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RECONCILING WATER LAW AND ECONOMIC EFFICIENCY IN WESTERN WATER ADMINISTRATION *

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I. INTRODUCTION

Over the past 200 years, water commissions have regularly examined the shortcomings of existing water policy. For at least the past 100 years, water commissions have consistently recommended reforming water policy. The following three themes have repeatedly emerged in these calls for reform: (i) conforming water policy to hydrologic realities; (ii) straightening out counterproductive economic incentives; and (iii) streamlining water-management institutions. Despite regular repetition of these recommendations, powerful vested interests and passionate political resistance continue to block significant change. Overcoming this resistance requires new coalitions that can demonstrate how water policy is relevant to front-page issues and coalitions that can cultivate the political will and leadership necessary to change the historical course of water policy reform in our country.[1]

II. EXAMPLES OF CONTINUING WATER LAW-ECONOMIC EFFICIENCY CONFLICT

The prior appropriation doctrine and its administration have served the Western United States quite well over the past 125 years, providing flexibility through the establishment of clearly defined and transferable water rights. How can it be, then, that a system that evolved specifically to achieve flexibility, efficient use, and avoid monopoly, still exhibits numerous conflicts between the administration of that doctrine and the most economically efficient patterns of our use of water resources?

Part of the answer lies in the fact that the development of prior appropriation water law occurred in eras when water related technologies were still primitive and the understanding of surface water-groundwater interactions was lacking. Water management has exhibited institutional inertia while the physical systems have been under increasing pressures from demand and supply imbalances worsened by climate change interacting with population growth. As pressure increases on water management, calls for greater flexibility are also increasing.[2]

A. THE CURRENT CONFLICT IN WELD COUNTY, COLORADO[3]

In Colorado's South Platte Basin, many surface diversions allocated for irrigation use date back to the mid-nineteenth century,[4] and are, thus, quite senior.

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1. Janet Neuman, *Are We There Yet? Weary Travelers on the Long Road to Water Policy Reform*, 50 NAT. RESOURCES J. 139, 166 (Dec. 2010).

2. *See, e.g.*, W. Governors Ass'n & W. States Water Council, *Water Transfers in the West*, i, vi, ix (2012), http://www.westgov.org/initiatives/water/373-water-transfers.

3. *See also* Charles W. Howe, *Water Law and Economics: An Assessment of River Calls and the South Platte Well Shut-Down*, 12 U. DENV. WATER L. REV. 181 (2008) (an earlier article from which this section is adapted).

4. NEIL S. GRIGG, COLORADO'S WATER: SCIENCE AND MANAGEMENT, HISTORY AND POLITICS, 58 (2003); RICHARD STENZEL & THOMAS CECH, WATER COLORADO'S REAL GOLD: A HISTORY OF THE DEVELOPMENT OF COLORADO WATER, THE PRIOR APPROPRIATION DOCTRINE AND THE COLORADO DIVISION OF WATER RESOURCES, 89-90 (2013) (Hal Simpson,

If low stream flows prevent senior rights from diverting the water to which they are entitled, the water commissioner can put a "call" on the river, requiring all upstream rights "junior" to the calling senior right holder to stop diverting water until adequate stream flow is restored.[5]

Following World War II, well drilling exploded in the alluvial valleys of the West, such as the Republican River Basin, based on improved pump technology, cheap energy, and the absence of regulatory frameworks over wells.[6] In Colorado's South Platte River Basin, irrigators tapped into the huge aquifer tributary to the South Platte River with thousands of wells that provided a reliable and handy water source.[7] During the same period, developments in hydrologic science clarified the connections between river flows and tributary aquifers,[8] and it was apparent that well pumping could, indeed, deplete stream flows.[9]

With this new knowledge of river-aquifer linkage, Colorado's 1969 General Assembly decided that wells tapping into the tributary aquifer should be incorporated into the priority system – awarding priorities according to the date of first use, thus making the wells very junior in priority in their respective basins.[10] The State began prohibiting tributary well use during prolonged droughts when the huge store of groundwater would be most valuable.[11]

To avoid this clearly uneconomic result, the Water Right Determination and Administration Act ("1969 Act") allowed the state engineer to approve temporary "substitute water supply plans," or augmentation plans, that would allow junior wells to continue pumping when there was a call on the river, as long as the well owners augmented surface flows to make up for shortages attributable to their current and past pumping – a formidable calculation in itself.[12]

During the 1970s, 1980s, and early-1990s, generous stream flows meant that calls on the river were generally confined to July and August, requiring only limited well augmentation.[13] As the drought of the early 2000s became increasingly severe, surface water shortages led to increasingly frequent calls on the

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Dick Wolfe, & Justice Gregory Hobbs as contributors).

5. *See* COLO. DIV. WATER RES., *Water Rights Dictionary*, http://water.state.co.us/SURFACEWATER/SWRIGHTS/Pages/WaterRightsTerminology.aspx (last visited Feb. 1, 2016); on the change in technology, *see* John D. Wiener, Roger S. Pulwarty & David Ware, *Bite without Bark: How the Socioeconomic Context of the 1950 U.S. Drought Minimized Responses to a Multiyear Extreme Climate Event*, 11 Weather and Climate Extremes 80, at 87; *see* STENZEL & CECH, *supra* note 4, at 411-12.

6. *See, e.g.*, Colo. Div. of Water Res., *Republican River Compact Administration Ground Water Model*, 1, 6 (2003), http://water.state.co.us/DWRIPub/Documents/rrca_model.pdf (noting the increase in groundwater pumping in the Republican River basin after World War II).

7. Lawrence J. MacDonnell, *Colorado's Law of "Underground Water": A Look at the South Platte Basin and Beyond*, 59 U. COLO. L. REV. 579, 604 (1988). Colorado underground water statutes were first enacted in 1963, and reorganized in 1965, as the Colorado Groundwater Management Act, with substantial changes. *Id.* at n.3; COLO. REV. STAT. §§ 37-90-101-143 (2014).

8. *Id.* at 581.

9. *Id.* at 582.

10. *Id.* at 588. The 1969 Act was a partial reorganization of Colorado water law called the Water Right Determination and Administration Act. COLO. REV. STAT. §§ 37-92-101-602 (2014).

11. Howe, *supra* note 3, at 182; MacDonnell, *supra* note 7, at 582-89.

12. MacDonnell, *supra* note 7, at 589.

13. SOUTH PLATTE RIVER TASK FORCE, WELL REGULATION IN THE SOUTH PLATTE RIVER

river, with almost continuous calls from 2002 through 2006.[14] This meant that the well users who had been operating under "substitute water supply plans" had to provide much larger volumes of augmentation water if they were to continue pumping while scrambling for increasingly costly surface rights or leases.[15] Most were unsuccessful. The state engineer shut down more than four hundred major wells in the early summer of 2006 through 2007, drying up thirty thousand acres of cropland with immediate, severe impacts on the farms and associated rural communities.[16]

With wells shut down, farmers immediately lost seasonal farm incomes because crops had been planted but had not matured.[17] Experts estimated direct farm income losses of approximately $390 per acre and total income losses of approximately $690 per acre.[18] These losses will continue into the future until the State permits wells to operate. In addition to the direct and indirect losses incurred by the inability to irrigate with groundwater, the groundwater table in Weld County has risen to the point of flooding basements and making fields unworkable[19] – an illustration of the legal system imposing a significant *inefficiency* on both the farmers unable to use the water and those injured by the high water table.

B. BARRIERS TO EFFICIENT WATER MARKETS: HIGH TRANSACTION COSTS AND EXCESSIVE/INCONSISTENT APPLICATIONS OF THE ANTI-SPECULATION DOCTRINE[20]

One would expect active water markets to correct uneconomic results like those noted above[21] because higher-valued junior users would profit from buying lower-valued senior users' water rights.[22] After all, Colorado has had more

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BASIN OF COLORADO, 4 (June 2007), http://www.cwi.colostate.edu/SouthPlatte/files/Well_Regulation-SPlatteTaskForce.pdf.

14. *Id.* at 5.

15. Hal Simpson, State Water Engineer, State Engineer's Office Forum: History of Well Regulation, South Platte Basin 3 (Sept. 6, 2006), http://dwrweblink.state.co.us/dwrweblink/0/doc/2810068/Page1.aspx.

16. Bill Jackson, *Salazar tries to help farmers with South Platte wells in the new Farm Bill,* THE GREELEY TRIBUNE (Oct. 31, 2007), http://www.greeleytribune.com/article/20071101/NEWS/111010116#.

17. Jerd Smith, *'Tough News' Dooms Crops – Rejected Proposal Would Have Let Farmers Start Wells,* ROCKY MOUNTAIN NEWS, June 3, 2006, at 4A.

18. Jennifer Thorvaldson & James Pritchett, *Economic Impact Analysis of Reduced Irrigated Acreage in Four River Basins in Colorado,* COLO. ST. U COLO. WATER INST. 1, 34 (2006), http://www.cwi.colostate.edu/old/pubs/series/completionreport/Completion%20Report%20207.pdf.

19. *Resolution Re: Declaration of Local Disaster Emergency,* BOARD OF WELD COUNTY COMMISSIONERS (June 11, 2012), https://www.co.weld.co.us/assets/357C9Ad9Ac2b6d744A77.pdf.

20. Adapted from Charles W. Howe, *Reconciling Water Law and Economic Efficiency in Colorado Water Administration,* 16 U. DENV. WATER L. REV. 37 (2012).

21. By some measures, the Colorado water market is efficient, but the scope of those measures is narrower than that proposed here. *See* Matthew T. Payne et al., *Price Determination and Efficiency in the Market for South Platte Basin Ditch Company Shares,* 50 J. AMERICAN WATER RES. ASSOC. 1488, 1499 (2004).

22. The term "water markets" can refer to anything from an individual farmer's sale of a right to an adjacent town to highly organized markets such as share trading in the Northern Colorado Water Conservancy District. *See* Charles W. Howe & Christopher Goemans, *Water Transfers and Their Impacts: Lessons from Three Colorado Water Markets,* 39 J. AM. WATER RES.

than a century of active water markets and has exhibited flexible legal innovations like instream flow protections and other environmental protections.[23]

However, water markets depend heavily on two key conditions for efficient functioning: (i) low transaction costs (efficient administrative procedures); and (ii) a legal framework that creates the potential for a wide range of transactions (sufficient *market scope*).[24] In Colorado, the water court system, through which all water right transfers must pass, remains cumbersome and costly, thereby ruling out some otherwise desirable market transactions.[25] At the same time, the "anti-speculation" doctrine can narrow market scope by preventing the useful and transparent packaging of agricultural rights to fit urban or industrial demands for large volumes of water. As a result of these two institutional conditions, the correlation between priority dates and economic productivity of the water supplies remains low.[26]

1. Transaction Costs

Transaction costs of carrying out an appropriation or transfer (in dollars per acre-foot transferred) include court costs, possible litigation, and evidentiary showings that the courts require to establish historic consumptive use and non-injury to other water rights holders.[27] The burden of these costs is squarely on the applicant.[28] The costs per acre-foot transferred depend on: (i) the size of the transfer because elements of fixed costs result in economies of scale through the transfer process; and (ii) on the level of controversy surrounding the transfer, which is partially measured by the number of protests.[29] In addition to monetary costs, delays in administrative review can inhibit fast turn-around transfers such as those that agriculture need during drought.[30]

The need to prove "no injury" to other parties not directly involved in the transaction is a substantial and often dominant complexity and cost. Proving *ex ante* the absence of injury to other parties is much more difficult than an *ex post* showing of damage. The burden of proof rests on the initiator of the transaction.[31] In "over-appropriated" basins, any change in a water right (place and timing of diversion, quantity, quality impacts, etcetera) is sure to have impacts

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ASSOC. 1055, 1055-56 (2003).

23. Sasha Charney, *Decades Down The Road: An Analysis of Instream Flow Programs in Colorado And the Western United States*, COLO. WATER CONSERVATION BD. (July 2005), http://cwcb.state.co.us/NR/rdonlyres/140CFE4B-65FC-47C5-9A26-99CCB45A8D45/0/ISFCompStudyFinalRpt.pdf

24. *See* Howe, *supra* note 20, at 38-39; HAL R. VARIAN, INTERMEDIATE MICROECONOMICS 15-16 (5th ed. 1999).

25. *See* Howe, *supra* note 20, at 39.

26. *Id.* at 38-39.

27. COLO. REV. STAT. § 37-92-302 (2014).

28. *Id.*

29. Charles W. Howe et al., *Transaction Costs as Determinants of Water Transfers*, 61 U. COLO. L. REV. 393, 397, 399, 401 (1990). It is also worth noting that if an applicant in Colorado appeals the water court's decision to the Colorado Supreme Court, the Court will often request amicus briefs from third parties to the suit regarding the proposed water right or transfer, even further delaying and adding complexity to the review.

30. It seems possible, if not inevitable, that parties needing quick access to water might attempt to privately negotiate with other water users not to oppose their applications in order to expedite the process.

31. COLO. REV. STAT. § 37-92-302 (2014).

on other parties. Even though the impacts may be small, current water law requires "no injury."[32]

When the state engineer advertises a change in a water right, any party can enter an "objection" to the change *without proof of damage.*[33] This often motivates towns to enter objections to water right changes in their basins to remain informed parties to the transactions should concerns for damages emerge from the transactions.[34] Thus, the balance of power in the water market strongly favors objectors and thereby discourages transactions. Under current practice the result is often

> costly, years-long litigation over small amounts of water – so-called "teacup changes to stream conditions". . . Complicating matters for the applicant, it is hard to propose mitigation without a clear and accepted approach to evaluate injury. It is accordingly often easier and cheaper for applicants to simply relinquish or transfer part of their water right to the stream or objectors than to prove no injury.[35]

It is also difficult to define mitigation steps where there is no "material" or "de minimus" standard for injury."[36]

Because Colorado lacks quickly accessible, basic water rights information, transaction costs further increase. Neither the state engineer's office nor the water courts have publicly available, centralized databases of water right owners by name, making it difficult to contact owners. The state records water rights transactions and ownership at the county level like real estate transactions,[37]which naturally complicates cross-boundary transfers. However, Colorado water court decrees are accessible on a case-by-case basis, and the Colorado Decision Support System is rapidly improving access to ownership and location of diversions.[38] Nonetheless, there are still substantial complexities in determining what is transferable.[39] Equally important, *no one comprehensively records sale prices with public access,* which complicates the problem of "price discovery," for example, figuring out what a reasonable offer to buy or sell might be.

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32. *Id.*

33. *Id.*

34. That many municipalities routinely file for the informational value as well some possibility of a risk is widely informally claimed, based on the authors' experience of water meetings and water law. This was confirmed by City of Boulder Assistant Attorney Pault-Atiase, personal communication 17 March 2016; *see also* COLO. WATER CONSERVATION BD., http://cwcb.state.co.us/public-information/publications/Pages/StudiesReports.aspx (accessed 14 Jan, 2014). Because there has been substantial competition between municipalities for water supply, there is motivation for close monitoring; *see also* Banks & Nichols, *supra* note 35.

35. Britt Banks & Peter Nichols, *A Roundtable Discussion on Colorado's No-Injury Rule,* 44 COLO. LAW. 87, 88 (2015).

36. *Id.* The costs of objection are quite low. *See* Colorado Judicial Branch, *Filing Fees, Surcharges, and Costs in Colorado State Courts,* JDF 1 R7/15 (2014), http://www.courts.state.co.us/Forms/Forms_List.cfm?Form_Type_ID=176 (last visited Feb. 18, 2016).

37. *Ditches & Diversions,* WATER INFO. PROGRAM COLO. DIVISION WATER RESOURCES, http://www.waterinfo.org/colorado-water/ditches-diversions (last visited Sept. 15, 2012). The prices are not disclosed or recorded.

38. *Colorado Decision Support System,* COLO. DEP'T OF NAT. RESOURCES, http://cdss.state.co.us/Pages/CDSSHome.aspx (last visited July 18, 2015).

39. *See id.*

When a person files an application for change of right, the water court requires the right owner's name and the nature of the changes in the application.[40] The water court clerk publishes resumes of such applications monthly, but the resumes include only limited information: the amount, priority date, location of the intended beneficial use, and general source of the water.[41] For a water market to function efficiently, more information, such as the types of crops irrigated and average water applications, is useful.

In 2007, the Colorado Supreme Court appointed a committee to review the water court process to identify possible ways to achieve efficiencies in water court cases through rule and/or statutory changes.[42] The committee's recommendations included amendments to the rules of procedure, educational programs for attorneys and judges, the establishment of a standing water court committee, better materials to assist the public and individuals without attorneys, and necessary funding for the courts and their staffing.[43] While the recommendations are steps in the right direction, the jury is still out on the effectiveness of the 2009 changes in the rules[44] and forms that water applicants must use.[45] The paperwork changes may have made the process even more complex and reducing transaction costs remains a challenge in Colorado. The required studies to show that a proposed water transfer will not impose injury on other water rights is still the major cause of transactions costs.[46]

2. The Scope of Water Markets: Market Size; the Beneficial Use Requirement and the "Spook of Speculation"

Both the geographical extent of the market and the breadth of legally allowable transactions define the scope of a water market: the larger the number of buyers and sellers, the more likely that market will function in a competitive manner.[47] The greater the scope of the market, the more effective the market

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40. *See, e.g.*, COLO. WATER DIVISION 1 DIST. COURT, WATER RESUME PUBLICATION (2012).

41. *See, e.g., id.*

42. Chief Justice Mary J. Mullarkey, *Order Concerning the Establishment of the Water Court Committee of the Colorado Supreme Court,* COLO. S. CT. OFFICE OF THE CHIEF JUSTICE (Dec. 4, 2007), http://www.courts.state.co.us/userfiles/File/Court_Probation/Supreme_Court/Committees/Water_Court_Committee/Water_Court_Committee_Chief_Justice_Signed_Order.pdf.

43. Justice Gregory J. Hobbs, Jr., *Timely, Fair, and Effective Water Courts: Report to the Chief Justice,* WATER CT. COMM. OF THE COLO. S. CT. (Aug. 1, 2008), http://www.courts.state.co.us/userfiles/File/Court_Probation/Supreme_Court/Committees/Water_Court_Committee/Final_Report_August_1_2008.pdf.

44. James S. Witwer & P. Andrew Jones, *Statutory and Rule Changes to Water Court Practice*, 38 COLO. LAW. 53, 53 (2009).

45. *See* Zachary Willis, *Water Court Forms Again Updated by Colorado State Judicial,* COLO. BAR ASS'N. LEGAL CONNECTION (January 12, 2012), http://cbaclelegalconnection.com/2012/01/water-court-forms-again-updated-by-colorado-state-judicial-new-denver-basin-application-issued.

46. W. Governors Ass'n et al., *supra* note 2, at 15; Banks & Nichols, *supra* note 35, at 88; *see* COLO. WATER CONSERVATION BD., COLORADO'S WATER PLAN SECOND DRAFT (July 2015), https://www.colorado.gov/pacific/sites/default/files/FINAL-2ndDraftClean-Appendices-2015%20Revised.pdf.

47. *See* ROBERT D. COOTER & THOMAS ULEN, LAW AND ECONOMICS 37 (1988); the geographic scope of potential transfers can be expanded with increasingly long distances of transfer and hence energy costs if water is moved uphill, or by means of exchanges of water rights, which

will be in producing advantageous transactions.[48] For example, a market that can generate transactions throughout an entire river basin is more likely to identify advantageous transactions than one confined to a smaller watershed simply because the larger number of buy-and-sell offers increases the likelihood that mutually beneficial matches will occur. Conversely, legislative proposals to prohibit out-of-basin transfers would, if passed, also rule out some advantageous transfers.[49]

In Colorado, two closely related doctrines that lie at the heart of prior appropriation further limit the scope of water markets: beneficial use and anti-speculation.[50] Both doctrines originated out of concerns about the monopolization of water supplies.[51] The common-sense beneficial use requirements[52] were intended to prevent wealthy developers or early settlers from claiming entire streams and to promote efficient use by discouraging "waste" through the threat of forfeiture of the right.[53] However, the doctrines have not kept up with the times. As Professor Janet Neuman states, "the doctrinal trinity of beneficial use, waste, and forfeiture. . . is ill-equipped in its present form to achieve the levels of efficiency that will be necessary to meet twenty-first century western water demands."[54]

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may be constrained by the availability of other water rights owners to collaborate in a plan; *see* Peter D. Nichols, Megan K. Murphy and Douglas S. Kenney, *Water and Growth in Colorado: A Review of Legal and Policy Issues*, Natural Resource Law Center, University of Colorado School of Law (2001); *see* ELLEN WOHL, *Virtual Rivers*, (Yale U. Press 2001), *passim*, on historic development of irrigation and water transfers; *see* Robert R. Crifasi, *A Land Made from Water: Appropriation and the Evolution of Colorado's Landscape, Ditches and Water Institutions*, 237-244, Boulder: University Press of Colorado (2015); *see* STENZEL & CECH, *supra* note 4, at 426-427; COLO. WATER CONSERVATION BD., COLORADO'S WATER PLAN, https://www.colorado.gov/cowaterplan, at 4-1 - 4-14 and 6-15 - 6-54.(discussing constraints).

48. *See id.*

49. There are several benefit-cost studies out-of-basin transfers. *See, e.g.* Howe & Easter, 1971, *Interbasin Transfers of Water,* Resources for the Future, Washington, D.C.; Howe, 1987, *Project Benefits & Costs from National and Regional Viewpoints: Case Study of the Colorado-Big Thompson Project,* Natural Resources Journal, Vol. 27, No.1:1-20; *See, e.g.*, H.B. 971286, 61st Gen. Assemb., 1st, Reg. Sess. (Colo. 1997); COLO. WATER CONSERVATION BD., COLORADO'S WATER PLAN *supra* note 47, at 4-1 - 4-14 and 6-1 - 6-54; *see also* David C. Taussig, *The Devolution of the No-Injury Standard in Changes of Water Rights*, 18 U. DENV. WATER L. REV. 116 (2015) (discussing transactions costs and limitations on transfers), Banks & Nichols, *supra* note 35.

50. Scott A. Clark & Alix L. Joseph, *Changes of Water Rights and the Anti-Speculation Doctrine: The Continuing Importance of Actual Beneficial Use*, 9 U. DENV. WATER L. REV. 553, 562 (2006) (citing High Plains A & M, LLC v. Se. Colo. Water Conservancy Dist., 120 P.3d 710 (Colo. 2005)).

51. COLO. REV. STAT. § 37-92-305(9)(b) (2015); *see also* High Plains A & M, LLC., 120 P.3d at nn. 2-3; DAVID SCHORR, THE COLORADO DOCTRINE: WATER RIGHTS, CORPORATIONS, AND DISTRIBUTIVE JUSTICE ON THE AMERICAN FRONTIER 28, 45, 48, 62 (2012).

52. Forfeiture of rights is infrequent in Colorado. The state has no forfeiture statute (which, in other states, returns the water to public use after a specified period of time, regardless of the water right holders' intentions). An abandonment proceeding requires a showing of intent to abandon the water right and is required to eliminate an unused right, although abandonment is presumed if water rights have gone unused for ten years. COLO. REV. STAT. § 37-92-103(2) (2014); COLO. REV. STAT. § 37-92-402(11) (2012).

53. SCHORR, *supra* note 51.

54. Janet C. Neuman, *Beneficial Use, Waste and Forfeiture: The Inefficient Search for Efficiency in Western Water Use*, 28 ENVTL. L. 919, 922 (1998).

In defining beneficial use, courts have used a custom-based, lowest-common-denominator standard that fails to either motivate the highest-valued water uses or "ratchet-up" reasonable use standards as better technologies become available.[55] For example, water-intensive flood irrigation should not qualify as a beneficial use if economic sprinkler techniques are available and widely used, unless there are other non-crop benefits generated by the flood technique, such as retiming of flows or ecosystem services.[56] In general, the water courts may not be well equipped to say what is – or is not – beneficial, so perhaps water users, water managers, and water markets should make that determination.

Closely related to beneficial use is the concept of "speculation" and the anti-speculation doctrine. In water law, the state has defined speculation, in relation to a proposed filing or transfer, as the lack of a "specific plan and intent to divert, store or otherwise capture, possess, and control a specific quantity of water for specific beneficial uses."[57] From the beginning of the change of use process, these conditions, namely a specific plan and intent, can preclude economically valuable transactions, such as "packaging" smaller rights to match larger users' supply needs.[58] When a potential buyer will not commit to buy or lease rights until the change of use is confirmed, it creates a "chicken and egg" problem because a definite transferee who has a clear "beneficial use" for the water must have a specific buyer with a clear "beneficial use."[59]

For example, in *High Plains A&M, LLC v. Southeastern Colorado Water Conservancy District*, High Plains acquired extensive water rights and options on the Fort Lyon Canal in Colorado's Arkansas Basin with the intent of reserving the consumptive fractions of those rights for transfer to unspecified, but fairly obvious, Front Range communities.[60] The water court denied High Plains' change of use application for these supplies and the Colorado Supreme Court affirmed the denial in 2005, concluding that the exchange application was speculative.[61]

Speculators are typically parties who invest in risky situations, banking on superior information or better-informed anticipation of future conditions to

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55. *See id.* at 947-48.

56. *See* Robert R. Crifasi, *Reflections in a Stock Pond: Are Anthropogenically Derived Freshwater Ecosystems Natural, Artificial, or Something Else?*, 36 ENVTL. MGMT. 625, 632, 635 (2005).

57. Pagosa Area Water & Sanitation Dist. v. Trout Unlimited, 170 P.3d 307, 315 (Colo. 2007) (citing COLO. REV. STAT. § 37-92-103(3)(a)(II) (2007)). The financial definition of "speculation" is the undertaking of a risky business or financial position in the expectation of a commensurate gain. In the futures markets, speculators accept contracts offered by "hedgers" who seek to avoid risk. This is a vital function in the allocation of risk. *See* VARIAN, *supra* note 24, at 236-37.

58. *See* Howe, *supra* note 20, at 41.

59. *Id.*

60. High Plains A & M, LLC v. Se. Colo. Water Conservancy Dist., 120 P.3d 710, 715-16, 721 (Colo. 2005).

61. *Id.* at 714. The Supreme Court explained that High Plains applied to change water rights historically used for irrigation for use in any of twenty-eight Colorado counties. The water court found that "there was no way to determine whether vested water rights would be injured by the change or to determine if there would actually be a new beneficial use made of the water." The water court found, and the Supreme Court agreed, that the proposed changes were "such a deviation from the original right" that High Plains had effectively requested a new water right altogether, which violated Colorado's anti-speculation doctrine.

profit from spot and forward sales or purchases.[62] These risk takers are needed to contract with risk-averse parties "hedgers" for a continuous, efficient market like those found in the grain, oil, and electric energy markets.[63] It is reasonable to assume that the High Plains group had made extensive investigations into emerging Front Range water needs and the willingness of Arkansas Valley farmers to sell parts of their water supplies. By providing a ready market for farmers, who wanted to sell some of their water, and an alternative source for buyers, High Plains could have beneficially served both. However, the anti-speculation doctrine – regarded as fundamental to the prior appropriation system, as it currently stands – prevented High Plains from doing so.[64]

The Arkansas Valley Super Ditch is an innovative proposal in which participating farmers agree to fallow part of their irrigated land on an annually rotating basis, so they can lease part of their collective consumptive use to other users for longer terms.[65] The proposed project allows water supplies to pass temporarily from agricultural users to other users without permanent sale of the underlying water rights.[66] Many protesters who filed against the Super Ditch in Division 2 Water Court alleged that the exchange application (10CW4) was speculative.[67] In spite of those protests, in 2015 this innovative institutional arrangement succeeded in effecting several small transfers[68] with many more likely to follow.

Some have argued that the biggest impediment to successful water banks and leasing programs, like the Super Ditch, is the lack of easily understandable information available to water rights holders about how such systems would function.[69] While California, Idaho, and Arizona have relatively active water banks, Colorado lags behind.[70] In 2004, the Arkansas River Basin attempted to establish an internet-operated water bank, but the lack of understanding among potential participants of how the internet-operated water bank would function and the poor design for price discovery, it failed.[71]

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62. *See generally* VARIAN, *supra* note 24, at 236 (discussing how and when to measure and equalize risk).

63. COOTER AND ULEN, *supra* note 47, at 55-70.

64. *High Plains*, 120 P.3d at 714.

65. Peter D. Nichols, DEVELOPMENT OF LAND FALLOWING-WATER LEASING IN THE LOWER ARKANSAS VALLEY (2011); *see also Super Ditch*, THE WATER INFORMATION PROGRAM, http://www.waterinfo.org/super-ditch (last visited Sept. 21, 2012).

66. Nichols, *supra* note 65.

67. *See* Chris Woodka, *Irrigation Regulations Draw Protests Across Valley*, PUEBLO CHIEFTAIN (Dec. 28, 2009, 12:00 AM), http://www.chieftain.com/news/local/irrigation-regulations-draw-protests-across valley/article_816422e6-8fa9-50d9-87c9-98a02b4d2e1e.html.

68. Nichols, *supra* note 65; *see also* Chris Woodka, *Catlin Lease Gets State's Blessing*, PUEBLO CHIEFTAIN (Jan. 28, 2015, 4:00 AM), http://www.chieftain.com/special/water/3285662-120/arkansas-ditch-super-valley.

69. Peggy Clifford, Clay Landry & Andrea Larsen-Hayden, *Analysis of Water Banks in the Western States* 1, ii (2004), https://fortress.wa.gov/ecy/publications/publications/0411011.pdf.

70. *See id.* at 29-31, 38, 55, 61.

71. This is the conclusion of John Wiener, who observed (and participated in) all known public discussions on the design and development of the Arkansas River Water Bank Pilot Project. John Wiener, *Next Steps for the Arkansas River Basin Water Bank Pilot Program* 1, 6, 9 (2005), http://www.colorado.edu/ibs/es/wiener/papers/WBSummExpMar05G.pdf; *see also* COLO. WATER CONSERVATION BD., *Brief History of Ark Basin Water Bank*, http://cwcbstate.co.us/loansgrants/alternative-agricultural-water-transfer-methods-grants/documents/briefhistoryarkbasinwaterbankfeb21.pdf (last visited February 18, 2016); Ralph Terry Scanga Jr., *Update*

There is no question that the anti-speculation doctrine has discouraged participation in water banking or pilot leasing programs. Effective administration should, instead, have the effect of injecting more information and flexibility into water markets.[72]

3. The Uneven Application of the Anti-Speculation Doctrine

The State has, in effect, unevenly applied the prohibition of speculation, and users have frequently circumvented it.[73] The *Denver Post* investigative series, "Liquid Assets: Turning Water into Gold," cited cases that showed that water brokers acquired water rights for undefined future sale, through temporary application, to specially formed water districts.[74] The subsequent *High Plains* ruling has not prevented local governments from forming additional special districts to accumulate water rights for later sale to unspecified users.[75] For example, the United Water and Sanitation District consists of a one-acre patch of land that can serve users anywhere in the state while accumulating water rights for unspecified future sale.[76] Another example is the thirty-nine-acre Elbert and Highway 86 Commercial Metro District, which is a statewide district that intends to build a 150-mile pipeline from the Lamar Canal to Elbert County for unspecified users.[77] Thus, while the State attempts to take an anti-speculation stance, highly speculative transactions have been able to proceed.

Another form of circumvention that denies the water market access to vital information is the frequent, secretive purchase of *options* to buy that are not disclosed, and remain undisclosed along with the prices paid or future prices.[78] This effectively end-runs the anti-speculation doctrine while making relevant market information even less available.

Colorado has not considered that *conditional water rights* (typically granted to municipalities for future planning) are speculative even though some have not been perfected for one hundred years.[79] It is difficult to distinguish between

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of Water Banking in the Arkansas Presented to the Interim Water Resources Review Committee (August 21, 2013), https://www.colorado.gov/pacific/sites/default/files/13WaterResourcesUpdate onWaterBanking.pdf. The Interim Water Resources Review Committee is a committee of the Colorado General Assembly, the legislature, which continues work between sessions.

72. *See generally* Clifford, Landry & Larsen-Hayden, *supra* note 69, at 19, 24 (discussing why the transfer process should encourage flexibility and to whom information is provided).

73. *See, e.g.* David Olinger & Chuck Plunkett, *Liquid Assets: Turning Water Into Gold*, DENV. POST, (Nov. 21, 2005), http://www.denverpost.com/news/ci_3235495.

74. *See id.*

75. *See id.*

76. *Id.*; Karen E. Crummy, *Colorado water developer "looted" development, lawsuit alleges*, DENV. POST (Sept. 17, 2012), http://www.denverpost.com/ci_21563447/colorado-water-developer-looted-development-lawsuit-alleges.

77. Karen E. Crummy, *Elbert County Commission Water District Soon Could Reach Across Colorado*, DENV. POST, (July 27, 2011), http://www.denverpost.com/ci_18556062.

78. *See* Olinger & Plunkett, *supra* note 73.

79. J. Gregory J. Hobbs, Jr., Colo. S. Ct., *Anti-Speculation and the Great and Growing Cities Doctrine*, 41st Annual Conference on Environmental Law for the American Bar Association (Mar. 23, 2012); Charles J.P. Podolak & Martin Doyle, *Conditional Water Rights in the Western United States: Introducing Uncertainty to Prior Appropriation*, 51 J. AM. WATER RES. ASS'N. 14, 17 (2015); Casey S. Funk & Daniel J. Arnold, *Pagosa: The Great and Growing Cities Doctrine Imperiled: An Objective Look from a Biased Perspective*, 13 U. DENV. WATER L. REV. 284, 294-96 (2010); *see also* Pagosa Area Water & Sanitation Dist. v. Trout Unlimited, 170 P. 3d

urban planning needs and "speculation." Many oil shale related conditional water rights are more than fifty years old, while some conditional irrigation rights are over one hundred years old.[80] By their mere existence, conditional rights whose development is uncertain introduces another element of uncertainty for all water users, especially those junior to the conditional rights.[81]

In a real sense, considering water prices are broadly expected to continue increasing, every water right owner is a speculator.[82] Most investment groups that have recently invested extensively in western United States ranchland clearly are not in business to raise cattle, but to acquire water rights.[83]

"Speculators All"[84]

C. THE "NO INJURY" REQUIREMENT FOR APPROPRIATIONS & CHANGES OF USE IN THE FRAMEWORK OF EXTERNALITY THEORY

Colorado water law does not allow negative impacts to other water rights owners when changes of use or new appropriations are made.[85] No injury is

307, 309–10 (Colo. 2007); Pagosa Area Water & Sanitation Dist. v. Trout Unlimited, 219 P.3d 774, 777 (Colo. 2009).

80. Derek L. Turner, *Pagosa Area Water & Sanitation District v. Trout Unlimited and an Anti-Speculation Doctrine for a New Era of Water Supply Planning*, 82 U. COLO. L. REV. 639, 643 n. 20, 670 n. 181 (2011).

81. Podolak & Doyle, *supra* note 79.

82. *See* Charles W. Howe & John S. Howe, *The Performance of Water Service Industry Stock Prices and Sensitivity to Highly Publicized Contract Failures*, 31 WATER INT'L 448, 448 (2006).

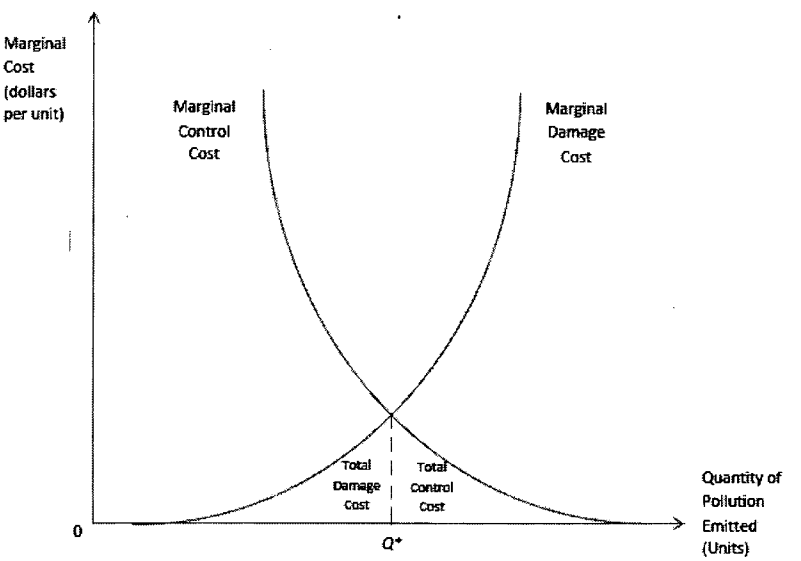
83. *Id.* at 448; Josh Zaffos, *What happened to heritage tourism in small towns in south eastern CO?*, COLO SPRINGS INDEP. (Jan. 6, 2016), http://www.csindy.com/coloradosprings/what-happened-to-heritage-tourism-in-small-towns-in-south-eastern-co/Content?oid=3547515.

84. Bruce Stark, *Baltimore Times, n.d.*

85. COLO. REV. STAT. § 37-92-302(2)(a) (2014).

perhaps the most basic tenet of appropriations doctrine.[86] We can consider such impacts as "negative externalities" imposed on other parties. It is well known from economic theory and common practice that it usually does not pay to *totally eliminate* a negative externality.[87] The efficient level of externality reduction (as defined in economics) is where the marginal cost of further reduction by the initiating party rises to equality with the (falling) marginal damage to the external party.[88] The figure below shows this point where Q^* is the optimal negative externality level. In most cases, this degree of reduction is less than eliminating the externality altogether. Thus, with few exceptions, the legal requirement not to impose any cost or injury on other parties will preclude some desirable changes and distort the scale, even though it carries a degree of fairness.

Allowing the initiating party to compensate the injured party for absorbing some damages can overcome this inefficiency. Rational bargaining should lead to a solution close to the efficient level. Water lawyers can use this procedure to overcome objections to filings and changes.[89]



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Colorado requires the water rights transferor who seeks a change to bear the burden of proof that other water rights will not suffer injury.[91] Many potentially injured parties may be involved in a proposed transfer and they have an incentive to hold the transferor to the high burden of proof. Such parties can

86. David C. Taussig, *The Devolution of the No-Injury Standard in Changes of Water Rights*, 18 U. DENV. WATER L. REV. 116, 118-19 (2014).

87. VARIAN, *supra* note 24 at 578.

88. *Id.* at 578.

89. Banks & Nichols, *supra* note 35.

90. THOMAS TIETENBERG AND LYNNE LEWIS, ENVIRONMENTAL AND NATURAL RESOURCES ECONOMICS, 8TH ED., 358-62, (2009).

91. Banks & Nichols, *supra* note 35, at 87.

enter objections to the transfer at a cost as low as just the filing fee.[92] Further, towns in Colorado typically enter *pro forma* objections to all proposed changes in their basin just to guarantee participation in the proceeding.[93] This practice increases costs to the transferring party even if no injury is likely. In many cases, the costs of bearing the burden of proving no injury can exceed the potential benefits sought through the transfer, further preventing efficient transfers that lower costs would allow.[94] This may also particularly impact small operations such as specialty or organic producers where agricultural water rights loans involve relatively small volumes, which have a 120-day duration, and a limitation on use to three years out of a ten-year period.[95]

The absolute no injury rule also hampers the goal of maximum beneficial use.[96] California and Oregon lead Western efforts in striking a balance between no injury and motivating conservation.[97] The Oregon law provides a transferable water right[98] of 75% of conserved water that proves no injury to other water rights. The state or political subdivision retains 25% of the conserved water (subject to determination on a case-by-case basis).[99] This creates a margin of safety from injury to others and applies on a case-by-case basis rather than as a general principle.[100]

D. FAILURE TO MOTIVATE WATER SALVAGE: THE COMPLEX CASE OF PHREATOPHYTES

Agriculture is the largest consumer of water in the West, so modest increases in efficiency could make substantial amounts of water available.[101] In addition to direct irrigation applications, vegetation along streams and ditches consumes large volumes of water in agricultural areas.[102] These phreatophytes ("well plants") may be native, as in the case of cottonwoods (*Populus spp.*), or invasive as in the case of tamarisk (*Tamarix spp.*, commonly known as Saltcedar), and Russian Olive (*Eleagnus angustifolia*).[103] Phreatophytes consume

92. *See Filing Fees, supra* note 36.

93. Authors' conclusion; *supra* note 34.

94. Banks &Nichols, *supra* note 35.

95. COLO REV. STAT. § 37-83-105 (2012).

96. SCHORR, *supra* note 51, at 107.

97. J.K. Fischer, *Muddy Waters: The Right to Conserved Water in Idaho*, 27 IDAHO L. REV. 303, 303-05 (1991); COMMITTEE ON W. WATER MGMT. ET AL, WATER TRANSFERS IN THE WEST: EFFICIENCY, EQUITY AND THE ENVIRONMENT 82-83 (National Academies Press 1992); W. Governors Association et al., *supra* note 2, at 32, 97-98, 110-11.

98. OR. REV. STAT. § 537.480 (1993).

99. Michael Hohnart, *Carrots for Conservation: Oregon's Water Conservation Statute Offers Incentives to Invest in Efficiency*, 66 U. COLO. L. REV. 827, 827-54 (1995).

100. *Id.*

101. Warren E. Bergholz, Jr., *Water Saved or Water Lost: The Consequences of Individual Conservation Measures in the Appropriation States*, 11 LAND & WATER L. REV. 435, 435, 445-57 (1976); Michael Gheleta, *Water Use Efficiency and Appropriation in Colorado: Salvaging Incentives for Maximum Beneficial Use*, 58 U. COLO. L. REV. 657, 657-58, 660 (1988).

102. P.L. Nagler, E.P. Glenn, C.S. Jarnevich & P.B. Shafroth, *Distribution and Abundance of Saltcedar and Russian Olive in the Western United States*, 30 CRITICAL REVIEWS IN PLANT SCIS. 508, 509 (2011).

103. Patrick B. Shafroth, Curtis A. Brown, & David M. Merritt eds., BUREAU OF RECLAMATION & THE USDA FOREST SERVICE, U.S. GEOLOGICAL SURVEY SCIENTIFIC INVESTIGATIONS REPORT 2009-5247, SALTCEDAR AND RUSSIAN OLIVE CONTROL DEMONSTRATION

more than a half million acre-feet of water in the South Platte alone.[104] In some sites, these plant communities may provide the only bank stabilization and habitat, while in others their removal may provide opportunity for large reductions in non-beneficial consumptive use.[105] The challenge is to motivate their removal in the non-beneficial situations.

Colorado refuses, on principle, to allow "salvage" rights (*i.e.*, the right to use the water saved through phreatophyte eradication for other purposes, or to allow any form of conservation credit for phreatophyte removal).[106] New Mexico State Engineer Steve Reynolds famously said, "[i]f individuals salvaging public water lost to encroaching phreatophytes were permitted to create new water rights where there is no new water, the price of saltcedar jungles would rise sharply. And we would expect to see a thriving, if clandestine, business in saltcedar seed and phreatophyte cultivation."[107]

Saltcedar and Russian Olive species are "the third and fourth most frequently occurring woody riparian plants, and the second and fifth most abundant species (out of 42 native and non-native species) along rivers in the western United States."[108] Critical bank and channel stabilization, sediment retention, water temperature control through shade, and ecosystem processes such as denitrification sometimes depend on these species in large areas.[109] Where farming is or is becoming uneconomic, and flow regulation and changed flow recession timing are present, these species dominate.[110] The halophytic saltcedar species may also dominate where salinity has increased due to irrigation, changes in evaporation, or changes in flow regimes.[111] Changing fire dynamics also play an increasing role.[112] Consequently, given the high volumes of water at stake and

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ACT SCIENCE ASSESSMENT, vii, 4, 21, 23, 123 (2010).

104. REAGAN M. WASKOM, REP. TO COLO. LEGIS., CONCERNING HB12-1278 STUDY OF THE SOUTH PLATTE RIVER ALLUVIAL AQUIFER 69TH GEN. ASSEMB. (2013).

105. Replacement of dense salt cedar and Russian Olive communities is expensive and labor-intensive; *see* BUREAU OF RECLAMATION ET. AL; *supra* note 103.

106. See Colo. Water Conservancy Dist. v. Shelton Farms, Inc., 529 P. 2d 1321, 1324, 1326-27 (Colo. 1974); J. Gregory Hobbs, *Colorado Water Law: An Historical Overview*, 1 U. DENV. WATER L. REV. 1, 23 (1997).

107. *See Shelton Farms*, 529 P.2d at 1327.

108. Nagler et al., *supra* note 102.

109. *Id.*; *see* WALTER K. DODDS AND MATT R. WHILES, FRESHWATER ECOLOGY: CONCEPTS AND ENVIRONMENTAL APPLICATIONS OF LIMNOLOGY, 2d Ed. 2010) 83-105, 345-57, 369-73, 643-62; Mariet M. Hefting, Ronald N. van den Heuvel and Jos T.A. Verhoeven, *Wetlands in Agricultural Landscapes for Nitrogen Attenuation and Biodiversity Enhancement: Opportunities and Limitations*, 56 ECOLOGICAL ENGINEERING 5 (2013).

110. Nagler et al., *supra* note 102.

111. J.C. Stromberg et al., *Legacies of Flood Reduction on a Dryland River*, 28 RIVER RES. APPLIC. 143, 143-44, 155-56 (2012); Laura G. Perry et al., *Vulnerability of Riparian Ecosystems to Elevated CO2 and Climate Change in Arid and Semiarid Western North America*, 18 GLOBAL CHANGE BIOLOGY 821, 829-31 (2011); BUREAU OF RECLAMATION & THE USDA FOREST SERVICE, U.S. GEOLOGICAL SURVEY SCIENTIFIC INVESTIGATIONS REPORT 2009-5247, SALTCEDAR AND RUSSIAN OLIVE CONTROL DEMONSTRATION ACT SCIENCE ASSESSMENT, vii, 4, 21, 23, 123 (Patrick B. Shafroth, Curtis A. Brown, & David M. Merritt eds. 2010).

112. Theresa Jedd, Colo. State. Univ., COLORADO CLIMATE CHANGE VULNERABILITY STUDY 32, 37 (Eric Gordon and Dennis Ojima eds. 2015); Jeff Lukas et al., Univ. Colo., CLIMATE CHANGE IN COLORADO: A SYNTHESIS TO SUPPORT WATER RESOURCES MANAGEMENT AND ADAPTION 34, 34-35, 81, 84 (2014).

the ecological values that phreatophytes sometimes generate, the "salvage" definition and policy is increasingly important and complex.[113] Someone who "salvaged" water from existing uses could receive a transferable right to it if "the water salvaged was, prior to the institution of the conservation measures, not otherwise available for appropriation."[114] The costs of making such a showing, however, may have prevented many such efforts to conserve water.[115] Strict traditional interpretations of beneficial use and waste, coupled with policies not requiring modernization or investment in efficiency,[116] are "virtually institutionalizing historic patterns of waste."[117]

The rigid Colorado policy limits incentives for change. The Federal government made very substantial investments in phreatophyte control, though the Natural Resources Conservation Service of the U.S. Department of Agriculture does not provide a central summary of the state-by-state allocations.[118] How much water could be restored to other uses with an incentive allowing transferability is unknown, but might be quite large. It is critical to the protection of other water rights that the transferable amounts not extend beyond the property owner's own water rights, and the market must motivate transfers so that water now being non-beneficially transpired can be freed for transfer to higher-valued uses.

III. THE ESSENTIALS OF WESTERN APPROPRIATIONS DOCTRINE AND ECONOMIC EFFICIENCY

A. THE PRIOR APPROPRIATIONS DOCTRINE

The Eastern United States generally uses a riparian system in which landowners adjacent to watercourses originally held all the water rights.[119] Eastern riparian states have transformed the system over time into various forms of "regulated riparian law."[120] The essential feature of riparian water law – reasonable accommodation for riparian water uses – was deliberately jettisoned in the

113. In Colorado, "saved" water made available from reduction of return flows has been distinguished from "conserved agricultural water" made available from reduction of a water right owner's historic consumptive use, and "salvaged" water is that made available from a non-beneficial use. COLO. WATER CONSERVATION BD., COLORADO WATER PLAN FINAL DRAFT, 192-93 (2015), http://coloradowaterplan.com. The distinction between saved and salvaged in the case of riparian area phreatophytes would be harder to draw were it not for the explicit treatment of the issue in the *Shelton Farms* decision. *Shelton Farms*, 529 P.2d at 1325.

114. Bergholz, *supra* note 101, at 443.

115. Gheleta, *supra* note 101, 663-64.

116. Neuman, *supra* note 54 at 922, 956-57, 961.

117. Mark Honhart, *Carrots for Conservation: Oregon's Water Conservation Statute Offers Incentives to Invest in Efficiency*, 28 U. COLO. L. REV. 827, 832 (1995).

118. *See* U.S. DEP'T OF AGRIC., NATURAL RES. CONSERVATION SERV., http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/ (last visited Feb. 18, 2016) (detailing areas of federal intervention and investment concerning riparian preservation); *see also* THE TAMARISK COALITION, MISSION & VISION, http://www.tamariskcoalition.org/about-us/our-mission (last visited Feb. 18, 2016) (representing a concerted effort by an independent coalition to curb loss of water in riparian lands and prevent further expansion of invasive plant species.).

119. SCHORR, *supra* note 51, at 51-52.

120. Joseph W. Dellapenna, *Adapting Riparian Rights to the Twenty-first Century*, 106 W. VA. L. REV. 536, 583-84 (2004).

West.[121]

Water law in the Western states developed from water scarcity and the need for cooperation.[122] The West adapted a model designed from the system of water claims used in the goldfields of the Sierra Nevada Mountains in California.[123] Prior appropriation law is named for the system recognizing that the earliest claim on a stream flow has a right prior to subsequent claims.[124] The prior appropriation doctrine is most clearly developed, and straightforwardly applied in Colorado.[125] As David Schorr argues, avoiding monopoly or financial control over water, and thus control over other activities, was a central goal in the prior appropriation system evolution.[126] Further, to solidify the basis for investment in water-dependent activities, water rights are granted as a property right rather than a permit that might be subject to government modification,[127] thereby increasing uncertainty for the owner.

Western American water uses, much like European uses, began with mining and farming, followed by early municipal-industrial development that employed gravity delivery.[128] The need to use water away from river-bank land ownership led to adopting water rules based on mining practices occurring during the California Gold Rush subsequently codified as the Mining Law of 1872.[129] In the Western United States, water quality regulation is largely separated from water quantity administration, reflecting that the right to use a volume of water is indeed a property right,[130] while rights to a particular quality of water are derived from Federal and State laws, and their administration.[131]

The concept of beneficial use is important in Western water law because it limits how often a water is applied and because it is also defines a limit[132]on the water right – excessive application constitutes waste.[133] Major changes in the concept of beneficial use include expansions of the uses for which water rights are granted, led by the innovation of *in-stream flow rights* for environmental protection.[134] Groundwater regulation is another example of legal evolution.[135] The physical complexity of groundwater has proven challenging all over the

121. SCHORR, *supra* note 51, at 5.
122. *See id.*
123. *Id.* at 7.
124. *Id.* at 5
125. *Id.*
126. *Id.* at 7 (explaining that history shows that prior appropriation was concerned with "equitable distribution of water and limiting the power of corporation. . . a like commitment to equal access and the prevention of concentrated control over water").
127. J. Gregory J. Hobbs, Jr. *Reviving the Public Ownership, Anti-speculation and Beneficial Use Moorings of the Prior Appropriation Water Law,* 84 COLO. L. REV. 97, 117 (2013).
128. *See* STENZEL & CECH, *supra* note 4, at XIX.
129. DAVID W. GETCHES, WATER LAW IN A NUTSHELL, 74-75 (5th ed. 2012); SCHORR, *supra* note 51, at 25; JOHN R. LESHY, THE MINING LAW: A STUDY IN PERPETUAL MOTION, Washington, D.C.: Resources for the Future (1987).
130. *See* Hobbs, *supra* note 127.
131. GETCHES, *supra* note 129, at 110.
132. Neuman, *supra* note 54, at 920.
133. GETCHES, *supra* note 129, at 120.
134. Charney, *supra* note 23.
135. *See infra* section 3.

West, likely requiring further regulatory changes.[136]

B. THE CONCEPT AND IMPORTANCE OF ECONOMIC EFFICIENCY IN NATURAL RESOURCE USE

People undertake economic activities, both public and private, with the intent of generating certain positive results, or "benefits."[137] Certain negative impacts, referred to as "costs," are necessary to produce benefits.[138] These benefits and costs are likely to come in quite different units, but the relevant decision maker must conduct some kind of comparison in deciding whether to undertake any given activity.[139] Presumably, the decision maker's point of view guides whether the activity's benefits exceed the costs, (*i.e.*, if "net benefits" are positive).

Colloquially, economic efficiency means avoiding waste and getting the greatest social good out of our limited resources, or "getting the biggest-bang-for-our-buck" from our resource use.[140] In technical terms, using scarce resources over a period of time that maximizes the present value of net benefits to society is how we achieve efficiency.[141] It can be applied to issues at the national level (e.g. ,in deciding among levels of federal expenditure on health, transportation, environment, etcetera); at the regional level, (e.g., Bureau of Reclamation multi-state projects); or at the individual project and policy change level (e.g. deciding on the size of a flood control dam or clean water policy rules). The cost-benefit analysis was first developed at the project level.[142]

Consider a proposal to build a dam on a river with the intent to produce electric power, irrigation water, improved land values, water for cities and towns, water-based recreation, and flood control. In physical terms, these outputs constitute the benefits of the project. To construct and operate the dam, the public will incur various costs some of which are obvious, and some not so obvious. These costs may include, but are certainly not limited to: construction costs; operation and maintenance costs; population inconvenience during construction; loss of the outputs of farmland and livelihoods taken by the reservoir; in-stream recreation losses; deterioration of water and air quality; and damage to riparian ecosystems.

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136. *See* Edella Schlager, *Challenges of Governing Groundwater in U.S. Western States*, 14 HYDROGEOLOGY J. 350, 351, 354, 360 (2006).

137. JOHN O'NEILL, ECOLOGY, POLICY AND POLITICS: HUMAN WELL-BEING AND THE NATURAL WORLD 44 (Taylor & Francis e-Library 2004).

138. *Id.*

139. HARRY F. CAMPBELL & RICHARD P.C. BROWN, COST-BENEFIT ANALYSIS: FINANCIAL AND ECONOMIC APPRAISAL USING SPREADSHEETS 3.2 (2d ed. Routledge, 2016).

140. JAMES BRADFIELD, INTRODUCTION TO THE ECONOMICS OF FINANCIAL MARKETS 8 (2007).

141. R.A. Young, *Economic Criteria for Water Allocation and Valuation, in* COST-BENEFIT ANALYSIS AND WATER RESOURCES MANAGEMENT 13 (Ray Brouwer & David Pearce eds., 2005).

142. C.D. Griffiths & W. Wheeler, *Benefit-cost analysis of regulations affecting surface water quality in the United States, in* COST-BENEFIT ANALYSIS AND WATER RESOURCES MANAGEMENT 223, 227 (Ray Brouwer & David Pearce eds., 2005) ("Comparing all of the monetized gains in consumer utility, called benefits, to the monetized losses in utility, called costs, is BCA"); A. ALLAN SCHMIDT, BENEFIT-COST ANALYSIS: A POLITICAL ECONOMY APPROACH 10 (1989) ("To judge whether proposed public spending or regulation improves aggregate welfare we need a way to add up the costs and benefits to all individuals").

Achieving economic efficiency in designing and operating the dam requires addressing three questions: (i) Is the project designed (size, technology, outputs included, location) to generate the largest net benefits?; (ii) Are the resultant net benefits (benefits minus costs) positive?; and (iii) Is this project a good use of resources compared to other uses?

When evaluating a project, we must start with a description of physical benefits and costs. Thus, the project evaluator must address the following issues: (Q1) How can the physical benefits and physical costs be compared?; (Q2) Whose benefits and costs are to be included?; and (Q3) How should future benefits and costs be compared with today's benefits and costs? The affected parties and how the benefits and costs impinge on their interests will determine the answers to each of these questions,[143] but the standard practice is to use a national accounting of benefits and costs to all affected parties.[144]

(Q1). Comparing Physical Outputs & Costs. The project proponent could simply describe the physical outputs and costs for the decision maker's comparison. For example, a description of the outputs could include: Kilowatts of energy produced annually; acre-feet of irrigation water produced annually; acre-feet of flood storage with resultant reduction in flood damages; natural and scenic areas created; and recreational sites created. Concerning the costs, a description could include: construction costs; anticipated lifetime operating and maintenance costs; opportunity cost of the water evaporated; agricultural lands and production lost; loss of stream fishing; and damage to riparian ecosystems. The problem is that public officials will have trouble balancing these physical benefits and costs in the public interest. In the absence of a widely accepted quantitative procedure for project evaluation, socially bad projects and special interests may dominate the evaluation and ultimately waste scarce resources.

The obvious, and standard, solution for comparing outputs and costs is to attach prices to the project inputs and outputs to see if the sum of the monetized benefits exceeds the sum of monetized costs.[145] Most prices are set in markets, but some are administratively set, while indirect tests estimate others.[146] Available prices may or may not incorporate all the social values that should be taken into account. The following situations can occur in our search for appropriate prices:

Some benefits and costs are valued using prices that result from reasonably competitive markets or from competent administrative determination, thereby closely reflecting social gains and losses;

Market prices may be readily available, but may contain distortions because of unfair trade practices, monopoly market power, price controls, or failure to account for "externalities;" nonetheless, corrections can be made in most cases.

No market price may exist, but various credible techniques can estimate the

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143. *See* SCHMIDT, *supra* note 142, at 15 (explaining that: "Interdependence exists in any situation of scarcity, because one person's choice and use of a resource affects the options open to others.").

144. *See* CHARLES W. HOWE, BENEFIT-COST ANALYSIS FOR WATER SYSTEM PLANNING 16 (1971).

145. Griffiths & Wheeler, *supra* note 142.

146. ROBERT A. YOUNG, DETERMINING THE ECONOMIC VALUE OF WATER CONCEPTS AND METHODS, 161-221(2005), (synthesizing a variety of valuation methods and their application, with particular treatment of irrigation water).

unit value indirectly, such as using: travel cost methods for outdoor recreation; contingent valuation for values of protecting ecosystems; and other benefit-cost measures taken from completed benefit-cost analyses in similar situations.

Some benefits or costs simply cannot be given prices that are credible within a given society's value system, (e.g. the loss of important species and ecosystems or destruction of unique historical artifacts). While someone evaluating these items may not include it in the discussion, they should describe such considerations in footnotes to the analysis. Some may include the value of a human life in this category, but there are credible techniques to estimate values of human life.

(Q2) Whose benefits and costs to include. The most responsible answer is that benefits and costs apply to all parties regardless of location (local, state, regional, national, global) or social class. The usual practice is to take into account benefits and costs within national boundaries, using a "national accounting stance" for benefits and costs.[147] However, regional and local administrators may find a regional or even local benefits and costs accounting more useful for certain types of projects.

(Q3) Comparisons of benefits and costs over time. How should decision makers compare streams of benefits and costs that are incurred over long periods of time? For example, most people would prefer to receive $100 today rather than wait (t) amount of years simply because they can start enjoying the use of the money today, either to satisfy consumption needs or to earn interest over the coming (t) years.[148] Simple financial algebra shows that if the sum B(0) today can be invested at an interest rate (r%) per year, the value in (t) years will be:

$B(t) = B(0)(1+r)^t$ or $B(0) = B(t)/(1+r)^t$ [149]

B(0) is referred to as the "present value" of the future sum B(t).[150]

These observations suggest that a project could be evaluated by the difference between the "present value" of benefits and costs:

$PVNB = [B(0)-C(0)] + \sum [B(t)-C(t)]/(1+r)^t$

where B(0) and C(0) are the up-front benefits and costs and B(t) and C(t) are the annual benefits and costs.[151] Economic efficiency requires that the project is designed and evaluated using these criteria and that PVNB>0 holds.

IV. STEPS TO MITIGATE THESE INEFFICIENCIES

A. EXPANDING ROLES FOR WATER MARKETS THROUGH THE REDUCTION OF TRANSACTION COSTS

As noted in Section 1.B, transaction costs are those costs imposed on the

147. HOWE, *supra* note 144.

148. *See* DANIEL W. BROMLEY, THE HANDBOOK OF ENVIRONMENTAL ECONOMICS, 45-60, 111-138, (Cambridge, MA, Blackwell 1995).

149. Howe, *supra* note 144 at 65-79.

150. *Id.*

151. *Id.*

market participants, primarily on the transaction initiator in a water market.[152] Furthermore, the bulk of these costs arise in complying with the high burden of proof for the no-injury rule.[153] Other costs arise from gathering necessary data related to the transaction and compliance with water law, which usually involves legal assistance as well as engineering supervision. Under current administrative procedures, the water market strongly favors objectors and discourages transactions that are not large enough to warrant the expense and delay of elaborate engineering and legal contests in water court. This means that well-financed actors, like municipalities with stronger financial bases, participate in water markets more than smaller agricultural entities, for whom small expedient transfers would be especially beneficial late in the season, but who face disproportionately higher costs.[154]

Data needs include searching to find partners for the desired transaction. With market areas spanning entire river basins, gathering this information isn't simple. While the Office of the State Engineer advertises proposed changes to existing water rights and past transactions,[155] it does not keep or publish records of water right. Thus, some transaction participants experience difficulty with "price discovery," (*i.e.*, in judging what a reasonable price might be).

Policy makers, attorneys, and interested parties have recommended several changes to these practices. A simple step would be to *allow the presumptive use* of historical data to determine diversion, consumptive use and other parameters of the case. The Colorado Legislature allowed for this in its attempt to establish a water bank in the Arkansas River Basin.[156]

A second step would be to define *through legislation* some range of allowable negative impacts on existing users within which protests could not be pursued. This would reduce the number of "teacup" injury protests even though it would involve some residual loss for impacted parties.[157] Britt Banks and Peter Nichols point out that the Colorado State Legislature has already statutorily declared that some types of water use do not enjoy no injury protection, namely small capacity household wells, gravel pit storage, and groundwater depletions.[158] However, it is not clear that exempting these uses is warranted because small-well use in a basin can be quite large while substantial volumes of storage in gravel pits and a lowering water table can also certainly have negative impacts on other users.[159] Ironically, State law allows increasing the consumptive use of a water right through increased crop consumption despite reducing return

152. COLO. REV. STAT. § 37-92-302 (2014).

153. *Id.*

154. Charles W. Howe, Carolyn S. Boggs & Peter Butler, *Transactions Costs as Determinants of Water Transfers*, 61 U. COLO. L. REV. 393, 401, 404 (1990).

155. *See, e.g.*, COLO. WATER DIV., *supra* note 40.

156. COLO. REV. STAT. § 37-80.5-101 (2014); *see also* OFFICE OF THE STATE ENGINEER, COLO. DIV. OF WATER RES., RULES GOVERNING ARKANSAS RIVER WATER BANK PILOT PROGRAM (2002), http://www.sos.state.co.us/CCR/DisplayRule.do?action=ruleinfo&ruleId=2121&deptID=13&agencyID=133&deptName=400%20Department%20of%20Natural%20Resources&agencyName=402%20Division%20of%20Water%20Resources&seriesNum=2%20CCR%202-12 (last visited Feb. 18, 2016); *see also* Scanga, *supra* note 71.

157. *See* Banks & Nichols, *supra* note 35, at 88.

158. *See id.* at 87-89.

159. *See* Waskom, *supra* note 104.

flows.[160]

Various other states have suggested measures of allowable impacts within a *de minimis* standard. Idaho's Court has allowed a 10% injury band of other parties' water rights, although water users strongly contested this.[161] Impact frequency and duration should be included in such determinations because cumulative *de minimis* changes could have significant impacts on existing rights and riparian ecological conditions with water quality impacts.

A final issue is where the burden of proof lies. Typically, the burden of proof lies on applicant for a change of use.[162] Some people suggest, after initially establishing non-injury, the burden of proof in further appeal actions should shift to the objector.[163] Britt Banks and Peter Nichols conclude that the current system is too costly and rigid, and argue that shifting some legal burden onto objectors in change proceedings would restore the balance that shifted over time.[164]

B. MODERNIZING THE ANTI-SPECULATION DOCTRINE

1. Traditional Justification for the Anti-Speculation Doctrine and Inconsistent Application

David Schorr states that,

> [t]he unofficial codes of the Colorado mining districts. . . focused primarily on rules designed to ensure wide distribution of property. Similarly, the statutes of the Colorado Territory, the water-right provisions of the State constitution of 1876 and the early judicial decisions culminating in the leading case of *Coffin v. Left Hand Ditch Co.*, were mainly concerned to prevent control of water by capitalists, and did so by breaking the common-law monopoly of riparian owners. . .[165]

The "originating principles" of Colorado prior appropriation doctrine includes public ownership, anti-speculation, and beneficial use limitations that circumscribe the amount and manner of use of each water right.[166]

As noted in Section I.C, the no injury principle precluding damage to other water users constrains both changes in water rights and initial appropriations. To effect this restriction, Colorado's water courts need to identify potentially damaged parties related to a transaction. Water courts gather this information in two ways: through the transaction publication and protest process, and by requiring applicants to identify all parties and water uses related to a proposed

160. This is the result of unwillingness to dictate crops or technology; see Neuman, *supra* note 1, who explores this throughout her article.

161. Jeffrey C. Fereday & Michael C. Creamer, *The Maximum Use Doctrine and its Relevance to Water Rights Administration in Idaho's Lower Boise River Basin*, 47 IDAHO L. REV. 67, 74 (2010); IDAHO ADMIN. CODE r. 37.03.11.042 (2015); *see* Clear Spring Foods, Inc. v. Spackman, 252 P. 3d 71 (Id. 2011).

162. COLO. REV. STAT. § 37-92-302 (2014).

163. Banks & Nichols, *supra* note 35, at 88, 90.

164. *See id.* at 90.

165. David B. Schorr, *Appropriation as Agrarianism: Distributive Justice in the Creation of Property Rights*, ECOLOGY L.Q. 3 (2005).

166. *See* Hobbs, *supra* note 127, at 101-02.

transaction at the time of application.[167]

In spite of these requirements, the anti-speculation doctrine is not consistently applied, as illustrated by several water acquisition practices that are blatantly speculative. Granting conditional water rights to cities also allows holding rights against an uncertain future need. Charles Podolak and Martin Doyle note that it is "completely permissible in accordance with the anti-speculation doctrine to hold on to a water right for many decades. . . As a result, there are a large number of old conditional water rights in Colorado."[168] Some of these conditional rights have remained unperfected for over one hundred years.[169] Podolak and Doyle also show that the State has allowed a large volume of conditional water rights to remain valid "until market conditions improve," for the oil, gas, and oil shale industries.[170]

2. The "Chicken-and-the-Egg" Problem Restated: Modernizing Anti-Speculation.

Water law defines speculation as a "lack of a specific plan and intent to divert, store or otherwise capture, possess and control a specific quantity of water for specific beneficial uses."[171] As mentioned above, this can preclude economically valuable transactions because someone seeking to transfer his or her water right must first find a buyer with a clear beneficial use, yet buyers are hesitant to commit without knowing if there is a valid change of use.[172]

The modernization of anti-speculation as presently applied seems warranted by the adverse impacts on available public information, as noted here. With any reasonable form of a no-injury rule, a proposed change decree or administrative approval of an augmentation plan or substitute water supply plan would trigger an examination, and that would require adequate specificity to show at least a presumption of no injury.[173] We suspect that the *status quo*, following the elaboration of the anti-speculation doctrine in the *Pagosa* cases favors those with more information over those with less.[174] Organizations such as municipal water providers and those playing the role of brokers with high levels of information, typically face irrigators (sellers) who may not have as much information, or financial capacity to acquire it, as the potential buyers.[175]

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167. COLO. WATER DIV., *supra* note 40; COLO. REV. STAT. § 37-92-302 (2014).

168. Podolak & Doyle, *supra* note 79, at 31.

169. *See id.* at 14.

170. *Id.* at 25, 27, 29.

171. Pagosa Area Water & Sanitation Dist. v. Trout Unlimited, 170 P.3d 307, 315 (Colo. 2007) (citing COLO. REV. STAT. § 3792-103(3)(a)(II) (2007)).

172. *See* Howe, *supra* note 20, at 41.

173. For discussion of possibilities, *see* Banks and Nichols, *supra* note 35.

174. Pagosa Area Water & Sanitation Dist. v. Trout Unlimited, 170 P.3d 307, 315 (Colo. 2007) (citing COLO. REV. STAT. § 3792-103(3)(a)(II) (2007)), and *Pagosa Area Water & Sanitation District v. Trout Unlimited (Pagosa II)* 219 P.3d 774 (Colo. 2009); *see also* Turner, *supra* note 80 (discussing the anti-speculation doctrine as related to urban supply acquisition.)

175. This is implicit in the discussion of "alternative water transfer mechanisms" in COLO. WATER CONSERVATION BD., *supra* note 46, at 6-111 - 6-122 (Chap. 6 Sec. 4); we argue that this asymmetry in information is an important hindrance to the expansion of markets and have experienced confirmation in a series of workshops held by the Ditch and Reservoir Company Alliance

The high transactions costs of transferring water and the concerns with information asymmetry are believed to inhibit commitments, and thus also disclosure of interest.[176]

Re-thinking the *High Plains* case, one company was seeking what would have been in effect a license to market water rights it had acquired or water from exercise of options it had acquired.[177] The inability to identify the risks of injury indeed made the application for a change decree outside of the intent of the current no-injury rule, as it could not be applied as presently held.[178] But the interactions with other elements of current Colorado water law are critically important. As Taussig demonstrated, the invocation of expensive and uncertain determinations of historic consumptive uses of an irrigation water right as a "devolution" of the no-injury rule may be seen as defense of water rights, but it may more powerfully limit willingness to participate.[179] With the risk of reduction of a water right, and relatively low information on the potential value, entering the market in public becomes a "chicken-and-egg" problem: without better information on potential final value, and with a risk from seeking the information, the *status quo* is maintained and the anti-speculation doctrine defeats its own purpose. It purports to limit speculation only by creating opportunity for purchasers of options to buy from those working with very likely poor information about other potential sellers and about prices being paid. The results, as shown by Olinger and Plunkett[180]are secrecy, non-disclosure terms, and disadvantage to those with little bargaining power. The irony includes the fact that the anti-speculation doctrine was originally intended to limit the power of wealth to control irrigation water.[181]

In a similar situation, the Colorado Corn Growers Association, Aurora Water, and Ducks Unlimited tried to develop a system where farmers could amend their water rights for other uses.[182] Farmers could auction their water rights in years they were not planning to use them while cities, industry, or conservation groups could bid for the flows.[183] Colorado water attorney, Andy Jones, asserted that the flex market is a "narrow, intentional exception to the State's anti-speculation rule," which the involved parties were in effect "trying to create incentives for water to stay in agriculture."[184] Nonetheless, various water agencies

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(www.DARCA.org) in which John Wiener was participant and served as rapporteur for the Alliance; these meetings were held 02 and 09 December of 2015 and 27 January at the Colorado Water Congress, and four in June and July of 2014.

176. *See* Howe, *supra* note 20, at 41.

177. *See* Lawrence J. MacDonnell, *Public Water–Private Water: Anti-Speculation, Water Reallocation, and High Plains A&M, LLC v. Southeastern Colorado Water Conservancy District* (2006) 10 U. DENV. WATER L. REV. 1, 9-11 (2006); High Plains A & M, LLC v. Se. Colo. Water Conservancy Dist., 120 P.3d 710, 716-17 (Colo. 2005).

178. *High Plains*, 120 P.3d at 716-17.

179. Taussig, *supra* note 50; COLO. WATER CONSERVATION BD., *supra* note 46, at 6-117.

180. Olinger & Plunkett, *supra* note 73.

181. SCHORR, *supra* note 51, at 5

182. Joshua Zaffos, *Can leasing irrigation water keep Colorado farms alive?*, HIGH COUNTRY NEWS (June 8, 2015), http://www.hcn.org/issues/47.10/can-leasing-irrigation-water-to-keep-colorado-farms-alive.

183. *Id.*

184. *Id.*

helped to defeat the bill that would have authorized the market.[185]

In spite of these rulings, a developer recently announced plans to buy 14,600 farmland acres with connected water rights to the Fort Lyon Canal.[186] Whether this will pass the speculation test remains for the court's analysis. Perhaps unfortunately for the rural economy of this area, the court will not decide whether the change is speculative until there is an application for a change of diversion, place, or kind of use. Although the Fort Lyon Canal Company may scrutinize the farmland and water shares purchase as a real estate transaction, there is no State or public involvement without some other triggering event. Even filing a change in ownership in water court may not invoke any scrutiny. The Colorado Water Plan's "Colorado Water Values" urge increased collaboration by encouraging all interested parties to participate in the review process earlier.[187]

From the public or social perspective of economic efficiency, the externalities involved in long ditches call for particularly close scrutiny to determine the full range of costs involved in a transfer, potential mitigation, and local impacts, which may or may not elicit local or state government involvement.[188] For example, water courts shall impose conditions on a transfer to mitigate the impacts on local tax bases and sometimes require revegetation and noxious weed prevention.[189]

The key to economic efficiency may be a modernized anti-speculation policy, which encourages early disclosure of aspirations, including willingness to bargain. Then, implementation would follow the rules and regulations optimizing use of water consistent with preservation of the priority system of water rights (as was sought for groundwater management).[190]

3. Accommodating Uncertainty in Water Administration

Section I.C argued that the no injury rule is too severe and that certain "de minimis" standards can avoid unneeded litigation over "teacup cases." Section III.B.1 pointed out that conditional water rights are issued on grounds of projected water demands that are subject to broad uncertainty, although the *Pagosa* rulings require tighter standards.[191] The *Pagosa* rulings recognized the need for planning.[192] The legal system recognized and adapted to the tension between

185. *Id.*

186. *Id.*

187. WATER PLAN, *supra* note 113, at 3-3

188. For a full description of considerations and contemporary ecosystem valuation sources for additional information *see* ARKANSAS BASIN ROUNDTABLE, CONSIDERATIONS FOR AGRICULTURE TO URBAN WATER TRANSFERS: REPORT OF THE WATER TRANSFERS GUIDELINES COMMITTEE (September 10, 2008) http://cwcb.state.co.us/public-information/publications/Pages/StudiesReports.aspx. For current methods and applications of ecosystem valuations, including benefits for amenity, recreation and some real estate value information, *see* Earth Economics, NATURE'S VALUE FROM CITIES TO FORESTS: A FRAMEWORK TO MEASURE ECOSYSTEM SERVICES ALONG THE URBAN-RURAL GRADIENT (2014) www.eartheconomics.org.

189. COLO REV. STAT. § 37-92-305 (4.5)(a)-(c) (2015).

190. COLO. REV. STAT. § 37-92-501(2)(e) (2015).

191. Turner, *supra* note 80, at 661, 673.

192. *Id.* at 661, 675-76.

planning needs and speculation, and to the need to accept some range of uncertainty in various dimensions of water administration to have a workable system. This is manifested in modifying the "great and growing cities doctrine."[193] In a similar fashion, the courts should relax the currently severe anti-speculation doctrine when judging proposed water market transactions that are forward-looking. The planning expertise of diverse water actors would then play a role in efficiently distributing water supplies over time through the market and amongst uses.

In major world markets, speculators play a vital role in allocating unavoidable risk by allowing "risk averse" parties to contract against the risks they face.[194] This is true in the grains, oil, and electric energy markets.[195] Even the priority doctrine allocates risk by differentiating between senior and junior rights that permit water users to adjust their portfolios to the degree of risk desired.

4. Encouraging Institutional Innovation in Water Administration

The Colorado Legislature established water banks in each major basin.[196] While it is clear that well-designed water banks can be quite effective in distributing water over time and among uses, it is also clear that we must follow the lessons of past attempts, successful and failed.[197]

The term "water banking" means a variety of ways of trading the use of water.[198] The Colorado Legislature's earlier experiment with a failed pilot program in the Arkansas River Basin resulted in a non-profit brokerage mechanism trading only stored surface water. The most significant advance may have been the precedent-setting agreement to use presumed figures for conveyance loss and consumptive use fractions from each major ditch, based on recent modeling and decades of data.[199] However, the negotiations over injury and litigation

193. *Id.* at 639, 651.

194. *See* VARIAN, *supra* note 24, at 236-37.

195. JOSEPH P. STIGLITZ, ECONOMICS, W. W. Norton & Company, 153-165 (1993).

196. COLO. REV. STAT. § 37-80.5-104.5 (2015).

197. *See* Payne et al., *supra* note 21, at 1488.

198. *See* Clifford, Landry & Larsen-Hayden, *supra* note 69, at ii.

199. OFFICE OF THE STATE ENGINEER, DIVISION OF WATER RESOURCES, DEPARTMENT OF NATURAL RESOURCES, STATE OF COLORADO, RULES GOVERNING THE ARKANSAS RIVER WATER BANK PILOT PROGRAM (2002), codified at 2 Code of Colorado Regulations 2 CCR 402-12, incorporating 2007 changes, http://www.sos.state.co.us/CCR/DisplayRule.do?action=ruleinfo&ruleId=2121&deptID=13&agencyID=133&deptName=400%20Department%20of%20Natural%20Resources&agencyName=402%20Division%20of%20Water%20Resources&seriesNum=2%20CCR%20402-12.

We argue that the 2002 rules were quite significant because of their acceptance of presumptive figures for transferable consumptive use from each of the major ditches in the lower Arkansas Valley. The claim that these were based on years of data and previous adjudications is based on the observation and participation in all known public meetings in the rule-making.

The confidence in past engineering was related to the development of a hydrologic model with water rights included, called the "Hydraulic-Institutional Model", which was "blessed" by acceptance for use in the U.S. Supreme Court original jurisdiction case, *Kansas v. Colorado*, No. 105, Orig., 514 U.S. 673 at 678-687. Hundreds of pages of detail are included in the reports of the Special Master appointed for the case, http://www.supremecourt.gov/SpecMastRpt/SpecMastRpt.aspx; *see* Report Original Case 105 No. 091997 at 7-20; subsequent reports and agreement continue to use this model.

concerns took substantial time and effort, while neither the internet-based implementation system facilitated price discovery, nor did most of the potential users trust it.[200]

This experiment in modifying traditional prior appropriation law reduced transactions costs and delays in water transfers, and was intended to increase flexibility to agricultural water rights holders' benefit. Most people expected this flexibility to become increasingly desirable during conditions of scarcity and to foster new approaches to alternative water transfer mechanisms ("ATMs"). However, because actors in the water market widely expected to encounter immediate litigation, the Office of the State Engineer and many parties negotiated a set of compromises, which reduced this theory with substantial appeal to an implementation that did not allow for any practical uses. The delay in execution was long enough to render implementation inapplicable for emergency or sudden needs, and the duration of the allowable lease-like transfer was not long enough to meet more predictable municipal and industrial needs.[201] By the time the water bank website went operational, the season had largely passed, and the limited outreach program had not had the opportunity to explain the website and procedures.[202] Thus, water users made only a few offers and a few bids resulting in no transactions (a view of the offers is available from Colorado Water Conservation Board).[203]

Among the lessons learned from the Arkansas Water Bank Pilot Project is the critical need for clear understanding among participants. The Colorado Water Plan and many years of public discourse somewhat meet this level of understanding, but it likely is not fully accomplished for any of the ATMs.[204] Potential users must be able to clearly identify: what is transferable and under what conditions (e.g., what if the water is not provided to the transferor?); the duration of the transfer contract or performance, if initiated; the timing of calls to perform or initiate; different prices for different timing, if desired (e.g., to cover incurred farming costs, which would be wasted if irrigation is stopped, or the costs of establishing a cover crop, including any needed water); how the irrigator will cope with farming interruption problems (e.g., will there be an arrangement for payment at times suitable to employ skilled labor in alternative tasks); how the ditch company or district will manage with the reduced flows; and how the share-holder and ditch company will assess the water rights and delivery, or foregone delivery.

C. SECURITY AND INVESTMENT IN THE FUTURE

There are hundreds of ways in which land ownership is divided among parties with different interests, such as direct users, easement holders, covenants

200. Scanga, *supra* note 71.

201. JOHN WIENER, PROBLEMS WITH THE ARKANSAS RIVER BASIN WATER BANK PILOT PROGRAM, http://www.colorado.edu/ibs/es/wiener/papers/One-pagerArkWBankPilotProgram.pdf (last visited Feb. 18, 2016).

202. *See id.*

203. HAL SIMPSON, STATE ENG'R, REPORT TO THE GOVERNOR AND LEGISLATURE ON THE ARKANSAS RIVER WATER BANK PILOT PROGRAM 2 (Nov. 1, 2005).

204. *See generally* COLO. WATER CONSERVATION BD., COLORADO WATER PLAN SECOND DRAFT *supra* note 46, *at* 94-266 (discussing alternative transfer mechanisms that are currently being researched).

for mutual benefit within an area, local land use regulations and zoning, state and federal regulations, mortgage lenders, and investors and creditors of many kinds. ATMs, as pilot projects, provide a great leap forward in water sharing.

Municipalities have the capacity, for example, as partners in joint ownership of some water rights, to employ bonding capacity for very low-cost capital.[205] Farmers have the senior water rights and the land, but are in need of capital and a longer planning horizon to transition from crops with very high water needs to more diverse farming systems. Water providers can and should represent the public's interests in conjunction with local government, regional coalitions, and consumer groups, such as school districts that use local and regional farm products, with frequent opportunities for public comment.

We must think of agricultural potential, urban and industrial supply, and environmental benefits, and consider what a desirable future would include. Many consider this the goal of Integrated Water Resource Management.[206] Municipalities simply thinking "just get the water" is no longer adequate for the pressures and the problems we already face, and will face more intensely in the coming years.

205. COLO. REV. STAT. § § 29-14-101-110 and 29-15-101-112; *see U.S. Environmental Protection Agency, Guidebook of Financial Tools: Paying for Environmental Systems*, Washington, D.C.: US Environmental Protection Agency (2008), https://www.epa.gov/envirofinance (discussing relevant costs).

206. AM. WATER RESOURCES ASS'N POLICY COMM., CASE STUDIES IN INTEGRATED WATER RESOURCES MANAGEMENT: FROM LOCAL STEWARDSHIP TO NATIONAL VISION 5 (Brenda Bateman & Raquel Rancier eds., 2012) http://www.awra.org/committees/AWRA-Case-Studies-IWRM.pdf.