

Fundamental questions about water rights and market reallocation

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Received 3 November 2003; revised 11 May 2004; accepted 28 May 2004; published 25 August 2004.

[1] Water markets have many advantages for water reallocation. However, water markets do not always function efficiently because the property rights structure was not designed for market transactions. The potential for successful markets can be determined by looking at the 10 fundamental questions relevant to water rights. The questions are relevant to any system of water rights, but the examples used are largely from the western United States. The questions are designed to raise issues about the basic structure of a water rights system. After discussing these issues, the paper turns to recommendations on how a water rights structure could be modified to facilitate markets. The recommendations are not meant to be an end point but are intended to stimulate discussion. *INDEX TERMS*: 6319 Policy Sciences: Institutions; 6324 Policy Sciences: Legislation and regulations; 6339 Policy Sciences: System design; *KEYWORDS*: markets, property rights, water law

Citation: Matthews, O. P. (2004), Fundamental questions about water rights and market reallocation, *Water Resour. Res.*, 40, W09S08, doi:10.1029/2003WR002836.

1. Introduction

[2] Water markets can be an equitable and efficient way to reallocate water. Unfortunately, water markets do not always function that way [Dellapenna, 2000]. Much of the problem lies in the fact that water rights systems were developed to resolve problems from a century or more in the past and were not developed with markets in mind [Kanazawa, 2003]. This legacy is still reflected in the current property rights structure, and that structure can inhibit the achievement of new societal goals and preferences [Opiela, 2002]. Although the volume of recent literature suggests water marketing may become a preferred way of reallocation [Kaiser and McFarland, 1997], markets will not succeed without an adequate property rights structure.

[3] All property rights systems have rules that define the rights, the obligations, and the relationships people have with regard to the property in question [Freyfogle, 1989]. Some rules are clear and distinct so that everyone knows and understands what they are. Rose [1988] calls these rules “crystals.” Not all rules are crystals. Exceptions, uncertainties, ambiguities, and misunderstandings lead to rules that are, in Rose’s terminology, “mud.” Many of the rules associated with water rights are mud rules. The uncertainties created by mud rules make it difficult for markets to function. The need for clarity is most important in defining the “relational” aspect of water rights. However, water’s mobility makes it intrinsically difficult to define the “relationships” between all users and uses. How these relationships are defined provides the core to any water rights system. As water passes through the hydrologic cycle, both public and private users must share. Exclusivity and autonomy are missing. Even though water is a shared resource, the rules controlling water rights frequently

create conflict and uncertainty by ignoring potential users. Reallocating water through markets must take into account these other interests. This goal can be achieved if the property rights structure is properly designed.

[4] Before a property rights system can be changed to improve water markets, the basic structure must be understood. The questions discussed below are designed to point out obstacles to water marketing. The answer to these questions provides the key to a market’s functionality. This article is divided into two parts. The first part has 10 fundamental questions about water rights. The second part discusses how the obstacles raised by the questions could be overcome.

2. Ten Fundamental Questions About Water Rights

[5] The 10 questions are designed to evaluate the basic structure of a water rights system. These questions are the who, what, when, where, and how of water rights. They deal with issues of certainty, integration, security, enforcement, and relationships between users.

2.1. What Water Is Subject to the Water Right?

[6] Water rights systems generally ignore hydrologic reality by limiting rights to a subset of the water available in the hydrologic cycle [Matthews, 1984]. For practical reasons, atmospheric moisture is generally excluded. In other instances, water is considered to be an intrinsic part of land and inseparable from the rights associated with it [Opiela, 2002]. In addition to dealing with the practicalities of the hydrologic cycle, sometimes policy choices are made, and a water right is created in specifically defined water such as navigable water [MacGrady, 1975].

[7] The line between water available under water allocation rules and water considered to be part of “land” is complex. In drawing the line between land and water, problems arise most often in dealing with diffused surface

water, soil moisture, and groundwater. Diffused surface water is defined as water running on the land's surface before a watercourse is reached. In the western United States, diffused surface water is part of the land and can be captured by the landowner [Beck, 2001]. In contrast, some Australian states place diffused surface water under state water allocation laws [Fisher, 2000]. Soil moisture is generally considered part of land, but soil moisture can be hydrologically connected to both groundwater and surface water. How soil moisture is "used" as a land right can interfere with someone's water right. In addition, places that follow the groundwater doctrine of "absolute ownership" allow landowners to have a right to pump groundwater at will. In essence, this is a land right because it cannot exist without land ownership.

[8] Drawing a line between land and water is a way of establishing "dominant" and "subservient" property rights. For example, if diffused surface water is under the jurisdiction of water allocation statutes, then land uses that interfere with surface water movements should be subject to the relevant water rights. The water right would dominate the land right. On the other hand, if diffused surface water is under the control of a landowner, the landowner can do things that will interfere with the movement of surface water, depriving a water right holder of water they would otherwise receive. The land right is dominant. A similar situation occurs with soil moisture.

[9] Rights may also be limited to specified water without regard to the hydrologic cycle. For example, "navigable waters" are subject to federal jurisdiction and have a variety of public rights and obligations associated with them [MacGrady, 1975]. Water rights established under state law are subject to the federal government's overriding power over navigation. However, "navigable waters" are not always defined in the same way, with different waters being affected depending on the context in which the term is used. Different "navigation" definitions exist for navigable servitudes, determining ownership of river and lake beds, the public trust doctrine, admiralty jurisdiction, commercial navigation, and waters subject to the Clean Water Act [*Solid Waste Agency of Northern Cook County versus Army Corps of Engineers*, 2001]. States also define navigable waters, often in order to determine the degree of public access for recreation [Leighty, 1971]. State definitions are based on the ebb and flow of the tide, saw log floatation, and other criteria. Defining this seemingly simple word can be a perilous task, but that definition sets the parameters for a significant number of water rights.

2.2. Who Has Rights and What Are the Competing Rights?

[10] The answer to this question can best be understood by looking at the entities that could potentially hold a water right. Answering the question of "whose right is it?" helps explain the full range of competing rights that may come in conflict. The water rights discussed here also include obligations. Indeed, it is often difficult to separate rights and obligations since one person's right may impose an obligation on someone else. Understanding the competing rights is central to understanding the interrelationship between rights [Arnold, 2002]. The categories below include the following types of rights: government rights, public

rights, rights/obligations created by regulation, private rights, and private rights created as an incident of property ownership.

2.2.1. Government Rights

[11] Government rights may be established in two major ways in the United States. First, government entities, like private individuals, may establish a water right under the state laws controlling water allocation. For example, when water is needed to carry out a government function such as a research laboratory, a state water right is obtained. Other government entities such as irrigation districts and cities follow state allocation law in order to obtain a water right [Davidson, 2003]. The question for those wanting to buy water is whether these government rights are subject to sale. Some government rights may be for sale but not all. For example, an irrigation district might sell surplus water created by conservation measures. On the other hand, a growing city may not want to sell its right, but they may lease or bank unneeded water on a short-term basis. Some government rights may never be for sale. The second type of government right exists because government land has an accompanying water right. By far, the most significant federal right of this type is the reserved water right [*United States versus New Mexico*, 1978]. Normally, reserved water rights are not subject to sale and can only be reallocated by federal legislative action. An exception is Indian reserved water rights, a special form of government right controlled by a tribal government [*Winters versus United States*, 1908]. Indian reserved water rights may be available for sale or lease.

2.2.2. Public Rights

[12] Three types of public rights have been identified in the United States. The first gives individual members of the public the right to use water in certain ways. This right is held in common with all other people and, at least historically, was free and unregulated. Rose [1986] calls this an "inherently public right." Historically, these public rights included a free right of navigation, a free right to fish, and a free right to dispose of waste. Many of these "rights" are now regulated or require permits and are no longer free. Inherently public rights are traditionally outside the market because they are free and open for all to use. The second type of right obligates governments to do certain things to protect the "public" from harm [Grant, 1987]. Western states recognize this obligation in two ways, the public trust doctrine and public interest reviews. In its theoretically broadest interpretation the public trust doctrine protects public resources from bad management by the government entity controlling the resource [Sax, 1970]. In addition to public trust obligations, public interest reviews are required in western states when establishing new water rights or when transferring an existing right. Public interest review criteria are becoming stronger, and the possibility exists for public interest reviews to become a constraint on water markets. The third kind of public right is the right to bring a lawsuit against a government agency in order to compel compliance with an environmental statute [May, 2003]. This right is included here because it is a right exercised by the public, not government.

2.2.3. Regulatory Rights

[13] In the United States, regulatory rights can exist at many levels of government. Although state law dominates

water allocation in the West, the regulatory structure for water use is more complex. Irrigation districts may have rules on how water is to be rotated between different users in the district. City and county governments may pass land use laws that effect water quality. States may have laws controlling recreational access to water. Perhaps the strongest presence is the federal one.

[14] Although the federal government has been careful to defer to state water allocation laws, this deference has not stopped them from passing a significant number of laws affecting water use [Kelley, 1996]. Many of these federally created rights and obligations evolved after the state allocation system was in place. As a result, conflicts between federal and state laws are common. Although some regulations are prohibitions, others create rights through issuing permits. Permits grant permission to do specified activities within the regulatory structure. Not all permits can be sold, but systems can be designed to create private marketable rights for permits.

2.2.4. Private Rights

[15] Most of the private marketable water rights were created by the regulatory/permit process [Nelson, 1986]. The most significant one in the West is the appropriative right. Appropriative rights are considered to be property similar to land and are protected from unconstitutional takings [Gray, 2002]. In addition to this form of private right the common law riparian right in existence in some eastern states is being replaced by regulated riparianism. Regulated riparianism is a permit system that could be designed to allow permits to be sold. Markets for other “water” rights could also be developed such as white water rafting permits and sewage or selenium discharge permits [Austin, 2001].

2.2.5. Rights Created as an Incidence of Land Ownership

[16] These rights exist as an incidence of land ownership, and many stem from the past when water rights were really land rights [Allison, 1994]. The most common are rights created by common law such as the riparian rights system that evolved in the eastern United States. In general, the riparian right is a contingent one, subject to loss through change of circumstances. The contingent nature of this and other common law rights creates uncertainty. Of similar common law origin are tort laws designed to protect the interests of a property owner, and in some circumstances these common law doctrines impact water. The doctrines of trespass, nuisance, negligence, and subjacent support have been used to protect land from flooding, draining, subsid-ing, and contaminated water.

2.3. What Are the Rules for Establishing and Transferring a Right?

[17] The “establishment rules” depend on a variety of circumstances. Nothing specific may need to be done such as when the right is an element of land ownership or when the right is an inherently public right or a public trust obligation. Although these public and private rights exist without having to follow specific “establishment rules,” enforcing these rights may be difficult. Other rights require a designated process be followed for establishment or modification. For example, water rights established or transferred under the appropriation doctrine must follow specific rules or they are invalid [Goplerud, 2000]. Permits

will not be issued if other water users would be deprived of water or if the public interest is harmed. The evaluation of these third-party effects may be handled completely by an agency, but notice provisions insure other parties with interests can object. Making a determination of third-party effects increases transaction costs. Some transfer rules restrict the place water can be used, thus constraining potential markets. For example, in the eastern United States, water could not be transferred out of its watershed. Some irrigation districts restrict water use to lands within their boundaries [Roos-Collins, 1987]. Another spatial restriction limits water use to its “area of origin” [MacDonnell and Howe, 1986]. Interstate compacts can be interpreted as a permanent allocation of water, thereby limiting markets. Spatial constraints in the transfer rules can limit markets in significant ways, but they may have constitutional problems [Sporhase versus Nebraska, 1982].

2.4. What Are the Operational Rules for Using Water?

[18] The operational rules provide answers to the following questions: How can the right holder use the water or what obligations does the right impose? How much can be used? Where is it measured, diverted, used, and returned? How is the water delivered and applied? When is use allowed? How much is paid? The operational rules for water are not always clearly defined, but they are, in fact, the key to how water is actually used. The operational rules define how, where, when, and how much water can be used. These “use” rights are a primary element of any water right.

2.4.1. Uses

[19] The uses water may be put to have traditionally been defined by mud terms that are subject to interpretation. In the eastern states, uses are allowed if they are “reasonable,” and in the West they are acceptable if they are “beneficial.” Determining reasonableness requires a balancing of the harms and benefits that would occur to all the right holders along a stream or river [Dellapenna, 2001]. The “use” right is completely contextual and can change with changing circumstances. “Beneficial use” historically included a variety of consumptive uses that were considered beneficial even if they were not efficient. Waste, however, was not considered to be a beneficial use [Neuman, 1998]. The place where clarity should be most certain is in a permit. Unfortunately, most permits, especially in the West, do not contain many details on how the water will actually be used. A general description of the uses allowed may be acceptable at times, but vagueness can lead to uncertainty and conflict. Definitions used in federal rights may also lack clarity. For example, federal reserved rights are established by congress when they reserve land for some purpose [United States versus New Mexico, 1978]. Congress never specifically states water is set aside, leaving the courts to interpret congressional intent. Congressional intent is not always clear.

2.4.2. Quantity

[20] Another primary operational rule for water is how much water is associated with the right. Problems associated with water volume occur because the language creating the right is subject to interpretation or because the actual measurement used is inappropriate. The first problem stems from the lack of clearly defined uses as discussed above. For example, the riparian rights doctrine is flexible, allowing any use as long as it is reasonable. However, flexibility

in use also means flexibility in volume. The second problem relates to how the water volume is actually measured. In appropriation, doctrine states a water right general entitles the right holder to divert a specific volume of water [Gould, 1988]. This diversionary entitlement allows for easy monitoring since taking water from a particular source can be gauged if needed. Even though this may have been sensible when initiated, using the volume diverted as the measurement of a water right creates substantial problems. The volume diverted is not the volume that can be sold. All that can be sold is the consumptive volume, and that volume is generally not defined. Because there is more than one method for determining consumptive amount, the process can become very contentious and may require a separate determination for each individual transaction [Gould, 1988]. Uncertainty about the consumptive volume leads to higher transaction costs in a water market.

2.4.3. Location

[21] Operational rules have four location aspects. Where is the right measured? Where is the water diverted? Where is it used? Where is the water returned to the stream if it is at all? These location questions are related, in part, to third-party effects [Gould, 1988]. Changing the point of diversion, the point of return flow, or the place of use can have an impact on the availability of water to other users. Where the right is measured, at point of diversion or place of use, can shift the burden of loss in delivery.

2.4.4. Delivery and Application

[22] For the most part, operational rules in the United States, except at the level of an irrigation district, ignore issues of how water is delivered and how it is applied. Standards for efficiency are absent, although waste is unacceptable [Neuman, 1998]. Operational rules need to cover all aspects of how the water is used and should include a consideration of conservation.

2.4.5. Time

[23] Many water rights are based on indistinct time periods such as the “irrigation season.” Changing the season in which water is used can have an impact on third parties [Gould, 1988]. For example, a water right is sold by a farmer to a city. The city wants to take the same volume of water consumed by the farmer but wants the water delivered all year. Others may be impacted because of the variation in seasonal use. Another temporal aspect results from using a rotation system. In irrigation districts, delivery to an individual rotates among different users, allowing each to take the full amount available in turn. By changing the basis of the temporal rotation, other rights may be harmed. Because of third-party effects a temporal limitation may be placed on a market reallocation. Such limitations can reduce the market value of a water right.

2.4.6. Cost of Use

[24] In the United States, irrigators and other water users generally only pay for the cost of delivery of water and not for the water itself. Even then subsidies often reduce what is actually paid. Subsidized water encourages inefficient uses and discourages market transactions.

2.5. Are the Operational Rules for Using Water Certain and Known to Others?

[25] Lack of certainty is a primary obstacle to water markets. Not only must the operational rules for water use be certain, but specific information on each right must be

available to potential buyers. Because the problems of uncertainty were considered above, detailed discussion is not warranted. A summary of the problems is helpful, however. The problems related to this question are as follows: (1) Permits do not include all the operational rules required for marketing. (2) Permit information may not be readily available or in usable form. (3) The uses allowed are based on flexible criteria and are subject to change. (4) The right is based on the volume diverted when the consumptive volume is what can be sold. (5) If a change is made in where water is diverted, returned, or used, then third parties can be impacted. (6) Restrictions on when water can be used are complicated by the uncertainties inherent in determine third-party effects, and (7) water prices are too low. The operational rules must be clarified for a market to function and information about existing rights must be public.

2.6. What Is the Source of the Right?

[26] Not all rights are “equal.” The “legal” authority that forms the basis of the right determines, in part, how conflicts between rights will be resolved [Sporhase versus Nebraska, 1982]. Two elements are important in understanding “source of law” issues: scale and basis of the right. Scale can vary with individuals signing contracts, irrigation districts developing rotation regulations, counties passing ordinances to control nonpoint sources of pollution, states passing water allocation statutes, the U.S. Supreme Court finding water is an article of commerce, and international treaties setting aside areas of international environmental importance. Water rights can be based on constitutions, statutes, treaties, compacts, regulations, executive orders, court decisions, administrative rulings, and contracts. Scale and basis of authority are used to determine which right is superior to another when conflicts occur. The “source” of law controls the process and structure used to resolve conflicts. A right created by federal statutory law is not the same as a right created by state common law. Conflicts between rights created under these different circumstances are complicated to resolve, but the source of law provides the context to do so within the legal system.

2.7. What About Enforcement?

[27] Enforcement has three aspects. Who has the power to enforce or protect the right? Is the right actually enforced? Is the right enforceable? Even though a water right such as the public trust doctrine may exist, it may not always be enforced because of public inertia. Enforcement is a fundamental issue in determining how water rights are exercised. Who can enforce a right is a different question than who “benefits” from the right or even who “possesses” the right. When the term “ownership” is added to the mix, confusion is certain to ensue. The confusion stems, in part, from the way water rights are exercised and the different parties that may be impacted. A water right is generally thought of as a use right (usufructuary right) giving the right holder the ability to use water for some purpose. However, some “rights” create obligations on the part of others. The obligation may be an enforcement obligation, or it may be an obligation not to interfere with another’s rights. Just because a right exists does not mean it will be enforced, and it may not be enforceable. Whether a right is “enforced” is a matter of human will, while “enforceability” means other factors prevent enforcement. Unpopular laws may be ig-

nored, and others may require expensive litigation which private parties are unwilling to under go. The right may not be enforceable for a variety of reasons, including lack of clarity in definition or insufficient budget.

2.8. How Secure Is Delivery/Satisfaction?

[28] If sufficient water exists to satisfy all rights, then the security of delivery is 100%. The key issue in examining “security of delivery” is what happens when water shortages require a reduction in delivery. Reductions mean that right holders must either share in the reduction or some users must curtail their use altogether. Therefore “preference allocations” and “shared reductions” are the two basic ways for determining how secure delivery will be when insufficient amounts of water are present. Often, the two basic methods are combined. Preference allocations can be based on type of use, who the user is, temporal priority, or some other system that allows a preference to be established [Beck, 2000; Trelease, 1955]. The higher the preference, the more secure the delivery. In areas where security of delivery is <100% the value of the right will be based, in part, on the order of preference. As the reliability of delivery goes up, the right becomes more valuable. Shared reduction systems deliver water to all who hold a right but at a proportionally reduced amount. The value of the water right is still based on how much water will be securely delivered each season. However, when all rights share equally in the risks, then they will all be of equal value when other variables, such as volume and location, are held constant. Regardless of the system used, the security of delivery will influence what uses can be made of water and the price paid on sale.

2.9. How Secure Is the Entitlement?

[29] If a water right can be lost, is limited by a short and unrenovable term of years, or can be superceded by a new but superior right, then the value of the right will be lower than if the title was completely secure. In addition, many water rights in the West are unadjudicated, making their validity uncertain. Also, in the western United States a right may be lost by forfeiture, abandonment, failure to use the right for a beneficial purpose, or waste [Roe and Brooks, 1989]. The most complex situation arises when a new right is created or a preexisting right is recognized that is superior in some way. As rights have developed to protect the environment, conflicts with allocation rights have occurred. Other examples include the public trust doctrine and the reserved rights doctrine. Even when one of these superior rights is recognized or created, other rights continue to coexist. In addition to the problems with security of entitlement it is important to consider whether the security of entitlement is transferable. Some leases and permits may be completely restricted. At best, the security of entitlement is no better than that held by the original right holder. Title cannot generally be made more secure through a transfer.

2.10. Is the System Integrated?

[30] Integration means incorporating all elements of the hydrologic cycle and including both water quality and water quantity. Fragmenting the hydrologic cycle can produce absurd results such as groundwater and surface water having separate systems of water rights available under each. For example, groundwater was excluded from most interstate compacts in the West. Having different regulatory

rights for water quality and quantity also creates conflicts. In the western United States, states commonly have separate agencies controlling water allocation and water quality. Although states generally control water allocation, water quality regulations take place under a federal umbrella. Separating water quality and water quantity into different regulatory regimes creates conflicts and uncertainty in delivery and entitlement.

3. Questions in the Context of Market Reallocation and Some Suggestions for Change

[31] The questions discussed in section 2 were designed to illustrate the fundamental structure of water rights systems. The questions allow problems with marketing water to be identified and allow for suggestions on structural changes within the property rights system. The structural changes suggested below are intended to stimulate thought. Although some suggestions may, at first glance, appear improbable, policy makers need to consider new, even seemingly radical solutions.

3.1. What Water?

[32] As question 1 points out, not all water is subject to a water right. Also, at times, water is land and then is magically transformed into water. This seems an absurd way to design a property rights system, but water is a mobile resource and such absurdities happen. What would happen if water was always water? This would require the water right to be “dominant” over the land rights. In arid areas this makes sense because land values are low without water. Why should land use practices “absorb” water in ways that prevent it from being treated as part of an integrated system? Water is water. Separate it from land rights and make it dominant. Water is more important than land where it is arid and should be the dominant right.

3.2. Whose Right?

[33] The first obstacle to be overcome in sorting out relationships between users is to discard the idea of ownership and the notion of exclusivity that goes with it. People can have a right to use water and can sell that right, but they do not need to own the “water” in order to do so. The second obstacle is to simplify the complexity of rights and reduce uncertainty. Only two kinds of rights should be allowed, and they should be registered so they are known. “Permit” rights established by regulations should be the only form of “use” right allowed. These rights should be freely transferable within a market context. Other “public” regulatory rights fall in the “thou shall not” category. These public “rights” restrict the way water can be used and should also be registered so the constraints are known. Unquantified rights such as reserved rights that are an incident of land ownership should be converted to a permit right or eliminated. One public regulatory right should be a minimum amount set aside as unavailable for any other form of allocation. Public rights should be “regulated” and registered as are all other rights. The registry system should include all use rights controlled by permits. All the regulations that constrain rights would be recorded along with the minimum public sector rights. All existing interests should be recorded, and new public regulatory rights would be subject to them. In order to create the certainty needed

for a market, registered rights must carry with them a title guarantee that they will remain valid. New rights must not be allowed to interfere with existing rights without compensation. If the relationships between rights are unclear, markets are difficult to develop. The register system and the simplification of the possible rights allowed would clarify the relationships [Young and McColl, 2002]. The register would, in essence, give all rights equal validity.

3.3. Transfer Rules?

[34] The third question addresses the rules for establishing and transferring a water right. In the western United States, two major hurdles exist: accounting for third-party effects and spatial restrictions on the new place of use. First, a simplified process is needed to determine third-party effects. A water right needs to include a diversionary entitlement and a consumptive amount. Both volumes should be standardized and recorded as part of the registry system. Determination of consumptive amount should be based on a standard discount rate that incorporates generically all third-party effects. For example, assume a farmer has 100 acres (1 acre = 4047 m²) of irrigable land. The diversionary entitlement is standardized at 3 acre-feet per acre (300 acre feet total; 1 acre-foot = 1234 m³). If the discount rate is 40%, then 60% of the diversionary entitlement would be available for sale or lease. The 60% represents consumptive amount, and the 40% remains in the system to satisfy third-party effects. The farmer who has a right to divert 300 acre-feet of water would be able to sell 180 acre-feet. In addition to the discount rate a transaction tax is needed. In the example above, a 10% tax (or some percent) placed on the transferable amount would put 18 acre-feet of water into public hands under a use permit. How this water is used will be discussed in section 3.7. Second, restrictions on where water can be sold should also be removed. Limitations on transferring water to land outside the boundaries of an irrigation district were designed to insure that the infrastructure of the system would be maintained over time. The result, however, fixes the way water can be used and prevents water from being put to more efficient uses. Spatial limitations also limit the potential size of markets. Limiting water use to an area of origin or a state through an interstate compact does the same thing. All spatial limitations should be removed.

3.4. Operational Rules?

[35] Many operational rules could be improved to stimulate water markets. Briefly, they include the following suggestions. (1) “Waste” is not an acceptable use in the West, but waste is defined in ways that allow many inefficient uses. Changing the definition of waste could stimulate reallocation. (2) Because rights can be lost for nonuse, water is used when it is not needed. Holding water without using it is speculation, which has been looked on in the past as bad policy. However, is speculation any worse than the overuse associated with “use it or lose it”? The answer in Australia is no [Young and McColl, 2002]. “Use it or lose it” should be eliminated. (3) All rights need to be quantified, including rights such as federal reserved rights. Until all rights are quantified and placed under a permit system, substantial uncertainty will continue. A time limit should be set for quantifying these rights. If they are not quantified within that period, they should be treated as

“new” rights. (4) The “where” questions under the operational rules are not as important if the discount rate is standardized. Third-party effects are taken into account by the discount rate. (5) In the western United States, traditional methods for delivering and applying water are acceptable. The best conservation practices are not always followed as a result. This could be changed by making better operational rules. However, a better solution would be to reward those making improvements by allowing them to sell the water conserved by changing practices. (6) Transactions that require a change in the timing of use have a different kind of third-party effect that may not be taken into account with the standardized discount rate. When this occurs, an additional restriction may be needed on the transaction either as an additional discount or a temporal restriction. (7) Prices charged for water need to be increased. The current subsidized system in the western United States allows many inefficient uses of water. Raising the price would stimulate water markets and conservation.

3.5. Known Operational Rules?

[36] The operational rules associated with each right need to be recorded as part of the registry system. The use permit should have sufficient detail to let others know the full nature of the right. Regulatory rights and public rights also need to have operational rules that are recorded. For land we have a system of recording that allows interests in land to be recorded and publicly known. The land recording system does not include a record of all regulations that may restrict the way land is used. A water recordation system needs to be different because the right is defined by the uses allowed. The operational rules define the uses allowed and are therefore essential to the right itself. These rules can be made known through the registry system.

3.6. Source of the Right?

[37] Under the current system in the western United States, not all rights are equal. With a registry system the basis of the right would be the registry. Rights that are on the registry would have equal validity. Claims not on the registry would be invalid. Having equal rights on the registry does not mean one right might not be preferred over another right in time of shortage. Making the rights equal means eliminating the conflicts that occur now when a public trust right “trumps” a private right. Additional discussion on this point will be found in section 3.8. Scale is still an issue. At present, rights exist at multiple scales. The registry would consolidate these rights, but what level of government should control the registry? One trend in water management supports managing water on the basis of a watershed with substantial local consultation. However, as stated above, boundaries need to be erased, and spatial restrictions need to be eliminated in water markets. This includes watershed boundaries. Restricting the registry to a small area limits its usability. The registry should be national.

3.7. Enforcement?

[38] In the system suggested, the potential exists for public rights to be underrepresented or for regulatory rights to be ignored. The same situation exists today in the West where public inertia must sometimes be overcome before public trust/interest rights are enforced. One way to insure

the public sector is better represented is through a public ombudsman. The public ombudsman would have two functions. One is the citizen watchdog function currently found in the citizen lawsuit provisions found in federal environmental laws. The ombudsman would have power to bring a lawsuit to compel an agency to follow the regulatory structure. The second function would be as an active participant in the water market itself. Some permit rights will be held in the name of the public. These rights are created by the tax on transactions. This public water could be used in a variety of ways. For example, assume that the watershed where a transaction takes place has adequate public interest protections. The ombudsman could choose to sell that water right and buy one in another location where public interest protections are inadequate. The ombudsman could also choose to leave the water in stream in the watershed if protecting the public interest required it. Public needs would have to be prioritized to guide the ombudsman's actions.

3.8. Security of Delivery?

[39] If all rights are satisfied, security of delivery is 100%. If insufficient water exists to satisfy all rights, then some kind of preference system or shared reduction system is needed. As a start, the minimum public right should always be satisfied. After that is done, many choices are possible. Temporal priority is probably not the best preference system for a market. If 100 users exist on a stream, 100 separate preference categories are possible. If preference 73 is for sale, how sure is the buyer that water will be delivered? The knowledge about reliability of delivery may be inadequate because of scientific uncertainty. From a market perspective the best system would be one in which the security of delivery is predictable. One way to do this is through the creation of preference categories. For example, three preference categories could be created with category 1 insured of receiving all their water 90% of the time. Category 2 would receive all their water 50% of the time, and category 3 would receive all their water 20% of the time. The number of categories and the percentages associated with them are arbitrary in this example. Categories would allow potential buyers to predict the likelihood of receiving water. The categories could be based on preferred uses so that urban uses are one category and agricultural uses are another. Preferences could be based on efficiency, time of use, or other criteria. Although preference categories have merit, they are not completely without problems. The alternative is to treat all water rights the same and reduce all usage by the same percent in order to satisfy shortfalls. The right would be based on a share of the water available from a particular source. A right holder with a 12% share would receive 12% of the water from the source after the public minimum is deducted. The amount delivered would be increased or decreased depending on the available supply. Perhaps the best way is to combine the two methods with a limited number of preference categories and equal sharing within the categories.

3.9. Security of Entitlement?

[40] In the West a water right can be lost for nonuse, may be unadjudicated, and is subject to newly asserted but superior rights. The register suggested above would ensure security of entitlement. Unused water could be more easily

identified for placement in a water bank, and productive use would be more likely. Adjudicated rights in the West are designed to make entitlements secure, but some rights are not adjudicated, and new rights are constantly being asserted. The registry would be a form of title guarantee designed to replace the current system. Adjudication is a contentious process that consumes tremendous resources. The registry system proposed would get around this problem by standardizing entitlements and eliminating temporal priorities. This standardization would eliminate many of the issues in dispute in the adjudication process. One of the biggest issues is what to do with new regulatory rights. In order for registry to guarantee title, any new right asserted must be subject to those rights already on the registry. If an endangered fish is found in an already allocated river, that would mean the ombudsman would be required to purchase rights from existing users in order to protect the fish. The tax on transactions would provide the resources.

3.10. Integration?

[41] As the discussion above indicates, the system proposed would be fully integrated. Boundaries would be ignored. All water would be included with water considered the dominant estate. Land uses that contribute to nonpoint sources of pollution would be subservient to water quality standards under the dominant estate concept. Water quality permits would be recorded and become part of the registry.

4. Conclusion

[42] The suggestions above are not meant to be the final solution for water markets but are intended as a starting point for discussion. The final solution needs to be a property rights system that is sensitive to societal needs and preferences. The goal is to create certainty, security, and well-defined relationships. Although better scientific models have been suggested as a way of achieving these goals within the current property rights structure [Matthews *et al.*, 2001], a better solution is to simplify and standardize the property rights system. The suggestions discussed above indicate some ways this could be done. The discussion also points out issues useful in understanding the structure of any property rights system.

[43] The suggestions can be summarized in the following way. In arid and semiarid areas, water rights should be dominant over land rights. The entire hydrologic cycle should be treated as a unit with the relational rights within the system being clearly defined. The kind of rights possible need to be simplified and a registry created so all rights are recorded and known. The rules for transferring a right need to be based on a standardized, average consumptive volume that takes into account third-party effects. Some transfer rules need to be changed such as spatial restrictions on use. The operational rules for each right must be recorded as part of the registry so they are certain. Operational rules need to be modified to encourage conservation. A certain minimum amount of water should be removed from the allocation process to protect public interests. A national registry system that erases political boundaries is needed. A public ombudsman needs to be created to protect the public's interest in water. A tax on each water transfer should be used to provide resources for the ombudsman's use. A simplified preference system needs to be developed for

allocating water in times of shortage. The preference system needs to be simple so the security of delivery and the risks associated with it are known. Entitlements should be guaranteed by the registry system. All rights should be included in the registry so that integration of the entire hydrologic system is possible. These suggestions are a starting point for discussion and are worth considering in reforming or developing any water rights system.

[44] **Acknowledgments.** This material is based on work supported in part an EPA-Star grant (An Integrated GIS Framework for Water Reallocation and Decision Making in the Upper Rio Grande) and an NSF grant (A Quantitative Assessment of the Economic and Institutional Impacts of Climate Change on the Upper Rio Grande Valley Using an Integrated Geographic Information System). Although this article has been funded in part by the United States Environmental Protection Agency through grant agreement R-82807001-0 to the University of New Mexico, it has not been subjected to the agency's required peer and policy review and therefore does not necessarily reflect the views of the agency and no official endorsement should be inferred. Any opinions, findings, and conclusions expressed in this material are those of the author and do not reflect the views of the National Science Foundation.

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