of what is known thus far about Indian water rights will illustrate their importance.

Winters reserved water rights differ from prior appropriation rights (the law of the western states) in several important respects. First, reserved rights do not rely on diversion and application of water to beneficial use for their existence. Rather, reserved rights may be implied from the creation of a reservation of land for a specific purpose.⁶ The priority date of a reserved right is generally governed by an underlying reservation of land.⁷ Thus, unlike appropriative rights which are created by the actual use of water, reserved rights may be created by legal acts which say nothing about water.⁸

This characteristic is important because many Indian reservations were created during and after the Civil War era when the United States also sought to secure the occupation of the west by settlers. As a result, many Indian reservations (and arguably their reserved water rights) predate the appropriative water rights of miners, farmers and towns.⁹

The second important characteristic of Indian reserved water rights is their potential magnitude. Since, as a general matter, these rights go to the head of the line in priority, other water users often worry about the amount of water the Indians may claim out of fear that the water available to satisfy their own rights will be diminished.

A third aspect of Indian reserved water rights is that they are not lost by nonuse. Under prior appropriation, water rights which have been unexercised for a prescribed time are subject to loss through abandonment or forfeiture proceedings and the water becomes available to other users and uses.¹⁰ This "bankruptcy" analogue of prior appropriation insures that water is applied to beneficial uses by weeding out those which are economically nonproductive. Indian reserved water rights appear to co-exist with the reservation of land which the water right is intended to serve, regardless of actual use. This characteristic highlights the need for equitable quantification of Indian reserved water rights initially, since any over or under allocation is much less likely to be revised at a later date than would be the case with appropriative rights.¹¹

6. *United States v. New Mexico*, 438 U.S. 696, 700-02 (1978).

7. *Cappaert v. United States*, 426 U.S. 128, 138 (1976).

8. Which explains why the *Winters* doctrine is often called the "implied reservation of water" doctrine. See e.g., Comment, *New Mexico's National Forests and the Implied Reservation Doctrine*, 16 NAT. RES. J. 975 (1976).

9. The priority date of a water right is as important as its quantity because water is distributed to each right in order of seniority. In times of shortage, a senior right will receive its full entitlement before the next right gets any water at all.

10. 1 R. CLARK, *WATERS AND WATER RIGHTS*, §§ 51-5-51.8 at 294-99 (1967).

11. Although, if the reserved water right were to prove insufficient for the Indians' needs, the United States could either appropriate or purchase additional water.

The process of quantifying Indian reserved water rights is complex. In a recent opinion concerning National Forest reserved water rights, the United States Supreme Court held that reserved water rights generally exist only to fulfill the primary purposes of a reservation and that needs for all other uses will be satisfied with water rights obtained under state law.¹² This analysis has been applied to the determination of reserved water rights for the Colville Indian Reservation in Washington.¹³

Applying the "primary purposes" analysis to most western Indian reservations, one would likely conclude that farming is the primary purpose of the reservation. Although Indian reserved rights have been decreed for fishing in the Pacific Northwest,¹⁴ irrigated agriculture has been a central theme in most Indian reserved water rights cases.

On the most recent occasion the United States Supreme Court has directly addressed the quantification of Indian reserved water rights, it has expressly approved an agricultural measure based on the well-recognized phrase: practicably irrigable acres, or "PIA". In *Arizona v. California*,¹⁵ the Supreme Court awarded the amount of water required to serve the practicably irrigable lands on five Indian reservations on the lower Colorado River as the reserved water rights for those reservations. Because of the precedent set by *Arizona v. California* and because PIA gives rise to claims to vast quantities of water, PIA has become the centerpiece of tribal and federal claims to water for most Indian reservations in the West. As a result, the concept of practicably irrigable acreage is likely to be the focus of controversy and litigation throughout the West in the coming years.

Part II of this article examines PIA, focusing on the role of economics in quantifying Indian reserved water rights. It also presents a different viewpoint on certain of these issues that were raised by Burness *et al.* in a recent article.¹⁶ Part III addresses a broader problem: whether PIA is an equitable means of allocating a scarce resource and quantifying reserved water rights for the needs of Indian people.

ECONOMICS AND PIA

General Considerations

While "practicably irrigable acres" is a compact and convenient phrase, it provides no criteria for determining whether particular land is indeed

12. United States v. New Mexico, *supra* note 6, at 702.

13. Colville Confederated Tribe v. Walton, 647 F.2d 42, 47 (9th Cir.), *cert denied*, 454 U.S. 1092 (1981).

14. See *e.g.*, United States v. Adair, 478 F. Supp. 336 (D. Or. 1979); Colville Confederated Tribes v. Walton, *supra* note 13.

15. 373 U.S. 546, 599-601 (1963), *decree*, 376 U.S. 340 (1964), *amended*, 383 U.S. 268 (1966), *supplemental decree*, 439 U.S. 419 (1979)(*per curiam*).

16. Burness, Cummings, Gorman & Lansford, *Practicably Irrigable Acreage and Economic Feasibility: The Role of Time, Ethics and Discounting*, 23 NAT. RES. J. 289 (1983).

practicably irrigable. Some elaboration is needed to render the concept useful.

In recent proceedings before a new Special Master in *Arizona v. California*, the United States and State parties agreed "that the land must be arable and the project within engineering feasibility" and that "economic feasibility is the appropriate general inquiry"¹⁷ in determining whether land is practicably irrigable. Although the Tribes disagreed about the relevance of economics, Special Master Tuttle concluded that "'practicably irrigable' as used by the parties and Court in the prior proceedings [those conducted before Special Master Simon Rifkind which resulted in the Court's 1963 opinion], very nearly means 'economically feasible'"¹⁸ and applied the same standard to the proceedings before him.¹⁹

In another recent trial of Indian water rights as part of Wyoming's Big Horn Adjudication, the major parties agreed that "those lands capable of sustained irrigation at reasonable cost" are practicably irrigable.²⁰ While there are many possible definitions of "PIA," these are helpful because they begin to articulate the concept with words which suggest some relevant inquiries.

"Lands capable of . . . irrigation" suggests that lands must be arable and that it must be possible to deliver water, thereby making the land "irrigable" as opposed to merely "arable." This phrase also suggests that there must be a dependable source of irrigation water upon which prudent planners would rely. The words "reasonable cost" imply some inclusion of economics in the inquiry and "sustained" suggests that the relevant time horizon of the analysis is long, an idea in harmony with the perpetual nature of a reserved water right.

While the definition and elements of PIA could fuel endless debate, several facts are self-evident within the context of reserved water rights litigation. The disciplines invoked and methodologies employed within each discipline must be selected with reference to the product (a quantity of water) and the context of the inquiry (quantification of a reserved water right which cannot be lost through nonuse and which likely will bear an

17. *Arizona v. California* (No. 8 Orig.), Report of Special Master Elbert P. Tuttle (hereinafter *Tuttle Report*) at 94 (February 22, 1982). While the Supreme Court rejected the Master's recommendation that PIA be relitigated for all five reservations, the Court did accept the Master's PIA analysis as applied to lands which had been added to the Fort Mojave Reservation since the prior proceedings. *Arizona v. California*, 456 U.S. 912 (1983). As a result, Master Tuttle's general discussion of the prior proceedings and his analysis of PIA in the current proceedings carries some precedential weight.

18. *Tuttle Report*, *supra* note 17, at 94.

19. *Id.* at 95.

20. See In Re: The General Adjudication of All Rights to Use Water in the Big Horn River System and All Other Sources, State of Wyoming (Fifth Jud. Dist., C.A. No. 4993) (Dec. 15, 1982) (hereinafter Big Horn Adjudication), Transcript of proceedings before Special Master Teno Roncalio at 13, 160-64.

early priority date). Because of the unique, nonforfeiture characteristic of reserved rights discussed above, we suggest that exacting standards and analysis are in order.

Many federal and state agencies have developed standards and criteria which may assist the PIA inquiry. Examples include the Bureau of Reclamation's guidelines for determining arability²¹ and the Water Resource Council's guidelines for determining the economic feasibility of water resource projects.²² While the appropriateness of these standards for the special inquiry of PIA is subject to a variety of considerations beyond the scope of this paper, these do at least offer a place to begin. Regardless of the precise standards involved in each discipline, it is clear from recent cases that the determination of PIA requires an examination of several factors. The following section addresses these.

Specific Elements of PIA

While PIA may involve a variety of additional studies, we believe that, at a minimum, determinations of arability, engineering feasibility, water supply, and economic feasibility are prerequisite to a finding that lands are practicably irrigable.²³

Arability

Although the practicability of irrigation is determined by the interaction of many complex factors, the arability of land is a cornerstone of the analysis. If land is not arable, it is not irrigable, and thus cannot be practicably irrigable. Sound economic and engineering analysis must rely upon an arable land base and other information provided by soil scientists. As a result, it is imperative that the information the soil scientist provides economists and engineers regarding soils, topography, and drainage be accurate and reliable to enable these investigators to determine matters such as sprinkler and drain design, cost estimates, and yield projections with confidence.

Engineering

An engineering analysis is a necessary component in determining practicably irrigable acres. In classifying land as practicably irrigable there

21. See e.g., U.S. DEPT. OF INTERIOR, Water and Power Resources Service Release No. 115-2, Series 110, Part 115, LAND RESOURCES INVESTIGATIONS (May 15, 1980).

22. See e.g., U.S. WATER RESOURCES COUNCIL, PRINCIPLES AND STANDARDS FOR WATER AND RELATED LAND RESOURCES PLANNING—LEVEL C; FINAL RULE, 45 Fed. Reg. 64366 (Sept. 29, 1980).

23. This list does *not* include factors such as present and historical ownership and status of land which would entitle it to a reserved water right or other considerations which might preclude, for reasons peculiar to the individual fact situation involved, the grant of a reserved water right.

must be a showing that using current technology,²⁴ engineers can design systems capable of delivering irrigation water to the lands and capable of draining excess irrigation water from them. In addition, engineering analysis is necessary to determine the water requirements for irrigation and thus provide benchmark data for an investigation into the adequacy of water supplies. A complete engineering analysis generally examines the location of an appropriate and adequate water source; it also designs capable on-farm, conveyance and drainage systems or establishes the existence thereof, determines water requirements, and estimates construction, operation and maintenance costs. Information developed through the engineering analysis must be supplied to economists and hydrologists as appropriate.

Water Supply

For land to be classified as practicably irrigable, there must be a reliable source of irrigation water upon which prudent farmers, investors, engineers, and economists would rely when the water supply is administered in accordance with applicable law.²⁵ If the land is water short, or if the owner must spend money to achieve a full water supply, economics may make it impractical to farm the land. In light of the fundamental importance of economics and water supply to the determination of practicably irrigable lands, it would be erroneous to classify significantly water short areas as practicably irrigable.²⁶

Economics

To successfully sustain long-term irrigation (planning horizons of 100 years are common), the land must provide returns which render the farming economically productive. As a result, we believe that it must be shown that the water delivery systems and farm units can be designed, built, operated, and maintained at economic costs which do not exceed the returns which will be realized from the land.

Economics is clearly the key in determining PIA because current precedent suggests that economically feasible lands may be practicably irrig-

24. Special Master Tuttle used current technology in developing his recommendations concerning PIA, as did the parties in the Big Horn Adjudication. *Tuttle Report, supra* note 17, at 97-98. In its recent *Arizona v. California* opinion, the Supreme Court indicated that changes in technology which increased the amount of PIA would not, standing alone, be good reason to recalculate the reserved water rights of an Indian Reservation. 103 S. Ct. 1382, 1394 (1983).

25. The water supply issue can be complex because the availability of water in priority depends, in part, on yet unresolved legal issues concerning the integrated administration of appropriative and Indian reserved water rights. In addition, the exercise of a reserved water right in some cases may be constrained by equitable doctrines such as estoppel.

26. Water-short lands might be practicably irrigable if water storage were part of a project design but the cost of storage would have to be included in the economic analysis.

able but economically infeasible lands are not. As Special Master Tuttle stated in *Arizona v. California*, "for present purposes, a finding that annual benefits exceed costs will suffice for a finding of practicable irrigability."²⁷ Likewise, the major parties and Master in the Big Horn Adjudication agreed that benefits must exceed costs for lands to be practicably irrigable.²⁸ In fact, the necessity that benefits exceed costs is as old as the PIA standard itself. In referring to the prior proceedings in *Arizona v. California*, Special Master Tuttle observed that "[t]he feasibility tests may not have been done in detail, but the testimony definitely indicates that a benefit-cost analysis was the standard then used as it was for the other federal projects studied by the United States experts."²⁹

Within benefit-cost analysis, however, many issues arise concerning the selection and application of economic assumptions. Three of the more controversial areas are the treatment of secondary benefits and costs, the selection of a discount rate, and the use of opportunity costs. We address these topics in the next section.

Economic Considerations

Secondary Benefits and Costs

Some commentators have argued that, in the evaluation of economic feasibility of irrigation projects proposed as a basis for PIA, the analysis should assess all secondary benefits "to whomsoever they may accrue."³⁰ While these commentators acknowledge that recent and current guidelines do not provide for an assessment of secondary elements,³¹ they argue that using contemporary economic standards to quantify PIA penalizes Indians in relation to more lenient economic standards non-Indians have used as the basis for funding irrigation projects in the past. There are several problems with this argument.

First, the nature of water rights at stake in federally funded reclamation projects are prior appropriation rights;³² Indian reserved rights are virtually their antithesis, as discussed above. As a result, the justification for automatically incorporating past reclamation guidelines into the quantification of Indian reserved rights is far from clear. In fact, it is incongruous to relax the feasibility standards used in the quantification of reserved

27. Tuttle Report, *supra* note 17, at 100.

28. Big Horn Adjudication, Report of Special Master Teno Roncalio (hereinafter "*Roncalio Report*") at 183 (Dec. 15, 1982).

29. Tuttle Report, *supra* note 17, at 94 n. 13 (citations omitted).

30. Burness, Cummings, Gorman & Landsford, *United States Reclamation Policy and Indian Water Rights*, 20 NAT. RES. J. 807, 824 (1980).

31. *Id. See*, 38 Fed. Reg. 24777 (Sept. 10, 1973); 45 Fed. Reg. 64366 (Sept. 29, 1980).

32. *California v. United States*, 438 U.S. 645 (1978) (unless explicit Congressional mandate to the contrary, federal reclamation projects operate within the confines of state water law).

rights from the guidelines applied to appropriative water rights which are subject to the ongoing economic test of beneficial use.

Second, given advances in irrigation technology, it is far from clear that Indian water rights would have been quantified at a more generous amount in the past. Recent developments in pump and sprinkler design have made irrigable today lands which would not have been considered irrigable three decades ago;³³ in the past, these lands would not have been eligible for consideration as PIA under any economic standards. The net changes in PIA as a result of technological advances and different economic standards would be difficult to determine, but there is no evidence that PIA determined at any time in the past would have been greater than it is today.

Furthermore, it would be inconsistent to evaluate PIA using current technological standards but past economic guidelines. This "time machine" approach would relegate the PIA analysis to a search for the most favorable conditions in each discipline. As Special Master Tuttle stated:

My reading of the transcript reveals that the evidence of "practicable irrigability" [in the prior *Arizona v. California* proceedings] was determined by then current standards. I am similarly convinced that my determinations of practicable irrigability should be based on present standards. Reference to past standards would introduce an additional complication in an already complex case. Given that these issues are to be litigated presently, the most sensible method of determining feasibility is by using present standards.³⁴

Finally, federal water project standards were developed to inform public spending questions concerning whether to build a project or which project to select. Reclamation projects usually made "new" water available (which had previously not been available for use when and where needed) through storage, thereby increasing the overall output of agricultural goods. Quantification of Indian reserved water rights involves an allocation to a senior but dormant right which may well displace existing uses. To the extent it does so, it represents a transfer of the right to use the resource (a "zero sum game"), rather than a net addition to the resources available to society as a whole.

Indeed, if PIA economics is to consider secondary benefits, then it must account for secondary costs as well, including the losses from discontinuing uses of water which are curtailed by the exercise of the

33. For example, lands of up to 20% slope are now considered irrigable by modern sprinkler systems; for the most part, gravity irrigation is feasible only on slopes up to roughly 5%. As a result, lands with 5% to 20% slope are now considered irrigable but in the past would not have been.

34. *Tuttle Report*, *supra* note 17, at 98 (footnotes omitted). While these comments were made in the context of irrigation technology, we believe they are equally applicable to all other components of the PIA analysis.

reserved right. Failure to do so is not unlike estimating the balance in one's bank account by adding up the deposits and ignoring the withdrawals. The United States Supreme Court also stated that adverse impacts on other water users should be considered in quantifying reserved water rights:

When, as in the case of the Rio Mimbres, a river is fully appropriated, federal reserved water rights will frequently require a gallon-for-gallon reduction in the amount of water available for water-needy state and private appropriators. This reality has not escaped the attention of Congress and must be weighed in determining what, if any, water Congress reserves for use in the national forests.³⁵

On this point, the Court was unanimous. The first sentence of the dissent begins:

I agree with the Court that the implied-reservation doctrine should be applied with sensitivity to its impact upon those who have obtained water rights under state law. . . .³⁶

While this language arose in quantifying reserved water rights for national forests, the same analysis has been applied to the quantification of Indian water rights.³⁷ And in recently refusing to allow the relitigation of PIA in *Arizona v. California*, the Supreme Court was careful to observe the potentially adverse consequences of relitigation upon appropriators in the Lower Colorado River Basin.³⁸

It may be that, given current standards, an analysis of only the primary benefits and costs of irrigation is sufficient for the PIA inquiry. If secondary elements are to be considered, however, the economist must account for secondary costs as well as secondary benefits.

Discounting Methods

There is probably no more controversial subject in the economics of reserved water rights than the selection of an appropriate discount rate. The subject is controversial because, first, the problem does not have a strictly objective solution; instead, the choice of a discount rate must be based upon professional judgment involving a careful analysis of the overall circumstances and the specific problem under analysis. Second, the chosen rate plays a major role in determining the outcome of economic feasibility analyses in general and benefit-cost analyses in particular. Low discount rates will tend to show benefits exceeding costs (thus establishing

35. *United States v. New Mexico*, *supra* note 6, at 705.

36. *Id.* at 718 (Powell, J. dissenting).

37. *Colville Confederated Tribe*, *supra* note 13.

38. *Arizona v. California*, 103 S. Ct. 1382, 1392 (1983).

the existence of PIA), while relatively high discount rates, other things being equal, will show costs in excess of benefits (the land is not PIA).

Some economists advocate the use of ethical considerations that tend to justify a relatively low discount rate.³⁹ The literature they cite concerning ethics,⁴⁰ however, focuses on questions of nuclear waste and CO₂ buildup in the atmosphere resulting from fossil fuels development. The assumptions implicit in these types of analyses include:

1. Benefits (more energy) would accrue to the current generation while costs (pollution) would be borne by future generations; and
2. A long time horizon (e.g. 1 million years) makes it impractical to assume that the current generation can compensate future generations for any costs imposed upon them.

Under these circumstances, justifying a low discount rate is possible. If a low discount rate were not used, the costs imposed upon future generations would be insignificant compared to present benefits viewed from the perspective of the current generation.

The problem of determining PIA is, however, quite different than problems involving CO₂ buildup and nuclear waste. Quantifying PIA does not involve a large disparity of costs and benefits among generations. The problem is intergenerational only in the sense that many generations are involved. Each generation individually will be faced with both costs and benefits attributable to irrigated agricultural endeavors, however, and for this reason, the compensation issue does not even arise. The relevant question is whether the costs exceed the benefits, or vice versa, for any given generation.

Even if the intergenerational problem were an issue in PIA, these economists⁴¹ seem to overlook the above points by focusing on the following statement:

39. Burness, *supra* note 16.

40. The literature cited by Burness draws upon the following works:

Schulze, Brookshire, Sandler, *The Social Rate of Discount for Nuclear Waste Storage: Economics or Ethics?*, 21 NAT. RES. J. 811 (1981) (hereinafter Ethics-1); d'Arge, Schulze, Brookshire, *Benefit-Cost Valuation of Long-Term Future Effects: The Case of CO₂*, Workshop on the Methodology for Impact Analysis of Climate Change, Ft. Lauderdale, Florida (April 1980) and Department of Economics, University of Wyoming (hereinafter Ethics-2); Schulze and Brookshire, *Intergenerational Ethics and Depletion of Fossil Fuels*, J. QUIRK, et al. (Eds.) *COAL MODELS AND THEIR USE IN GOVERNMENT PLANNING* (Praeger Publishers, New York, 1982, Chap. 10) (hereinafter, Ethics-3); S. Ben-David, A. Kneese, and W. Schulze, *A Study of the Ethical Foundations of Benefit-Cost Analysis Techniques*, Working paper, Program in Resource Economics, University of New Mexico (August 1979) (hereinafter Ethics-4); A. Kneese, S. Ben-David, D. Brookshire, W. Schulze, and D. Bolt, *Long-Term Nuclear Waste Storage: An Economic and Ethical Perspective*, Working paper, Department of Economics, University of Wyoming (no date), forthcoming in *ETHICS AND VALUES: THE ISSUE OF NUCLEAR WASTE STORAGE* (R. Kates ed.) (hereinafter, Ethics-5).

41. Burness, *supra* note 16.

. . . Discount rates are then determined solely by the ethical criteria employed in the analysis.⁴²

The literature referenced, including the paper from which the above quote was taken, *clearly indicates that the discount rate should be equated to the market rate of return if compensation is possible:*

In the Utilitarian Ethic, *if investment is possible* then the appropriate discount rate is the market rate of return . . . where an egalitarian solution is achieved, the discount rate *exceeds or equals the market rate of return* if compensation (investment) is possible . . .

The Nietzschean criterion depends on whether the present or future can be best off. In case (a) the present can be best off. Thus a discount rate of + infinity is placed on the future in all cases. In case (b), the future is best off. If investment by the present is possible, then the market rate of return is the appropriate discount rate for decision making . . .

. . . in the Paretian ethic, if investment is possible . . . implies the market rate of return is again appropriate as the discount rate.⁴³

There is no evidence to suggest that compensation between generations is impossible with respect to Indian reserved rights; further we argue that it is irrelevant to the issue here.⁴⁴ With regard to market rates of return, there is no way of making a totally objective assessment. As one witness testified in the Big Horn Adjudication:

There is no objective way of picking a discount rate. You can get some people that will tell you it's very high, and some people that will tell you it's very low.⁴⁵

Given that there is no objective way to pick an appropriate discount rate, it seems inappropriate to quantify a reserved right based upon a single arbitrary discount rate. To do so, in effect, would make the quantification of PIA on Indian reservations a subjective matter. Instead, we

42. *Id. Accord* Ethics-3, *supra* note 40, at 176.

43. Ethics-3, *supra* note 40, at 174-76 (Emphasis added).

44. Even if compensation is not possible, the Burness interpretation, *supra* note 16, is far less conclusive than they make it out to be. For instance, if compensation is not possible then under the Utilitarian, Egalitarian and Paretian ethical systems the discount rate is bounded by -1 and infinity—hardly a “low” discount rate. In a sub-case for the Nietzschean and Egalitarian ethical system the discount rate equals infinity—hardly a low rate. Only in the alternative sub-case for the Nietzschean and Egalitarian ethics is the discount rate equal to (-1)—truly a low rate. Thus, only in 2 out of 8 cases under four ethical regimes is the discount rate low. Ethics-3, *supra* note 40, at 175 (Table 10-1).

45. Big Horn Adjudication, *supra* note 20, transcript at 8875. Even the same individual will utilize in various work alternative discount rates. See Cummings, Burt and McFarland, *Defining Upper Limits to Groundwater Development in the Arid West*, 59 AM. J. OF AGRIC. ECON., 943-47 (1977).

suggest the use of a range of discount rates for evaluating the economic feasibility of irrigation on Indian reservations. The relevant task is then to pick a reasonable range of discount rates, and decide whether PIA exists if economic feasibility results vary within that range of rates.

We think a reasonable range of discount rates can be determined using the following criteria:

1. that range should include the discount rate or rates which are commonly used in evaluating federally funded non-Indian water projects, a contention that is certainly justifiable in terms of equity between Indians and non-Indians. This rate is approximately $7\frac{7}{8}$ percent today;⁴⁶
2. a zero discount rate is too low because it reduces economic feasibility analysis to a trivial, nondiscriminatory case where no distinction is made between current versus future consumption; and
3. the range should bracket real (adjusted for the effects of inflation) rates of return experienced in the private sector of the economy.

The vast majority of real rates of return to capital in various sectors of the American economy are between 4 and 11 percent.⁴⁷ For this reason and because it satisfies criteria (1) and (2) above, we suggest 4 to 11 percent as a reasonable range of real discount rates for evaluating the economic feasibility of irrigated agricultural projects used in establishing reserved rights on Indian reservations.

We choose an "unweighted" range—much as Burness, et al. did in the "consumption displaced" determination of a discount rate to reflect the inherent inability to determine whether the actual "investment displaced" would or would not be tied to an index of capital stock.⁴⁸ Other sources, however, of *weighted* average rates of return can be found in Lind, et al.,⁴⁹ which includes a paper by Stockfish⁵⁰ which presents results that for 1961–1971 the corporate and non-corporate weighted average of return ranged from 8.4% to 14.2%.

46. 48 Fed. Reg. 3665 (Jan. 26, 1983).

47. Fraumeni and Jorgenson, *Rates of Return by Industrial Sector in the U.S., 1948–76*, 70 AM. ECON. REV. 326–30 (May 1980).

48. Another issue which constantly arises is the "marginal versus average rates of return as the appropriate measure." Often the assertion is made "that average returns are higher than marginal." Burness, *supra* note 16 at 300. This assumption overlooks the fact that in competitive general equilibrium, average and marginal returns are equal. In addition, new technology and new markets demonstrate that the world is not a forever downward treadmill of diminishing marginal productivity where eventually we will reach a point that the "last" investments' marginal productivity in terms of capital will be indistinguishable from zero.

49. R. Lind, K. Arrow, G. Corey, P. Dasgupta, A. Sen, T. Stauffer, J. Stiglitz, J. Stockfish and R. Wilson, *Discounting for Time and Risk in Energy Policy* (Resources for the Future, Inc. Washington, D.C., distributed by The Johns Hopkins University Press, 1982).

50. *Id.* at 269 (Table 7-4, Measuring the Social Rate of Return on Private Investment).

Rather than belabor the argument further, we simply note that available empirical evidence does not uniformly point to a low discount rate but, depending on the assumptions and data, a wide range will be derived and should be used in a PIA quantification. This technique avoids the extreme result of penalizing either Indians or non-Indians by the use of an arbitrarily low or high discount rate.

Thus, within a range of 4–11 percent for the real rate of return to capital, it is still likely that benefits might exceed costs at certain discount rates, yet the reverse might be true at higher discount rates. We suggest there should be no absolute rule for using a discount rate to determine what PIA is and is not under such circumstances. Instead, we suggest leaving this ambiguity as latitude in which courts may exercise their discretion and evaluate the ethics and equities of the problem, particularly in view of the shortcomings in the PIA concept discussed in Part III below.

Opportunity Costs

Benefit-cost analysis, like most other contemporary economic methods, assumes that inputs such as the material and labor used in a project should be valued at their “true” cost rather than their market price, if the two differ. Economists usually equate the true cost of a resource with its opportunity cost; that is, the cost of what society gives up in putting the resource to a different use. For example, if a laborer employed in digging an irrigation canal could alternatively be used to build a highway, then the opportunity cost of that labor would be what society gives up in highways to build irrigation canals instead.

Taking this notion one step further, it is apparent that if the labor used to build an irrigation canal could be employed in no other way, its opportunity cost is zero. This concept is often used to justify assigning little or no cost to labor used to construct a project in an area of high unemployment. Since Indian reservations are traditionally areas of high unemployment, it is not surprising that some economists advocate the use of zero opportunity costs for labor in benefit-cost analyses to quantify PIA on Indian reservations.

For example, two witnesses in Wyoming’s Big Horn Adjudication argued that virtually all of the labor employed in building, operating and managing a large-scale irrigation project should be assigned an opportunity cost of zero over a project life of 100 years.⁵¹ This position is contrary to contemporary economic practices which suggest that using a zero opportunity cost for labor in the short run may be appropriate. We

51. Big Horn Adjudication, *supra* note 20, at 4986–89 and 8856–60.

believe it unreasonable in the long run, however, to assume that labor that is able and competent to be employed in one project (say an irrigation project) would not ever have the opportunity or training to work on anything else over a period of 100 years. Furthermore, once labor is trained, its opportunity cost cannot be zero.

Using a zero cost of labor over a 100 year period biases economic analyses toward economic feasibility, resulting in larger quantified reserved water rights on Indian reservations. Proponents view it as another way to correct some of the "shortcomings" or inequities in the PIA concept. They further argue that there are simply no "opportunities" for Indian employment other than irrigated agriculture.

In effect, using a zero opportunity cost for labor over a time frame of 100 years or more is equivalent to assuming that no efforts will be made by individual, tribal, state or federal groups to improve employment opportunities on Indian reservations during the next 100 years, in the absence of an irrigation project. It also assumes Indians place no value upon their leisure time and that the time spent by otherwise "unemployed" Indians on cultural or other work related to Indian heritage is of no value to their Tribes. Furthermore, it assumes that generations of Indians yet unborn will be unable to find employment in pursuits not related to irrigated agriculture, but will readily accept employment in irrigated agriculture if opportunities exist.

No one doubts that unemployment on Indian reservations is a complex and pervasive problem. What facts are known concerning this situation, however, appear to be contrary to the assumptions outlined above. For example, evidence introduced in the Big Horn Adjudication shows that employment on irrigated agriculture projects is not valued as highly in terms of tribal, cultural and lifestyle preferences as is employment in ranching and other pursuits.⁵²

In view of this evidence, it appears that increased employment opportunities in irrigated agriculture may not be the solution to Indian unemployment and that the rationale for opportunity costing labor associated with such projects at zero over the long term is unsound.

As this discussion illustrates, virtually every facet of an economic analysis to determine PIA can become a conceptual battleground. Given the stakes in most Indian water rights litigation, however, we doubt that anyone could devise a quantification standard which all sides would accept. While it may be the best available standard thus far, the concept of PIA does have some shortcomings which we briefly discuss below.

52. *Id.* at 13214-25.

PROBLEMS WITH PIA

The problem of arriving at a fair and equitable quantification of Indian reserved rights on reservations in the West is a complex one. This issue, however, presents two separate questions:

1. Is the practicably irrigable acreage concept an equitable means of quantifying reserved Indian water rights?
2. If so, what methodologies should be used to determine PIA on a given reservation?

Section II of this paper discussed some aspects of methodologies for determining PIA. It is apparent, however, that regardless of the methodologies used, there are serious problems with using PIA as a universal tool for quantifying water rights on all Indian reservations.

One problem is that PIA is based on engineering, soils, and economic considerations concerning specific land masses, irrespective of human needs on a reservation. It is possible that relatively few Indians residing on a large fertile reservation could receive an enormous reserved water right, far beyond the amount necessary to maintain a decent standard of living. On the other hand, PIA might suggest a minimal reserved water right to a large population of Indians on a reservation where land is less susceptible to irrigation. These examples would appear to contradict the philosophy underlying the *Winters*⁵³ decision that the principal rationale for reserved water rights is to "improve" the Indians through their personal participation in farming.

Another problem with PIA is that, in the arid West, it could lead to the conclusion that all water in a river was reserved for Indian use. Such a conclusion would contradict other Congressional intent evidenced by federal laws which encouraged non-Indian irrigation in the West. The Supreme Court seems to have recognized this conflict by suggesting that reserved water rights must be quantified with sensitivity to other users.⁵⁴

A third problem with PIA is that the amount of practicably irrigable acreage changes through time as technology and economic conditions evolve. For example, modern sprinkler and pumping technology can supply water to land that would not have been irrigable 30 years ago. However, the Supreme Court's suggestion that changed technology, alone, is insufficient basis for the *recalculation* of PIA, means that the quantity of an Indian reserved water right may depend, in part, on the arbitrary selection of the time at which the quantification occurs.⁵⁵

53. *Winters*, *supra* note 1.

54. *Supra* notes 33 and 34 and accompanying text.

55. *Tuttle Report*, *supra* note 17.

Finally, much of the legal basis for the PIA concept derives from an assumption that Congressional intent expressed in treaties establishing Indian reservations was primarily to "civilize" the tribes by teaching them to farm. We doubt that Congressional intent one hundred years ago is necessarily related to the needs or aspirations of modern day Indians.

Burness *et al.* point out one of these potential problems in their recent article; i.e., that a determination of PIA ". . . precludes any future assessment of the project."⁵⁶ They then argue for lenient standards (i.e., low discount rates) by introducing intergenerational and ethical arguments in an economics context. The specific problems with these arguments have been discussed in Part II above. In a broad sense, however, we feel they have focused on the wrong issue. If PIA reserved rights really are irreversible, the Courts should be just as concerned with an over-allocation of water as with an under-allocation.

This problem seems to have been recognized by the courts in their more recent decisions. For example, the Supreme Court has modified the scope of the reserved right by suggesting other criteria such as "minimal needs,"⁵⁷ "primary purposes,"⁵⁸ "entirely defeated"⁵⁹ and "moderate living."⁶⁰ In its most recent decision, the Court partially justified its refusal to reopen the *Arizona vs. California* PIA adjudication by pointing out that if it did, it might also reconsider whether PIA is an appropriate tool for quantifying Indian reserved water rights.⁶¹

Special Master Tuttle stated:

. . . the "practicably irrigable" standard is not necessarily a standard to be used in all cases and when it is used it may not have the exact meaning it holds in this case. The amount reserved in each case is the amount required to make each reservation livable.⁶²

CONCLUSION

The very nature and purpose of Indian reserved water rights makes their quantification a controversial issue. Despite its shortcomings, the concept of practicably irrigable acreage probably will continue as a yardstick for Indian reserved water rights in western water planning. To the extent that it does, we recommend that strict and appropriate criteria be used to quantify PIA. While ethics is undoubtedly important in the quan-

56. Burness, *supra* note 16.

57. *Cappaert v. United States*, 426 U.S. 128, 141 (1976).

58. *United States v. New Mexico*, *supra* note 6, at 702.

59. *Id.* at 700.

60. *Washington v. Washington Commercial Passenger Fishing Vessel Ass'n.*, 443 U.S. 658, 686 (1979).

61. *United States*, *supra* note 6.

62. *Tuttle Report*, *supra* note 17, at 98-99.

tification of Indian reserved water rights, ethical considerations should be applied as a whole by the Court, not individually by each discipline within the PIA inquiry.

Because of the inherent problems with the concept of PIA, however, we do not believe it should be applied blindly in all cases involving the quantification of Indian reserved water rights. Recent court decisions seem to support this interpretation. Whether PIA will ultimately serve to determine the reserved water rights of most western Indian reservations remains to be seen.