

Comparative Analysis of Legal Regimes with Respect to Fostering Healthy Water Markets

November 2016

Part III

Final Report on
Political Economy
of Water Markets

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Preface

This paper is one output of a project entitled “The Political Economy of Water Markets.” The project was carried out by Ecosystem Economics LLC and AMP Insights. The outputs of the project include a final report and a set of case studies.

The final report consists of three papers and an annex:

1. Healthy Water Markets: A Conceptual Framework by Bruce Aylward, David Pilz, Megan Dyson and Carl J. Bauer
 2. Political Economy of Water Markets in the Western United States by Bruce Aylward, David Pilz and Leslie Sanchez
 3. Comparative Analysis of Legal Regimes with Respect to Fostering Healthy Water Markets by David Pilz, Megan Dyson, Bruce Aylward, Carl J. Bauer and Amy Hardberger
- Annex: Water, Public Goods and Market Failure by Bruce Aylward

The eight case studies consist of the following.

1. The Evolving Water Market in Chile’s Maipo River Basin by Carl J. Bauer
2. Addressing Overallocation and Water Trade in New South Wales, Australia: Namoi Basin Groundwater by Megan Dyson
3. Evolution of Australian Water Law and the National Water Initiative Framework by Megan Dyson
4. Opportunities for Surface Water Right Marketing in Idaho’s Rapidly Urbanizing Treasure Valley by Jeff Fereday
5. Texas Groundwater Markets and the Edwards Aquifer by Amy Hardberger
6. Oregon’s Umatilla Basin Aquifer Recharge and Basalt Bank by Martha Pagel
7. Truckee-Carson Surface Water Markets in Northern Nevada by Leslie Sanchez, Bruce Aylward and Don Springmeyer
8. Smart Markets for Groundwater Trading in Western Nebraska: The Twin Platte by Richael Young

The report and case studies can be downloaded from the AMP Insights website at <http://www.ampinsights.com/rock-report>.

For further information on this work please contact Bruce Aylward at bruce@ampinsights.com.

Acknowledgements

This paper was prepared with financial support from The Rockefeller Foundation. All errors and omissions remain the responsibility of the authors.

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Contents

- 1. INTRODUCTION 1
- 2. LEGAL REGIMES 2
 - 2.1 RIPARIAN DOCTRINE (SURFACE WATER) 2
 - 2.2 RULE OF CAPTURE (GROUNDWATER) 3
 - 2.3 CORRELATIVE RIGHTS (SURFACE AND GROUND WATER) 4
 - 2.4 PRIOR APPROPRIATION (SURFACE AND GROUND WATER) 5
 - 2.5 AUSTRALIA’S NATIONAL WATER INITIATIVE FRAMEWORK (SURFACE AND GROUND WATER) 6
 - 2.6 CHILEAN WATER CODE (SURFACE WATER) 8
 - 2.7 DISCUSSION 10
- 3. ENABLING CONDITIONS FOR WATER MARKETS 12
- 4. LEGAL ELEMENTS OF SCARCITY 14
 - 4.1 LIMITS ON ISSUANCE OF NEW RIGHTS 14
 - 4.2 REDUCING RIGHTS AND SETTING ALLOCATIONS 15
 - 4.3 QUANTIFYING LIMITS AND CAPS 15
 - 4.4 ROBUSTNESS OF CAPS 16
 - 4.5 FINDINGS AND DISCUSSION 16
- 5. LEGAL ELEMENTS OF SECURE, WELL-DEFINED AND FLEXIBLE WATER RIGHTS 19
 - 5.1 OWNERSHIP AND THE SOURCE OF RIGHTS 20
 - 5.2 PRIORITY, SHARING, ENFORCEMENT AND DISPUTE RESOLUTION 20
 - 5.3 ENFORCEMENT OF WATER RIGHTS 21
 - 5.4 DURATION OF RIGHTS 21
 - 5.5 QUANTIFICATION OF RIGHTS 22
 - 5.6 RIGHTS TO PROTECT THE ENVIRONMENT AND OTHER EMERGING VALUES 22
- 6. LEGAL ELEMENTS OF TRADABILITY AND TRANSFERABILITY 25
 - 6.1 ABILITY TO REASSIGN AND TRADE WATER RIGHTS 25
 - 6.2 ABILITY TO TRANSFER WATER RIGHTS 26
- 7. ENABLING CONDITIONS FOR HEALTHY MARKETS IN EACH REGIME 29
 - 7.1 RIPARIAN DOCTRINE 29
 - 7.2 RULE OF CAPTURE 29
 - 7.3 CORRELATIVE RIGHTS (STORED WATER, WESTERN US) 30
 - 7.4 PRIOR APPROPRIATION 31
 - 7.5 AUSTRALIA’S NWI FRAMEWORK 32
 - 7.6 CHILEAN WATER CODE 34
- 8. DISCUSSION: ROLE OF WATER MARKETS IN WATER MANAGEMENT 36
- 9. CONCLUSIONS 39

List of Tables

Table 1: Legal Elements of Scarcity 14

Table 2: Legal Elements of Scarcity by Regime..... 17

Table 3: Legal Elements of Secure, Well Defined and Flexible Water Rights 20

Table 4: Legal Elements of Secure, Well Defined, and Flexible Rights by Regime..... 24

Table 5: Legal Elements of Tradable and Transferable Rights 25

Table 6: Legal Elements of Trade and Transferability by Regime 28

1. Introduction

This is the third of three papers that make up a final report on the political economy of water markets. The report is part of a larger effort that includes a set of case studies of water markets in the western US, Australia and Chile. A group of authors with expertise and a mix of academic and professional experience in their particular markets and jurisdictions, either as attorneys, economists or geographers carried out these case studies. The final report therefore aims to build on the experiences of those directly involved in the *practice* of water markets. This practice includes the sometimes-messy job of just *making things work* in the best way possible given a difficult set of circumstances. The opportunity to step above this grind and write about the bigger picture and the rules of the game is gratifying but also intimidating.

The primary aim of the overall report is to identify and understand the economic incentives and the enabling political and legal conditions that lead water markets to function as a useful counterpart to other tools for sustainable water management. To that end, a central objective is to identify market, policy, institutional, and legal failures that impede water market function. The premise is that poor (and unhealthy) markets lock up water in traditional uses despite opportunities for beneficial trades that promote the productivity of water in its many economic, environmental or social guises.

A central objective is to identify market, policy, institutional, legal or combined imperfections and failures that are impeding water market function.

This paper forms Part III of the report and presents a comparative analysis of a set of different legal regimes for managing water rights. The primary purpose of comparing the different regimes is to analyze the degree to which they either foster or hamper *healthy* water markets and to highlight aspects of certain regimes that are particularly conducive to water markets. In addition to this primary purpose, this paper also highlights the importance of physical and other contextual factors in legal rules for water rights. Context is critical to this discussion because a

common question in comparative analyses of legal regimes for water rights is “why should we, or how can we, take lessons from one legal regime and apply them to a different location?”

This analysis is useful for two reasons. First, it can help identify locations where healthy water markets can be a successful and positive water management tool. Second, it can help tailor water market design and implementation to the strengths and weaknesses of the legal, geographic, social, and political context in which they exist or may be created. The approach to comparing legal regimes in this paper begins with a description and brief analysis of six different legal regimes. Each of these regimes is then examined for three broad *enabling conditions* that are helpful in analyzing markets for public goods like water. These enabling conditions are: 1) scarcity; and 2) secure, well defined and flexible property rights, that are 3) tradable and transferable.

This paper begins by describing the six legal regimes. Following these descriptions is a discussion on the importance of context in comparing the regimes. The next section describes how the enabling conditions are broken into discrete legal elements and how these legal elements are analyzed for each of the legal regimes. The legal elements of each enabling condition are then applied to the six legal regimes in a series of tables with side-by-side comparisons. These comparisons lead to a discussion of the degree to which each legal regime either fosters or hampers healthy water markets and a number of conclusions drawn from the paper’s analysis.

2. Legal Regimes

The six legal regimes analyzed in this paper represent a diversity of geographies, approaches, and structures and, while they provide a broad cross section of examples, they are by no means exhaustive. The six legal regimes include: the Riparian Doctrine (as used in the US), the rule of capture (as applied to groundwater in the US), correlative rights, the Prior Appropriation Doctrine, Australia’s National Water Initiative framework and Chile’s water code. The term “regime” is used in this paper to describe both broad legal doctrines and specific statutory water codes. For example, the Riparian and Prior Appropriation Doctrines are broad legal doctrines that are applied with variations in different settings. Correlative rights, though described as a *regime* in this paper, is not a standalone doctrine, but rather a framework for sharing access to water. For their part, Australia’s NWI framework and Chile’s water code are specific statutory legal regimes, though they too are applied with variations within Australia and Chile. This section introduces the six regimes and describes elements of each that are pertinent to comparing the degree to which each regime fosters or hampers healthy water markets. Where the regime is taken to apply primarily to a particular resource this is also indicated.

2.1 Riparian Doctrine (Surface Water)

Riparian water law has ancient origins, dating back to Roman times. It is a common law body of jurisprudence, meaning that the bedrock contours of the law come from judicial pronouncements and precedent rather than from a statutory framework. The modern version of Riparian law is based on common law from England. At the highest level, Riparian law is simple: the right to use water in rivers and lakes is directly tied to, and is inalienable from, the ownership of land abutting water (Getches 1997). Any person whose land is adjacent to a river or stream has the right to use that water. Where the doctrine becomes complicated, and where variations in the doctrine between different jurisdictions arise, is in the details of how riparian landowners can use water.

The six legal regimes analyzed in this paper represent a diversity of geographies, approaches and structures and provide a broad cross section.

The general principle that guides riparian water use is the concept of *reasonable use* (Getches 1997). Reasonable use dictates that riparian landowners can make changes in the quantity and/or quality of surface water flows, and the physical morphology of waterways, lakes, etc., including diminishing flows or lake levels, as long as such changes can be accomplished without harming other users’ similar rights to reasonable use. Reasonable uses of water are generally those that have some economic or public benefit, are not wasteful, and do not harm other riparian

landowners. However, thousands of pages of case law, with more added each day, attempt to define exactly what uses are beneficial, not wasteful, and/or exactly what constitutes unreasonable harm. One potential class of unreasonable harm is harm caused to public interests in water such as access for recreation or environmental health.

Riparian common law does not contain provisions for transfers of the right to use water except upon transfer of the riparian land itself. Under the riparian system, the right to use river or lake water only exists due to the location of land adjacent to a water source. The idea of moving, or *transferring*, a riparian water right from land adjacent to water, to land that is distant from water undermines the bedrock principle of the Riparian Doctrine. Riparian water uses are also not generally subject to significant, or even any, regulatory oversight. Broadly speaking, judges rather than regulatory bodies adjudicate conflicts between riparian users, for example determining when a use is unreasonable as regards other users and

uses. There is a still-evolving body of law known as *regulated riparianism* that is increasing the role of regulation in riparian water law regimes, but the specific contours of those regimes are not discussed in this paper.

As a final note, riparian water law was developed in climates and locations where water availability was generally adequate in comparison to consumptive uses. A major result of this is that many riparian jurisdictions have no clear provisions for sharing water when consumptive needs are greater than natural water availability. As climate change and population growth impact water supplies around the globe, even in places where scarcity was historically not an issue, the limits of the Riparian Doctrine are being tested. Some of the doctrine's defining features – limited regulatory oversight, no provision for transfers, limited capacity to adjudicate conflicts efficiently (i.e. outside of court in an administrative proceeding) – hamper riparian water users' individual and collective abilities to manage water scarcity.

2.2 Rule of Capture (Groundwater)

Like the Riparian Doctrine, the rule of capture has ancient and common-law origins with different modern iterations. This section outlines two specific variations on the rule of capture as it applies to groundwater: what this paper calls the *pure* form of the rule, and the rule of capture with ownership in place. Review and analysis of rule of capture and ownership in place, as currently applicable in the state of Texas is provided in Hardberger (2016), one of the case studies allied to this final report.

The pure rule of capture dictates that an owner of land has the right to capture any water they can access from beneath their land. Groundwater pumpers in pure rule of capture jurisdictions are free to pump as much water as they can capture, even when their pumping negatively impacts their neighbors' or anyone else's ability to capture water themselves. The only limit that sometimes applies in pure rule of capture jurisdictions is a bar on maliciously injuring other groundwater pumpers or pumping that causes land subsidence. Simply denying or impacting others' ability to pump by pumping yourself is not barred by the doctrine as long as the use is beneficial. Beneficial uses are generally thought to be economically or otherwise publicly beneficial (and not wasteful) uses of water and the specific definition of *beneficial* is subject to judicial interpretation with the potential to evolve over time.

Under pure rule of capture, actual capture, via pumping, is the basis for, and the genesis of the right to take and use groundwater though, as discussed below, this right may be alienable (Hardberger 2016). However, the amount of water that can be withdrawn is not tied to the amount of land owned. For example, in some parts of Texas, it is possible to purchase a very small piece of land and pump very large amounts of water for export to a distant use. Depending on the jurisdiction, it may also be possible to transfer the right to capture itself, separate from land ownership under the pure rule of capture. However, it should be noted that the costs of purchasing water and developing infrastructure to transport the water to its end use may be more than the simple costs of purchasing land which would give the owner the relatively unlimited right to pump as much water as possible. In sum, pure rule of capture jurisdictions allow for the alienation of the right to capture with or without a sale of the land and also allow for the transfer of water that has already been captured to a location distant from the point of extraction.

As with Riparian jurisdictions, pure rule of capture jurisdictions generally do not have provisions for significant, if any regulatory oversight of water extraction and use, conflicts are adjudicated by the court system, and no provision is made for reducing water extraction as supplies dwindle. In times of shortage, water continues to go to those who can pump it.

The primary difference between the pure rule of capture and the rule of capture with the modification of ownership in place is that land ownership, not capture, is the basis for, and genesis of the legal entitlement to groundwater (Hardberger 2016). In other words, any landowner has the inherent right to use water, even before undertaking any effort to capture water. Though this may seem like a small distinction, it is

especially important to the ability to regulate groundwater extraction and use. When landowners have an inherent right to water underlying their land without first capturing it, regulations that might restrict groundwater use may be challenged by landowners who have not captured and used any water even though these regulations have yet to impact the landowner. Under the pure rule of capture, capture gives rise to the right and so a landowner who has not yet captured water cannot claim to have been impacted by an existing regulation.

2.3 Correlative Rights (Surface and Ground Water)

The simple Merriam-Webster definition of *correlative* is: reciprocally related. Correlative rights then are water rights that imply a reciprocal duty on each right holder to all others withdrawing from the same source. This reciprocity is borne out through a sharing framework under which all water right holders accessing the same water source share the burden of shortage. For example, the Riparian Doctrine is a type of correlative rights structure because each user owes a duty to all others using water from the same source.

Non-riparian correlative rights frameworks distribute water use among users in relation to the number of users and the total amount of water available. One exception is correlative ownership in place of groundwater in which the distribution is determined by land available, not water available. Users are assigned a maximum amount of water use either based on volumetric shares or on a percentage of available water. Reductions in use when supplies are short are then applied equally, i.e., shared in proportion to the users' rights. For example, in the case of water stored in a reservoir, if water available in a given year is 80% of the total capacity of the reservoir, then all entitlement holders receive 80% of their right; they share in proportion to their rights. No one water right holder then has priority over others such that they can take 100% of their entitlement while others receive less.

Correlative frameworks can be applied to surface water (storage or natural flow) and groundwater. They are generally easier to apply to a pool of water, such as with reservoir storage or groundwater, than a constantly varying supply, such as natural flow.

In correlative groundwater systems, there is a range of different strategies for determining when users can take their full entitlement. For example, a regulatory or other agency in charge of managing a groundwater source, may dictate that users are allowed to take their full water right only in years where modeled recharge to the groundwater source meets some minimum threshold. As another example, groundwater managers may cap uses at modeled *sustainable annual yield*, a number that represents the amount of groundwater that can be pumped from an aquifer each year without for example, lowering the upper water table of the aquifer. Under such a system, rights may be defined as a set percentage of sustainable annual yield.

One important aspect of correlative rights frameworks is that they can exist as the basic rights framework or the correlative sharing of rights can be nested within other rights systems. The example, cited above, of applying correlative rights within an ownership in place system is an example in the case of groundwater. Also, it is not uncommon for reservoirs within Prior Appropriation jurisdictions to be managed on a correlative rights basis. The water right to fill the reservoir is generally a Prior Appropriation right, but the secondary right to use water released from storage may then be managed as a correlative right. Access to correlative rights in surface storage is often granted on a contractual basis where the owner or manager of the storage contracts with individual users for temporary, long-term, or permanent access to a correlative right to storage water.

2.4 Prior Appropriation (Surface and Ground Water)

The doctrine of Prior Appropriation is a unique system of water management that developed in the western United States beginning in California in the 1850s. The basic elements of the doctrine were imported to the water context by gold-rush miners. In the mining context, the primary mechanism for excluding other miners from a potential mine site was to stake your claim—literally to post a sign warning other prospectors that a given location had been claimed by another. The first person to stake a claim to a given site had the exclusive right to prospect at that site. These same basic rules were imported into the water context and have held sway in the western US ever since.

The result is a priority system commonly referred to as *first in time, first in right*. Assuming water is available, the first person to make use of water, give notice of their use to other potential users on a given stream and divert water is given the first (highest priority, also called *senior* priority) right, meaning that they are entitled to take their full claimed right before anyone else is allowed to take theirs. Subsequent claimants (*junior* priority rights) are placed in line to take their fill according to when they effectuated their own claims. However, because water in the arid western US is a scarce resource, and water is generally required to make any productive use of arid lands, additional rules and restrictions developed over time to spread the benefits of water use as widely as possible.

The most important restriction that was added to the basic tenet of *first in time, first in right* was the concept of *beneficial use*. Today, the concept of beneficial use is enshrined in Prior Appropriation jurisdictions as the *basis, measure, and limit* of the right to use water. Beneficial uses are generally those that are widely agreed upon as socially, economically, or otherwise in the best interest of the public. Many states specifically define what uses of water are beneficial but courts have long held that the concept of beneficial use is not static and that beneficial uses can and should be added and changed as the public's definition of what is beneficial changes over time. Additionally, in many jurisdictions, if beneficial use is ceased for any or all of a water right, the water right or part thereof may be subjective to forfeiture. This is commonly referred to as the *use it or lose it* principle of Prior Appropriation.

At this point, it is critical to note the important role that the public interest plays in Prior Appropriation water law. As the west was settled over time, the federal government gave states broad autonomy over managing natural resources on lands that the federal government did not keep for itself. In particular, water law became primarily a matter covered by state law. Except for rivers that cross borders and federal water infrastructure projects, most water in the west is managed according to state water law. Most state constitutions or laws explicitly say that the people of the state, or the public, own water. The right to use water is therefore referred to not in terms of owning water, but of owning the *right to use* water (the legal term is a *usufructory right*). The concept of beneficial use is directly tied with this public ownership concept—in order to maintain the right to use publicly owned water, the use of water must be beneficial in some way to the state and its people as a whole. Beneficial use then, not only prescribes the types of uses to which the public allows water to be put, but also to the way water is used. Wasteful uses of water are not considered to be beneficial, but what this means in practice is generally left unspecified. Still, there are generally accepted norms about how much water it should take to achieve certain types of beneficial use. For irrigation water rights for example, it is possible to determine how much water is required for consumption by crops given crop type and climate and precipitation data and applying vastly more water than required could be seen as wasteful.

In the early nineteenth hundreds, most states in the western US began to enact statutory schemes – water codes – to enshrine the Prior Appropriation laws into their legal frameworks. Doing so resulted in systems of water right permitting and certification. Through various complex legal processes, states set out to solidify claims to water rights made before their water codes were enacted and to govern the issuance of water rights in the future. These court proceedings, called adjudications, also set in stone the relative priorities and quantities of existing rights and form the basis for quantification and prioritization of future

rights. Some states in the west are still in the process of sorting out the quantity and priority of their water rights through these legal processes. Once relative priorities and water right quantities are known and certified (recognized by a water right certificate), state regulators then oversee the distribution of water. During times of shortage when demand exceeds availability, regulators enforce the priority relationship between rights on shared water sources by requiring junior users to shut off their diversions to provide sufficient water for right holders.

In addition, the codification and certification of water rights allows for states to regulate formal changes to water rights. Water rights are said to attach to specific lands (called *appurtenancy*) in Prior Appropriation jurisdictions. The result of appurtenancy is that water rights change hands automatically if the land they are attached to is sold. However, unlike under traditional riparian systems there are no limitations on where the water is used in relation to the water source. Ownership of water rights can also be transferred separate of land by going through a process generally referred to as a *transfer*. Other changes, such as changes in where a water right is diverted, are also allowed with review and oversight in Prior Appropriation jurisdictions. Due to the interrelationship of water rights on shared sources in the Prior Appropriation system and the partial consumptive nature of water uses, particularly irrigation, transfers and other formal changes to water rights require careful analysis to avoid injury to other water users. While injury is a complicated legal term of art, it generally refers to maintenance of identical conditions (of flow amount, timing, and location) in the water source before and after changes are implemented.

2.5 Australia's National Water Initiative Framework (Surface and Ground Water)

Australia inherited the British common law in relation to water rights – riparian rights for watercourses and for groundwater, a regime similar to the pure rule of capture discussed above. However, by the early 1900s, all states had legislated to assert their right to control access to all water resources, and replaced common law rights to water with statutory water rights. Water rights in Australia were initially issued on the basis of the area permitted for irrigation, but from as early as the 1960s some states began to move to rights quantified on a volumetric basis. From 1994, all states agreed to phase out the use of area-based rights, and this had largely been achieved by 2000.

Water rights have been tradable in Australia in most states since the mid 1980s. Trading developed as a consequence of the separation of land and water rights, the progressive imposition of caps in resources evidently suffering from the effects of overuse, and growing demand for water (National Water Commission 2011).

In 2004, Australian states and the federal government signed an intergovernmental agreement known as the National Water Initiative, or NWI (2004). The NWI is a comprehensive framework for management of surface and groundwater, covering water planning, water access entitlements, water markets and trading, water pricing and institutional arrangements, management of environmental water, water resource accounting, urban water reform, community partnerships and adjustment, and knowledge and capacity building.

Central to the NWI framework are statutory water plans. A plan for each resource is to provide for environmental water requirements, cap total consumptive water use, allocate water rights within the cap (and reallocate rights where overuse is identified), and manage the take and use of water under rights (NWI 2004). First, a water plan will identify both the consumptive and the environmental and other public benefit outcome requirements for the resource. Environmental requirements include requirements for water to maintain ecosystem function and biodiversity. Public benefit outcomes are mitigation of pollution, provision for public health and support for indigenous, cultural, aesthetic and recreational values. Where trade-offs are necessary between competing water needs, they will be based on best available science, socio-economic analysis and community input. The plan then caps consumptive use at a level that reflects any trade-off and secures the environmental and other public benefit outcomes

identified. The amount available for consumptive use – that is, the amount that is within the cap – is referred to as the consumptive pool.

Water plans also set out rules for allocating water in the consumptive pool to water rights holders. As the NWI framework has been applied over existing state water right regimes, existing water rights holders receive replacement entitlements consistent with the relevant water plan. The process of conversion – which for some resources has included reduction in rights in order to meet the identified cap – is included in each water plan. States have adopted their own methods for conversion in consultation with affected communities. In relation to reductions in order to meet the cap, the NWI specifies a number of principles, amongst them that options for water recovery to meet a cap should include investment in more efficient water infrastructure and on-farm water management practices as well as purchase of water rights.

The size of the consumptive pool varies in response to the quantity of inflows to the water resource during the year; rules set in the plan determine how available water is shared between rights holders, though generally these are managed under a correlative rights framework. Water plans are generally designed so that the allocation formula ensures that the cap on use is met as a long term annual average rather than a fixed proportion of inflows each year; the formula is based on an assumption that actual use will be 20-30% lower than allocations, enabling a lower year-to-year variation in allocation than would be possible if use was assumed to be 100% of allocation. Another method for reducing variations in allocations between years is to issue shares with varying classes of reliability. When less than full entitlements are available in a season, water is shared according to a formula so that higher reliability rights receive a greater share than lower reliability rights.

The NWI requires that the duration of a plan be commensurate with the levels of knowledge about the resource and expected growth in development. States have variously stipulated that their plans will be ten-year plans with potential for extension after review, or will be ongoing plans with ten-year review. The purpose of review is to see whether the plan is meeting its objectives – in particular, to check that the division between consumptive uses and environmental and other public benefit outcomes remains appropriate.

Under the NWI, water rights are to be separated into their component parts ('unbundled') (NWI 2004):

- A water access entitlement is a perpetual entitlement, rather than being issued for a fixed term. The entitlement gives its holder exclusive access to a share of water from the specified consumptive pool as described in the water plan.
- A water allocation is the specific volume of water allocated to a water access entitlement in a given season, determined according to rules set in the water plan. For example, a plan might stipulate that each share has a nominal value of 1 ML, (0.81 acre feet) and a percentage of that value will be available each year according to the size of the consumptive pool in that year.
- Approvals for the operation of works to take water (e.g. pumps, diversion weirs, dams), and for the use of water at a particular site for a particular purpose are issued consistently with state natural resources management and land use planning legislation, and with the water plan. Approvals take into account environmental, social and economic impacts of water use, including impacts on downstream users.

Any person may hold a water access entitlement, for any purpose. This means that environmental water users (who might be government agencies, environmental advocates or private individuals) can hold entitlements and use them for environmental purposes (e.g., to fill a private wetland or by leaving the water instream).

Water rights and approvals are enforced by state authorities, which ensure compliance by rights holders with the conditions of their water access entitlement and relevant works and use approvals. Conditions generally include requirements to meter or otherwise measure water taken and used, and to report this to

the state authority. Recognizing metering as the most accurate form of measurement of water taken, the NWI states that metering should be implemented wherever water rights are traded as well as where there are disputes over sharing available water, and that all new entitlements should be issued with a requirement for metering (NWI 2004).

As Australian water rights are statutory rights, breach of which is an offence, it is primarily the responsibility of the state regulatory authority to take relevant action to ensure compliance, and the authority would investigate a complaint made by a third party. Some state legislation allows private individuals to make a civil application to court for an order requiring another person to comply with their water entitlement, provided they can show that their interests are affected by the alleged breach (for example, if water is being taken in excess of an entitlement in an unregulated stream during a dry season, preventing another rights holder from taking their water). However, given the responsibilities of state regulators, examples of an individual seeking a court order for compliance are extremely rare.

Water access entitlements and allocations may be reassigned, sold or leased in whole or in part. Reassignment of rights in their entirety without changing the parameters of the right generally requires no review. Trading or transfer that requires a change (for example a change in location from which water is taken, or the quantity or rate at which it is taken) will be subject to review, the level of which depends on the potential impact of the change on the environment or third parties. Review rules and restrictions on change are set out in water plans or other state water laws. Under the NWI, water market and trading arrangements, including review requirements, are to recognize and protect the needs of the environment and provide appropriate protection to third parties. However, as these rights are defined as consumptive volumes (rather than diversion rates as in the western US) the scrutiny required is limited (and much less than in the injury review process found in the western US under Prior Appropriation). This, as for planning purposes, it is assumed that none of the water taken will return to the source.

Other NWI principles for trading rules are that restrictions on extraction, diversion or use of water resulting from a trade can only be used to manage environmental impacts (including impacts on river or aquifer integrity), physical delivery constraints or features of major indigenous, cultural heritage or spiritual significance. To facilitate trade, trading zones should be established, and exchange rates used to account for transmission losses (NWI 2004). For the Murray-Darling Basin states, the NWI water trading provisions have been overtaken to some extent by the more explicit legal requirements for water trading rules and market regulation that are now set in the Basin Plan (Commonwealth of Australia 2012).

2.6 Chilean Water Code (Surface Water)

The water rights system in Chile is renowned or infamous, depending on point of view, as the paradigmatic example of free-market economics applied to water. The system dates to 1981, when the current national Water Code was approved by the military regime that ruled Chile during 1973-1990 (Bauer 1997). As a former Spanish colony, Chile has a long history of irrigation and water rights laws. The previous Water Code was passed in 1967, as part of a comprehensive law for agricultural land reform. That Water Code was never fully implemented, but on paper it granted sweeping authority to government agencies to allocate water and regulate its use, and it redefined all existing private water rights as government permits.

The 1981 Water Code swung the pendulum to the opposite extreme, from centralized regulation to *laissez-faire* (Bauer 1997). (This radical change reflected the military government's overall economic policies, which is a topic beyond the scope of this document.) In formal legal terms, like the much of the world, Chile defines water resources as publicly owned, while rights to use that water are private. Chilean law defines water as a "national good for public use" (*bien nacional de uso público*). This is a specific category in Chilean civil law, which also includes roads and beaches, and such goods cannot be transferred to private ownership. Water was first defined this way in the 1855 Civil Code, and the language was

repeated in later legislation, including the current Water Code. The right to *use* water, however, is now defined as a private property right, like other kinds of real estate. Chile's Constitution of 1980 mentions water rights briefly, at the end of the article defining private property rights (Art. 19, No. 24), but says simply that all legal rights to use water are the property of their owners (with no mention of national goods for public use).

The Water Code defines private rights broadly and government regulatory powers narrowly. Water rights are separate from land ownership and can be bought, sold, transferred, mortgaged, and inherited. Water rights are not taxed, however, and owners have no legal obligation to use their rights: Chile does not have a *use it or lose it* rule or a beneficial use doctrine. Water rights are not tied to a specific use of water, which the owner is free to change, and the law does not prefer one kind of use over others.

According to the Water Code, water rights should be defined as a specific volume of water, as the DGA has done with rights granted since 1981. But the Code and the higher courts in Chile have also recognized water rights that were granted or legalized under previous laws, including customary rights that have never been written down, and these older rights are measured in various ways, including proportionally, i.e. as a share of changing river flows. Although there are legal procedures to “regularize” water rights by defining legal titles, this information is incomplete and often of poor quality.

Government regulations, in contrast, are limited. The national water agency (DGA, *Dirección General de Aguas*) carries out administrative and technical functions involving water rights and resources. The most important functions are to grant new water rights and to maintain legal and hydrological records and information. The DGA is required to grant new rights to applicants if water is available, at no cost. The agency had no discretion to consider other factors of public interest until the Water Code reform in 2005, by which time the vast majority of water rights nationwide had been granted or recognized. The DGA has no authority over how private owners use their water rights, or over conflicts among them. Conflicts among water users may be resolved by private water users' organizations, called canal associations or vigilance committees (groups of canal associations), if the conflicting parties are members. With a few exceptions nationwide, water users' organizations in Chile consist only of farmers and so they have no authority over non-agricultural water uses. Many water conflicts, in short, go to the ordinary court system as the final arena for decision-making. There are no specialized judges or courts for water rights issues.

Unlike several other regimes analyzed in this paper, Chile generally does not standardize how water is shared during times of shortage. Within the agricultural water user sector, canal associations and vigilance committees manage water sharing during shortage. Sharing arrangements in these contexts can include proportionate, correlative, and even some first in time, first in right-like mechanisms among others. However, Chile lacks river basin organizations to govern multiple water uses, and neither DGA nor other government agencies can fill this void. In other words, while water sharing may be coordinated for agricultural uses within canal associations, there are no official channels for sharing water between agriculture and other uses such as municipal or hydropower. Finally, Chile likewise does not manage ground and surface water as connected sources.

Although private water rights owners are free to change or transfer their rights without DGA review or approval, in theory they cannot injure other water rights owners as third parties. Water rights owners who allege injury from a transaction must take legal action in court. (The DGA does have power to review water rights transactions that involve changing the place of diversion from a shared river or stream.)

Another special feature of Chile's Water Code is the creation of a new kind of water rights, called *non-consumptive* rights. Traditionally all water rights in Chile were consumptive rights, exemplified by farmers diverting water from rivers and using it to grow crops. Non-consumptive rights, in contrast, allow their owners to divert water from rivers, use it, and then return it to the river farther downstream. The purpose is to encourage hydropower development on rivers in the mountains and foothills, without reducing water

supplies to farmers downstream who already had consumptive rights to the same rivers. Non-consumptive rights can be bought and sold like consumptive rights, but the two markets are separate.

Non-consumptive rights have revealed two of the Water Code's most controversial aspects. First is the potential for speculation. The Water Code encourages speculation by forcing the state to grant water rights free to applicants, without charging taxes or fees over time, and without requiring any beneficial use. In fact, speculation has been much more important in non-consumptive rights than consumptive rights, largely because the category was new and therefore the rights were available throughout the country to applicants who knew the rules and were savvy. This problem was partially addressed by the 2005 reform, which imposed annual fees on owners of water rights who did not use them.

Second, non-consumptive rights have highlighted the problems of water governance and conflict resolution mentioned above. The Water Code offers few rules and little guidance about how to coordinate the multiple uses of consumptive and non-consumptive rights: the task is left to private bargaining and to water users' organizations dominated by irrigators. Multi-sectoral water conflicts must go to the ordinary courts.

2.7 Discussion

One way to distinguish the regimes described above is between those that come from historical (Roman and English common law) origins, and those that represent more modern approaches. Though even the doctrines with historical origins have evolved considerably over time, they still bear many of the hallmarks of their time. The legal regimes are not only creatures of the time periods they arose from, but also of the physical, political, economic, social, and environmental circumstances that shaped their evolution. The regimes today exhibit widely varying characteristics depending on some or all of these interrelated factors.

For example, the Riparian Doctrine and the rule of capture both have origins in Roman and English common law. As a result, they are also greatly influenced by the fact that, at the time of their founding, demands for water by relatively small communities with relatively unsophisticated water needs and infrastructure were small relative to overall water availability. At the other end of the spectrum, Australia's NWI framework is a tailored, modern response to a combination of severe water scarcity, volatility of supply, and recognition of the role of water management in economic reform. Among other things, these different driving forces result in modern variations in overall levels of regulation of water use. A legacy of little to no regulation of water use persists today in the doctrines born from ancient, wet conditions, while more significant regulation of water use is characteristic of modern regimes from dry conditions.

One notable exception to this is the Chilean Water Code where a conscious choice was made to limit regulation for political, social and economic reasons. This exception highlights another important observation. In addition to the physical context in which the legal regimes arose, it is also important to consider the legacies left today by the political, social, and economic motivations behind each of the regimes. Both the rule of capture and the Prior Appropriation regimes were motivated by a drive to withdraw and use as much of the naturally available supply of water as possible to spur economic development. Some modern legacies of these original motivations are dry streambeds in Prior Appropriation jurisdictions and declining aquifers and land subsidence in some rule of capture jurisdictions.

Meanwhile, increasing overall water use efficiency and preserving water for key environmental resources, among other things, motivated Australia's modern NWI framework. While Australia has yet to fully realize the potential environmental benefits of this approach, it is on a path more likely to result in environmentally healthy water sources than either Prior Appropriation or rule of capture jurisdictions. Chile on the other hand pursued a neoliberal approach to water as a purely economic resource and is now left without a strong regulatory system for managing water in the face of increasing demand and

climate change. The Chilean laissez-faire system is therefore even less likely to provide for environmental and social outcomes.

Examples of the importance of history and context to the current status of the legal regimes are especially important when the discussion turns to whether and how each regime enables water markets. With the exception of Chile and Australia, none of the regimes were primarily or even secondarily motivated by the intent to enable water markets. Reforms to help enable healthy water markets therefore must be grafted onto laws and policies that were not intended to enable markets at all. The next section introduces three broad enabling conditions for water markets and further explains this paper's approach to analyzing legal elements that make up these enabling conditions.

3. Enabling Conditions for Water Markets

Because not all regimes enable water markets, or do not enable them to the same degree, an obvious question is what conditions are required to enable water markets? And, more specifically, what conditions are required to enable *healthy* water markets (broadly speaking, this means markets that do not only serve private goals but also promote environmental, social, and other public outcomes). This section attempts to answer that question beginning with a broad set of enabling conditions for *healthy* water markets. Next, these three broad conditions are teased apart into a number of legal elements that are used to compare the regimes described above in terms of the extent to which they enable healthy water markets.

The three generally accepted conditions required to enable water markets are scarcity, well-defined and secure property rights and the ability to trade. These requirements reflect the necessary and sufficient conditions for any market, not just water markets. Part 1 of this final report, provides a detailed discussion of these three high level enabling conditions (Aylward et al. 2016). This discussion is summarized here but not repeated in its entirety.

The three generally accepted conditions required to enable water markets are scarcity, well-defined and secure property rights and the ability to trade.

Scarcity is required to enable a market in a good or service because if the good or service is not scarce then no one will take the effort to find someone who has the good and offer to purchase it. In other words, scarcity drives demand. Second, in order for a buyer to expend resources in the market the buyer must obtain something of value. A *well-defined and secure property right* provides assurances that what a buyer purchases is for their own consumption – that the buyer can exclude others from enjoying it – and that the good or service is as advertised. Finally, in order for *trades*

to occur a key question is whether the relevant governing institutions recognize trades and confirm that buyers may use the good they purchase for their intended use. The final condition for a market then is that there be rules that allow for and govern the *trade* of goods.

To more fully capture the concept of *healthy* water markets the report adds two more concepts – flexibility and transferability – to the three enabling conditions.

Enabling healthy water markets requires flexibility in laws and policies. A regime in which the governance of rights and uses is inflexible leaves no room for adaptation. In such cases water rights themselves, or water right regimes more generally, risk being out of step with society's changing values for water, with climate and other hydrologic realities, or both. Flexibility in water right regimes is essential for public policy to adapt water management to changing values and changing circumstances. By implication the security of rights, from the right holders perspective is lessened, but this reflects the necessary balancing act between collective action and property rights. These questions are particularly important in the context of providing water to meet environmental water needs. If the history of water resource development is that all water is allocated to out-of-stream needs, for example, then secure rights implies that water for the environment can only be obtained if water right holders are willing to sell their rights and the public is willing (and able) to buy them. The paper therefore discusses how the various regimes provide (or not) for flexibility in the water right system.

Second, the ability to trade may be assumed to necessarily include the ability to transfer acquired rights to new uses. In some regimes, the ability to transfer a water right (change the right to suit the needs of the buyer, if necessary) upon trade can in fact be assumed. For example, transferability is built into the system for trading under Australia's NWI framework. For other regimes however, transferability can present a

hurdle and cannot be assumed even where rights are technically tradable. For example, under the Prior Appropriation Doctrine, the ability to trade does not necessarily imply the ability to change the water right to fit buyers' needs. When trade in water rights takes place, the new user may want or need to change one or more of the parameters of the water right they purchased (place of use, type of use, location of use, and others). This is referred to here as *transferability*. The relevance of this to healthy markets is that transfers that may erode environmental or social uses and values must be properly reviewed, assessed, and modified as necessary. This is a regulatory function generally speaking. For markets to be healthy these regulatory protections must be effective, meaning that the necessary capacity in the regulatory entities and civil society must be present to ensure this function is carried out. It is therefore vital to be clear that tradability of rights involves both the trade and the transfer of these rights, and that the transfer requires the necessary regulatory protections and capacities. This paper therefore discusses the extent to which each regime allows for transferability in addition to allowing trade.

Ensuing sections briefly describe how these enabling conditions are broken into component elements for analysis in this paper. The focus in teasing apart the enabling conditions is on the role that law plays. In other words, how do the presence, absence, or specific contours of different laws and regulatory policies combine to create enabling conditions for healthy water markets? Evaluation of the primary legal regimes against these elements illustrates how the different regimes provide for the authorities or functions relevant to these enabling conditions.

4. Legal Elements of Scarcity

There are a number of legal elements that help articulate how different legal regimes respond to or create scarcity through property rights (Table 1). These consist of the authority of the state to limit the issuance of new rights or to reduce existing rights. To the extent these authorities exist and are implemented, the state can drive scarcity and market activity as a policy matter. Implementation of these authorities then raises questions of the basis for these limits and the robustness of their implementation.

TABLE 1: LEGAL ELEMENTS OF SCARCITY

Enabling Condition	Elements	Inquiry/Questions
Creating Scarcity through Limits (or Caps) on Rights and Allocations	Authority to limit the issuance of new rights	Can the state impose a limit on developing new water rights, or is there some other form of limit?
	Authority to reduce existing rights	Can the state impose further scarcity by reducing allocations to existing water rights? Can the state reduce the amount of existing water rights?
	Basis for limit	How are these limits determined and quantified?
	Robustness of limit (susceptibility to leakage)	What mechanisms exist to prevent the limit from being undermined? I.e. Is conjunctive management of ground and surface water in place? Are all uses of water accounted for within the cap? Is the cap enforced?

4.1 Limits on Issuance of New Rights

Scarcity is required to motivate buyers to participate in a water market rather than simply develop or acquire new water rights in some other way. In this sense, if fostering water markets is a particular goal of a legal regime, then that regime needs scarcity in the availability of water to foster market activity.

Scarcity can be a policy choice or an inherent feature of a given legal regime.

Scarcity is required to motivate buyers to participate in a water market.

For example, under Australia’s National Water Initiative, a portion of available water is defined as off limits to access by consumptive water rights. This is implemented through an explicit planning process for each water resource.

Scarcity can also be a consequence of policy but occasioned for purely physical reasons. Prior

Appropriation provides a particularly interesting case in this respect. Many Prior Appropriation jurisdictions historically permitted water rights in amounts that, at least during some times of the year or in dry years, exceed natural water availability. Resolution of this problem is left to the first in time, first in right principle. In other words, water users were free to develop new water rights, but did so with the understanding that their rights would not be reliable during low water availability times of year. Prior Appropriation creates a subset of rights (the most senior rights) that are fully reliable and other classes of rights that are less than fully reliable, including some rights that may be available only infrequently. If full reliability is an important characteristic of a water right to a prospective water user, then Prior Appropriation effectively caps the amount of these rights, creating a scarcity of suitable water rights and enabling market activity.

In breaking scarcity into component legal elements then, this paper includes both explicit policy mechanisms for creating scarcity such as capping consumptive use as Australia has done, and limiting water rights in some other way as Prior Appropriation does through the first in time, first in right mechanism.

4.2 Reducing Rights and Setting Allocations

A second question for each of the legal regimes is whether the state has the legal authority to limit the drawdown of aquifers or leave water in streams by implementing a cap in the case of regimes that currently lack one, or further restricting a cap in the case of regimes that do have some existing cap?

For example, could the state in a Prior Appropriation jurisdiction make some amount of water off limits to water rights, in effect taking water away from existing water rights? The question of whether the state has the authority to implement a mechanism such as a limit on consumptive water use depends on the strength of the property right to water balanced against the state's power to and political appetite to regulate. For example, the Fifth Amendment to the US constitution provides strong protections for private property rights and to the extent that imposing a regulatory cap on water use would deprive current water right holders of exercising some or all of their existing, valid rights, such an action could be found unconstitutional (Horchem 2008).

On the other hand, Australian states are under no such constitutional impediment and have asserted their right, through legislation, to control access to water resources including by imposing limits on quantities that may be taken under existing rights. Further, water rights in Australia are statutory in nature and as such may be qualified or removed by statute. In Chile, the state, through DGA, has the legal authority to change existing water rights. However such changes would require specific legislation to expropriate and compensate, which is extremely rare in Chile.

4.3 Quantifying Limits and Caps

Where legal regimes impose scarcity by limiting water rights (either through an explicit mechanism like a cap or through operation of a mechanism like first in time, first in right), the question then becomes how the limit itself is quantified and executed. Limits on water rights can be designed to play a number of different roles and the specific role helps to determine how the limit is set and enforced. Limits may be implemented for one or more purposes including: stimulating market activity, prioritizing one or more type of use over others (such as setting aside water for environmental or other public uses), stemming the decline of a limited groundwater aquifer, or as a way to manage water rights within the natural variability of a hydrologic system.

For regimes that impose limits, the question becomes what and how uses are limited to achieve the purpose. In Australia for example, the NWI framework limits consumptive uses in order to protect environmental and other public benefits and secure the future availability and quality of water resources. In some groundwater systems in the US, groundwater pumping is limited to the amount of annual recharge to the aquifer to maintain the aquifer over time and preserve the aquifer as a source indefinitely. In the Australia example, quantifying diversion or extraction limits requires identifying water needs of key environmental assets, ecosystem functions, and the productive base of the resource. In the western US example, quantifying groundwater extraction limits is often interpreted as a matter of quantifying annual recharge rates. Neither of these exercises is simple and both can include some level of subjectivity and considerable controversy. This is especially the case where the science suggests a limit that would severely restrict consumptive use or pumping. At that point, the question becomes a policy choice and requires balancing competing values. This paper does not go into depth on these policy choices, but rather attempts to broadly characterize how each regime quantifies limits or sets caps.

4.4 Robustness of Caps

The final legal element of scarcity is the robustness of caps on water use, and how susceptible they are to *leakage*. A cap on water use can be undermined by a number of factors including failure to include all water uses within the cap, failure to observe or enforce the cap, and failure to take account of all connected water sources. If important water users are not included in the cap – for example, water taken and disposed of in the course of mine dewatering, or the take of water by municipalities – then that unaccounted for take will undermine the cap, reducing physical availability of water to those uses which are counted within the cap. Similarly, if connected water resources are not included within the cap or otherwise accounted for, the cap will be undermined. For example, if a limit is placed on surface water use but not on use of groundwater, then prospective water users may be able to simply drill a well to access water rather than access the market to obtain water rights. If the water accessed by the well is in hydrologic connection to the capped surface water source, pumping the well will deplete the water available under the cap.

4.5 Findings and Discussion

Table 2 shows the comparison of each of the legal regimes based on the component legal elements of the enabling condition of scarcity.

TABLE 2: LEGAL ELEMENTS OF SCARCITY BY REGIME

Regime	Limit on New Rights	Authority to Reduce Existing Rights	Basis for Limit on Developing New Water Rights	Robustness of Limit (Preventing Leakage)
Riparian Doctrine (Common Law)	Yes	Limited by the 5th Amendment of the US Constitution	Limited amount of riparian land	Not robust
Pure Rule of Capture (US)	No		N/A	N/A
Rule of Capture with Ownership in Place (Texas, US)	No		N/A	N/A
Correlative Rights (Stored water, western US)	Yes	Limited by the 5th Amendment of the US Constitution (Except for use it or lose it principles in some jurisdictions)	Storage space and storage rules	Varies (some states manage ground and surface water conjunctively, other do not)
Prior Appropriation (western US)	Yes		Implicit cap through physical limit on amount of water available	Varies (some states manage ground and surface water conjunctively, others do not)
National Water Initiative Framework (Australia)	Yes	Yes	Water sharing planning process determines explicit cap as consumptive pool (accounting for environmental and other instream needs)	Yes (caps account for all uses and connected sources)
Laissez Faire Free Market (Chile)	Yes	Limited by Chile's constitution and has not ever been exercised	New water rights can be limited based on hydrologic availability but DGA must issue new rights if any water is available	Not robust (no joint management of connected sources)

The comparison of legal regimes in Table 2 provides several insights. First, the Riparian Doctrine, the pure rule of capture, and the rule of capture with ownership in place lack one or more of the legal elements of scarcity and thus water markets are not likely to develop in these regimes. Under the Riparian Doctrine for example, access to water rights is limited (and therefore scarce) by the limited amount of land directly adjacent to a water source. However, if connected groundwater is also managed under a common law doctrine, then prospective users are likely free to drill a well to serve their purposes, as common law doctrines treat surface and groundwater as separate entities.

A second, subtler observation involves teasing out the difference between regimes with an explicit planning approach to setting allocations like Australia's NWI framework and the Prior Appropriation Doctrine where annual limits on extraction of surface water are determined by the interplay of historic rights and available water. On the surface, systems like the NWI Framework with explicit, policy-based limits on use seem more likely to foster water markets because they create obvious, transparent caps. Prior Appropriation water rights on the other hand create a more nuanced scarcity. First, there is scarcity in physical water availability. If a prospective surface water user does not have a water right, they cannot simply develop a new right and expect to receive much or any water. Assuming groundwater is not available, the same user would need to purchase a senior water right to access a reliable water supply. Prior Appropriation then, creates a scarcity of high reliability water rights through the first in time, first in

right mechanism. While this is not an explicit cap, it does create a demand for senior water rights that can only be satisfied by permanently or temporarily acquiring an existing right.

Likely what matters even more than the form of the limit on water rights is the context and basis for setting the limit in the first place. If markets were not envisioned when the regime was created, as with Prior Appropriation, markets may not work efficiently just because there is scarcity. Chile presents a slight variation on this theme as fostering water markets underlies much of the Chilean water code, and yet limits on new water rights are either rarely imposed by the DGA, or can be circumvented. As a result, market transactions occur in Chile but active water markets have yet to mature in much of the country (Bauer 2016).

A final observation is the importance of conjunctive management. Australia's NWI framework and an increasing number of western US states have authority for conjunctive management – that is to manage ground and surface water jointly where they are in fact connected. In regimes where conjunctive management is either not present or is present but only variably, any limit on water rights risks being undermined by prospective water users accessing groundwater to avoid limits on surface water.

5. Legal Elements of Secure, Well-Defined and Flexible Water Rights

After scarcity, the next enabling condition for healthy water markets is secure, well-defined, and flexible rights. Imagine purchasing ten widgets from a shopping mall only to find after arriving home that you can actually only use between five and eight of them at any given time; and further, imagine that someone else can take and use some or all of those purchases at any time without warning and without recourse. In this example, the rights to the widgets are both poorly defined and insecure. It is easy to see how a market for insecure and poorly defined goods will quickly fail. The same idea can be applied to water markets. Water right security includes the ability for right holders to exclude others from their rights, as well as the ability to seek enforcement of their rights and recourse when their rights are infringed. Well-defined rights are clearly quantified both in terms of amount and duration as well as how, if at all rights vary based on varying hydrologic conditions. The degree to which water rights are secure and well defined as a matter of law combines a number of legal elements including:

- how rights are allocated;
- the relationship of rights from the same source to one another;
- the enforcement of rights and corresponding duties;
- the forum for settling conflicts between rights holders;
- the duration of rights; and
- the way in which rights are specified - including in the quantification of the amount of water that may be taken under the right, and the amenability of rights to variation in response to changes in availability of water.

In addition to security and definition, a healthy water market requires flexibility to adapt to new and changing values. A key indicator of flexibility is the degree to which regimes enable the state to recover water and water rights previously allocated and allow environmental interests to actively participate in the market on the same basis as other water users. This includes whether secure, well-defined water rights can be held for the environment. Although environmental

A healthy water market requires flexibility to adapt to new and changing values.

water needs can be protected as part of limiting access to water rights (e.g., in the setting of a cap on consumptive use, as Australia’s NWI framework does), the ability for secure, well-defined environmental water rights to be held on an equal footing with other rights is especially important in regimes where the state has little authority to set aside water for the environment because other users have already taken up entitlements to all available water.

Table 3 shows the legal elements of secure, well defined, and flexible rights.

TABLE 3: LEGAL ELEMENTS OF SECURE, WELL DEFINED AND FLEXIBLE WATER RIGHTS

Enabling Condition	Elements	Inquiry/Questions
Secure, Well Defined, and Flexible Rights	Authority to allocate rights	Are rights allocated by the state and if so what is the source of the state’s power to do so?
	Basis for claim of right	How do users obtain rights, and how is ownership identified?
	Allocation during shortage	Is water shared when need exceeds available supply and if so how?
	Enforcement	Are/how are, and by whom are rights enforced?
	Conflict arbitration	What forum is used for adjudicating disputes between rights holders?
	Duration of rights	How long do rights persist once granted?
	Quantification/basis of rights	How clearly are rights defined in terms of the quantity of water to which an owner is entitled and where this quantity applies (e.g., at point of withdrawal or place of use)? (quantity may be based on volume and/or rate and time, area, or purpose)
	Specification of rights to protect the environment and avoid third party impacts	Are/how are rights specified or defined to avoid impacts to the environment and third parties?
	Ability to hold water rights for environmental purposes	Can water rights be held for environmental purposes, on equal footing with water rights for other uses?

5.1 Ownership and the Source of Rights

Many of the legal regimes analyzed in this paper recognize that *ownership* of water is vested in the public and that water rights represent only the right to *use* the public’s water. A starting place for how the regimes differ is in how water users initially acquire rights. There are a number of options. Water rights can be given out by the state through a permitting process, they can be an incident of land ownership, they can be awarded by a state or court to users who undertake specific actions outlined in either statute or common law (such as capture), or they can come from a combination of one or more of these mechanisms. The precise point at which ownership vests in a place or an individual can be a critical determinant of the state’s power to regulate, especially in the US context. For example, under the pure rule of capture, a regulation on water use only affects those who have already captured water, while under the rule of capture with ownership in place, the same regulation affects anyone who owns land (Hardberger 2016). The way in which rights are acquired can also have consequences for development of a market. In a system where the precise parameters of a right can only be determined through the judicial process, potential participants in the marketplace will likely be restricted to those whose rights have been determined.

5.2 Priority, Sharing, Enforcement and Dispute Resolution

A second set of related elements that impact water right security (including exclusivity), definition and flexibility include if and how water is shared when need exceeds available supply, whether, how and by whom water rights are enforced, and how disputes between rights holders are settled. These three elements help to define the interrelationship between water rights from the same source, between the regulatory body (if one exists) and water right holders, and between water right holders who come into conflict with one another. As with many of the elements discussed in this paper, if and how water is shared when there is not enough to meet the full entitlement of every right holder is largely a product of the

context from which the legal regime originates. Some legal regimes, like the Prior Appropriation Doctrine, were designed specifically to manage water during shortage. The choice made in the Prior Appropriation Doctrine is that scarcity is not a shared burden, but rather is the sole burden of junior water right holders. For its part, the NWI framework is designed around a concept of shared sacrifice where all water right holders potentially suffer in the face of scarcity. Knowing if and how water rights change in response to scarcity is a critical legal element of secure, well-defined, and flexible rights.

5.3 Enforcement of Water Rights

Enforcement of water rights generally proceeds by one of two pathways: by a regulatory body enforcing all rights or by individuals enforcing their rights against one another in a judicial or other less formal forum. Enforcement is a key element of water right security and exclusivity because it ensures that individual rights are kept whole and not infringed upon by others and also in some settings that water use occurs within the terms and conditions imposed on water rights by the state (both individual rights and all rights collectively). For its part, dispute resolution is a subset of enforcement and involves the process by which conflicts between water users or water rights are settled. Enforcement of all rights by the state is characteristic of regimes that involve statutory permitting schemes such as Australia's NWI and the Prior Appropriation Doctrine, while dispute resolution on a case-by-case basis is indicative of regimes that follow common law principles such as the rule of capture and the Riparian Doctrine. When the state is charged with enforcing all rights, water right holders appeal to state regulators if their rights are being infringed and the matter is generally settled through administrative processes. On the other hand, in regimes that lack overarching regulatory oversight of water rights (or active oversight, as in Chile), water right holders generally must resort to courts to adjudicate individual disputes. Both systems can result in secure water rights; however, the need to resort to a court to settle individual disputes can introduce significant delay and, more importantly, the uncertainty that comes with the judicial process.

5.4 Duration of Rights

Duration of rights is a question of the definition of the right, and affects both the security and flexibility of rights. Water rights can be time-limited, permanent, time-limited subject to periodic renewal, or permanent subject to periodic revision. Permanent rights are most likely to encourage long-term investment, but can significantly reduce flexibility for water managers – including not only by limiting management options when demands for or availability of water changes, but also by *locking up* unused water rights. In some settings, those where there are no penalties for non-use, permanent water rights can also encourage hoarding. All of these concerns can be addressed by policy measures. Depending on the power of the state to manage water rights, use of a variable consumptive pool, or a statutory power to vary a water right, are ways to manage future changes in the quantity of available water. Concerns about hoarding unused water can be addressed by policy measures such as requirements for active use or payments of annual fees, or incentives such as the ability to trade unused rights. Time-limited or renewable rights (depending on the criteria for renewal) may tend to discourage long-term hoarding but, unless carefully crafted, may introduce enough uncertainty to discourage capital investment.

Whether and how a right can be terminated before the expiration of its duration is also relevant to the characteristics of security and flexibility. A right that can be cancelled by the state easily and in a range of circumstances is flexible from the state's point of view, but much less secure than one that can be cancelled only, for example, if the rights holder breaches the right. A riparian right, as an incidence of land ownership, is highly secure from intervention (although subject to rights of other riparian rights holders) but not at all flexible. There is no *correct* duration of water rights that enables healthy water markets. Rather, the duration of water rights should be analyzed in combination with other factors in context to determine whether duration contributes to, or detracts from the security, definition, and flexibility of rights required for healthy water market activity.

In practice, however, regimes that rely on the premise of the tradability of water rights, including Australia, Chile and the western US, generally assign rights in perpetuity. As with other property rights in capitalist systems, the ability to trade and faith in the efficiency of market allocation argues in favor of permanent rights. The difficulty of course is, when such rights are inflexible in response to changing circumstances and policy needs, permanent rights bind the hand of policy-makers, leaving the fraught process of buying-back existing rights as the primary method for adjusting water allocation and use.

5.5 Quantification of Rights

Whether a water right is well defined depends in large part on how clearly the parameters of individual rights are specified. Specification of rights also establishes the degree of adaptability of the right to changes in water availability. One particularly important element of that specification is the quantification of water to which the owner is entitled and the circumstances in which this quantity might change (for example due to changes in the availability of water for physical or policy reasons). Water rights can be quantified in a number of different ways. Rights can be quantified once and never change, they can be quantified initially subject to changes at a later date upon certain occurrences, or they can be un-quantified (i.e., the quantity permitted to be taken under the right is unlimited).

Differences in the manner of quantification are significant to development of a water market.

Quantification of rights based on an area that may be irrigated, and/or a crop type that can be planted (or other specified use) limits the ability of right holders to change uses over time, whereas quantification expressed only as a total consumptive volume (with or without limits relating to the time and rate of extraction) leaves decisions about the area irrigated or purpose of use in the control of the rights holder. Volumetric quantification has a number of benefits in market settings. First, volumetric quantification is straightforward – almost equivalent to giving each right holder a discreet bucket of water to use as they see fit. In contrast, area- or use-based quantification can make changes to the area irrigated or the end use of a right difficult. As with duration of a right, different options for quantification have benefits, costs, and risks that must be balanced in relation to context to determine the extent to which they contribute to enabling healthy water markets.

The Australian NWI approach of quantifying rights as consumptive volumes is a principal advantage of this system when it comes to enabling trade. Such a system greatly simplifies the transfer of water rights from one use and from one place to another. Transferring Prior Appropriation rights from irrigation to urban or environmental use is considerably more difficult as the total volume under the right includes (either implicitly or explicitly) the consumptive use for the assigned acres plus an additional non-consumptive amount necessary to cover seepage losses incurred in irrigation.

5.6 Rights to Protect the Environment and Other Emerging Values

A healthy water market avoids adverse impacts on the environment and society. Achieving this can be done in a number of ways. One specific way is to allow for creation of water rights for the environment and other emerging values such as recreational uses. Prior Appropriation jurisdictions have evolved to include environmental and some other uses as beneficial uses. However, these jurisdictions have not uniformly provided clear pathways to create meaningful senior water rights for these uses. In addition to setting aside water for the environment through the planning process, Australia also allows for water rights to be acquired (including through purchase) and used for environmental purposes on the same footing as rights for consumptive use. Chile has a less clear mechanism for creating environmental water rights, but it has a mechanism nonetheless. The common law doctrines uniformly lack mechanisms to create rights to protect the environment. This does not necessarily mean there are not other mechanisms in these regimes that could enable healthy water markets. For example, common law can be flexible as judges' decisions often reflect societal changes over time. However, for the purposes of this analysis,

whether each regime allows for creation of specific water rights for the environment and other emerging values is used as an indicator for the degree to which the regime promotes healthy market activity.

Table 4 compares the legal elements described above to analyze the degree to which each regime creates secure, well defined, and flexible rights. Few bright line distinctions emerge from the comparison of the regimes in the table. Rather, subtle differences in combinations of security, definition, and flexibility explain why some regimes enable healthy water markets better than others. For example, none of the regimes stand out as having particularly insecure rights. Even though Riparian and rule of capture jurisdictions lack enforcement, security is provided by virtue of owning land. The lack of enforcement in these regimes could mean that over the very long term, as aquifers are emptied and riparian water needs increase these rights are not secure. However, the point is that rights in these regimes seem secure enough that insecurity is likely not driving the lack of markets. Another distinction that partially helps to explain the level of market activity is the difference between volumetric and area-based quantification. Volumetrically quantified rights are more explicitly defined and can therefore be more easily enforced, flexible and homogeneous. Volumetric quantification is also discussed further below as it makes tradability and transferability considerably easier than use- or area-based quantification.

TABLE 4: LEGAL ELEMENTS OF SECURE, WELL DEFINED, AND FLEXIBLE RIGHTS BY REGIME

Regime	Basis for Claim of Right	Sharing or Prioritization of Rights During Shortage	Enforcement of Rights by the State	Dispute Resolution	Duration of Rights	Quantification of Rights	Ability to Hold Rights for the Environment and Other Emerging Values
Riparian Doctrine (Common Law)	Own riparian land	Reasonable use remains the guiding principle	None	Judicial	Perpetual	Reasonable use test	No
Pure Rule of Capture	Own land and capture water	No sharing or prioritization	None	Judicial	Perpetual (unless capture/withdrawal is ceased or water is unavailable)	Unlimited use	No
Rule of Capture with Ownership in Place (Texas)	Own land	No sharing or prioritization	None	Judicial	Perpetual	Unlimited use	No
Correlative Rights (Stored water, western US)	Contract and/or statutory permit	Reductions in availability shared among rights	State regulates right to fill and owner/regulator limits individual and overall withdrawals	Regulatory	Contractual (can be perpetual or renewable)	Volumetric share of overall pool	Rights can be allocated for environmental uses
Prior Appropriation (western US)	Permit and beneficial use	First in time, first in right	Regulator shuts off rights out of priority	Regulatory	Perpetual (unless beneficial use is ceased)	Beneficial use (area-based rate and/or volume for irrigation)	Create new rights with junior priority or purchase and modify senior water rights
National Water Initiative Framework (Australia)	Statutory permit	In reference to share of overall consumptive pool	Regulator limits individual and overall withdrawals	Regulatory	Perpetual (but reviewed periodically for changes)	Volumetric share of overall pool	Limit on consumptive use sets aside a pool for the environment; water rights can also be held for environmental use
Laissez Faire Free Market (Chile)	Permit, no use requirement	No standard provision for sharing or prioritizing water uses	None	Judicial or through private water user associations	Perpetual	Specified volume (with exceptions for customary rights and other pre-code rights)	Chile's non-consumptive rights could include environmental uses but applicability is limited

6. Legal Elements of Tradability and Transferability

Tradability and the related concept of transferability are the final broad enabling conditions analyzed in this paper. A number of sequential and related elements are required to enable water right tradability and transferability (see Table 5). These include the ability to reassign rights with no changes, the ability to sell rights separate of land, the ability to lease or sell annual use rights or allocations, and the ability to change specific parameters of water rights including when the use of the right is moved to a different location. The ability to make changes, and the level and content of reviews of water right changes can have a major impact on trade and transferability.

TABLE 5: LEGAL ELEMENTS OF TRADABLE AND TRANSFERABLE RIGHTS

Enabling Condition	Elements	Inquiry/Questions
Tradable and Transferable Rights	Ability to reassign rights (with no change in rights)	Can ownership of rights in place be changed?
	Ability to sell underlying right separate of land	Can one user sell rights to another user?
	Ability to lease or sell annual use right	Can users lease or sell some or all of an annual use right to another user?
	Ability to transfer (i.e., change parameters of rights)	Can buyers change parameters of rights upon sale, lease, and/or movement of rights to different place or user?
	Regulatory review and approval of changes to rights	What is the level/content of review of impacts of changes to third parties (including the public and environment) and scope for participation in this process by other users and civil society?

6.1 Ability to Reassign and Trade Water Rights

Water right holders must first be able to reassign – change ownership of – water rights without altering the parameters of the rights. This entails the reassignment of water right ownership to another owner at the occurrence of a specific event, for example the sale of land to which the water right is attached in the Prior Appropriation Doctrine, or inheritance of a water right upon the death of the original owner. In the Riparian and rule of capture regimes, water rights are incidents of land ownership and the authority to reassign is part and parcel of the right to sell the land.

The ability to make changes to rights can have a major impact on trade and transferability.

Beyond simply changing ownership upon occurrence of a specific event, a second level element is the ability to sell some or all of a water right to another user. Many variations on this exist. The sale of a water right may or may not involve a change in the parameters of the water right. Some systems, such as Australia’s unbundled NWI framework, allow for aspects of the water right (in Australia, the water access entitlements and allocations) to be owned separate of land ownership. In these cases, water rights can be sold and

no change to their parameters is required. Extraction of water under the right, or use of the water at a new location requires issuance of an approval specific to that location and may in some circumstances (particularly in unregulated systems) also require a change in parameters of the right. While the Prior Appropriation Doctrine in many jurisdictions also allows for ownership of water without ownership of

underlying land, using the water right does require moving it to a new place of use and possibly changing other parameters of the right. Sale of water rights separate of land is not possible in the Riparian Doctrine because the right to use water is strictly tied to riparian land. The rule of capture on the other hand, allows both the sale of the water already captured, and the sale of the right to capture, to others who do not own the land from which the right emanates (Hardberger 2016). For Chile's part, relatively unfettered sale of water rights is one of the foundations of its Water Code.

In addition to outright permanent sales of water rights, legal regimes also differ on whether and how they allow for leases of annual water use rights or sales of annual allocations. In unbundled systems like the NWI framework, annual allocations are discrete *buckets* of water that can be sold each year (or leased for a number of years) without selling the underlying permanent right. In the Prior Appropriation system, water right holders can lease their right to use water to another entity but doing so requires temporarily changing the location and possibly other parameters of the right.

6.2 Ability to Transfer Water Rights

The final element of a framework for trade and transferability of water rights is the ability to change parameters of rights (often referred to as a *transfer*). Water right changes take many forms and may or may not also involve a sale or lease of the right. The most common changes that accompany changes in ownership (either permanent or temporary) are changes in the type of use, place of use and location of withdrawal. It is important to point out that changes do not include changing the source of the right or increasing the water entitled to be taken under the right. Both of these are not *changes* but require either accessing additional rights from the same system, or new rights from a different system.

Not all legal regimes discussed above require a formal process for a change to a water right. As a general matter, only the regimes that include an administrative system for issuing and managing rights require formal change processes. Those regimes that rely on reasonable use to determine the parameters of rights for example do not require administrative processes. In these systems, reasonable use applies equally to the original water use and any contemplated new or changed use. Implications for the environment or third parties from any change in such regimes are dealt with only through the judicial system on the complaint of an affected person. In other words, unless environmental interests correspond with those of other rights holders who challenge a change, or unless the definition of reasonable use in the specific jurisdiction includes no harm to the environment, the system does not provide any forum for redressing adverse environmental impacts.

However, some legal regimes, especially those with administrative permitting requirements, require the assessment of proposed changes to determine the presence and extent of potential impacts both to third parties and more generally to the public's interest as owners of water resources (including environmental interests). The NWI framework and Prior Appropriation offer insightful examples at opposite ends of the review spectrum. The NWI sets out a framework whereby at the resource-scale, acceptable levels of impact are assessed and provided for during the water planning process. Trading zones and trading rules can be defined that allow trade to occur within acceptable levels of impact. Some local level impact assessment may still be required to minimize third party and environmental impacts, particularly for unregulated systems and groundwater. This approach front-loads much of the review process to the point that changes can be completed without significant additional review so long as they fall within the known and acceptable parameters agreed to in the planning process and set out in the resultant rules (which are contained either in the relevant water plan or under legislation).

The Prior Appropriation Doctrine on the other hand, typically requires review of every change with a high degree of scrutiny. The nature of water rights and water use in Prior Appropriation jurisdictions is such that water rights are interdependent upon one another and therefore, in depth reviews are required to avoid harming or otherwise reducing the security of other water rights. The consequence for trade in

these two systems is greatly reduced transaction costs and generally easier trade under the NWI framework compared to Prior Appropriation.

It is important to note that reviewing water right changes can be easier for some types of water sources than for others. Regulated surface water systems, those with dams and other infrastructure to store and control flows, are the easiest systems for reviewing changes to rights. Water rights in these types of systems tend to be more independent of one another and also tend to be volumetrically quantified. That is, regulation of flows allows for water rights to be filled almost as though they are buckets of water under a spigot. Unregulated surface water sources on the other hand, are generally more complex, as are groundwater systems although once again there is a high degree of variability. For example, under the Prior Appropriation Doctrine, downstream water rights often depend on inefficiency in the use of upstream water rights (called *return flows*) to provide some of their water. Under this scenario, changing the place or type of use of the upstream right can have significant consequences for downstream rights holders.

Table 6 displays a comparison of the legal regimes based on tradability and transferability. All of the regimes allow rights holders to reassign rights without changes. With the exception of the Riparian Doctrine, all of the regimes also give rights holders the ability to sell water rights separate of land and to lease or sell annual use rights or allocations. The biggest differences between the regimes are on the topic of transferability. Specifically, the regimes vary greatly on the ability to change parameters of water rights and the level of review applied to these changes. This is a critical distinction because the ability to reassign, sell, or lease rights is severely limited if those rights cannot easily be changed to meet the needs of the buyer. Rule of capture jurisdictions turn a blind eye to changes as long as the changes do not maliciously harm other users. At the other end of the spectrum, Prior Appropriation jurisdictions conduct detailed reviews of each individual change. This greatly increases the time, cost, and effort required for any change. Changes under Australia's NWI framework, with its volumetrically quantified rights and largely front-loaded review processes can be fast with relatively low transaction costs, particularly in regulated surface water systems. Correlative rights to water in storage in the western US can function much like NWI water rights (they are generally volumetrically quantified) and require limited review of changes because water in storage has been effectively removed from the natural flow regime and changes do not carry much risk of third party impacts.

To understand the importance of transferability to enabling water markets, a very practical example is illustrative. Imagine if a grocery store allowed a shopper to purchase an apple but would not let him or her take it home and eat it without subjecting the shopper to a lengthy personal interview about their eating habits. Purchasing a water right and changing it to a new type or place of use in Prior Appropriation jurisdictions is not unlike this scenario. The ability to purchase something without the corresponding right to use it is practically meaningless. At the same time, *healthy* water markets depend on reviewing changes of use to ensure against harmful third party and environmental or social impacts. Transferability then, is as much about how reviews of changes are carried out as it is about the presence or absence of reviews in the first place. Among the regimes examined in this paper, the NWI framework lays out the most efficient process for reviewing changes to water rights and market activity in Australia is evidence of this. At the same time, Australia also promotes healthy market activity by setting aside water for environmental needs and allocating the remaining consumptive pool as consumptive volumetric rights. Changes are reviewed at scale and at the front end of the planning process. For its part, changes to rights are approved all the time in Prior Appropriation jurisdictions, but the costs in terms of time and effort can be great. The review process is essential to the security of the rights, but only protects existing rights, meaning that in jurisdictions where the environment and other public values are not established as rights these uses may not be well looked after. Table 6 compares the regimes based on legal elements of tradability and transferability.

Teasing apart the legal elements that relate to each of the three enabling conditions – scarcity, secure, well defined and flexible rights, and tradability and transferability of rights – is a useful exercise to highlight

specific differences between legal regimes. However, drawing broad conclusions about the overall extent to which each regime does or does not enable healthy water markets requires bringing all of the disparate elements back together. The next section attempts to do just that.

TABLE 6: LEGAL ELEMENTS OF TRADE AND TRANSFERABILITY BY REGIME

	Authority to Reassign (With No Changes in Rights)	Authority to Sell Underlying Right Separate of Land	Authority to Lease or Sell Annual Use Right or Allocation	Authority to Change Parameters of Rights	Review of Changes to Rights
Riparian Doctrine	Unlimited	None	None	Unlimited (as long as change is reasonable)	Review by a court in event of conflict between users
Pure Rule of Capture	Unlimited	Unlimited (can sell water or right to capture water)	Unlimited (can lease water or right to capture water)	Unlimited (as long as change does not maliciously injury others)	None
Rule of Capture with Ownership in Place (Texas)	Unlimited	Unlimited (can sell water or right to capture water)	Unlimited (can sell water or right to capture water)	Unlimited (as long as change does not maliciously injury others)	None
Correlative Rights (Stored water, western US)	Unlimited	Up to full correlative share	Up to full correlative share	Upon approval of storage facility owner/manager and state regulator	Requires limited review and approval
Prior Appropriation (western US)	Unlimited	Up to amount of beneficial use (may be limited by historic consumptive use)	Up to amount of beneficial use (may be limited by historic consumptive use)	Upon approval of regulatory body	Requires public interest and detailed injury review of each change
National Water Initiative Framework (Australia)	Unlimited	Up to full entitlement	Up to full allocation	Upon approval of regulatory body	May require review by regulator depending on potential impacts of change
Laissez Faire Free Market (Chile)	Unlimited	Unlimited	Unlimited	Unlimited	Only changes in location of diversion require review

7. Enabling Conditions for Healthy Markets in Each Regime

Much of this paper has focused on breaking enabling conditions and legal regimes into component parts to highlight the breadth of factors that can influence the existence of healthy water markets. This section puts all of the parts back together, providing brief discussion for each regime on the presence or absence of each of the three high level enabling conditions. Based on this, and based on case studies prepared as part of this final report, this section also discusses the degree to which healthy water markets actually exist in each regime.

7.1 Riparian Doctrine

Scarcity. Water rights in Riparian jurisdictions are scarce more due to the relative paucity of riparian land than a lack of water. However, this scarcity does not give rise to water markets because the limitation of access to water is easily overcome either because these jurisdictions generally have sufficient natural precipitation, or because of a lack of conjunctive management. Farmers may be able to grow crops without irrigation and to the extent that water is needed for irrigation or another use such as manufacturing, groundwater is likely readily available for non-riparian landowners. Although physical limits to available water can create scarcity in riparian jurisdictions, other limitations discussed below means that this scarcity does not translate into market activity.

Putting all of the parts back together allows for a discussion of the degree to which healthy water markets actually exist in each regime.

Secure, Well Defined, and Flexible Rights. Riparian rights are secure rights up until the point where water needs begin to exceed natural supply. At that point, the lack of enforcement and the requirement that courts resolve disputes can make riparian rights insecure. Riparian rights are not well defined however, because reasonable use is a malleable and evolving concept that does not result in easily or clearly quantified rights. This malleability does provide for some flexibility however,

because reasonable use can evolve to include protections of public values such as environmental and social health.

Tradability and Transferability. While riparian water rights can be reassigned upon sale of land, the bar on selling rights separate of land essentially bars market activity in water rights themselves. To borrow from the grocery store analogy above, if a buyer needs to own a grocery store to have access to apples, then a market in apples will clearly not develop and buyers will find another way to eat apples.

Existence of Healthy Water Markets. Few if any water markets, let alone healthy markets, exist in riparian water right jurisdictions.

7.2 Rule of Capture

Scarcity. Water rights in rule of capture jurisdictions are scarce to the extent that groundwater at accessible depths is not available. As this is a condition that typically appears only after a long period of pumping, these jurisdictions therefore generally lack the scarcity required to foster market activity. However, it is worth pointing out that some market activity is observed in rule of capture jurisdictions. For example, in Texas, it is not uncommon for a business or municipality to purchase and transport water from a rule of capture water right holder (Hardberger 2016). In these municipal cases, it may not always be scarcity in access to water rights that drives these purchases, but rather a calculation on the part of the

buyer that it is more cost effective to purchase someone else's water than to purchase land and develop the infrastructure required to capture water themselves.

Secure, Well Defined, and Flexible Rights. As with Riparian water rights, rule of capture groundwater water rights are secure until overall extraction begins to unsustainably deplete sustainable natural water supplies. However, the rights are not exclusive, in the sense that there is no way in which a landowner can prevent another person from sinking a well on adjacent land and taking the water that the landowner might otherwise have taken. Finally, rule of capture water rights are not flexible because these regimes generally make little or no provision for adapting to changing environmental and other public values.

Tradability and Transferability. Rule of capture water rights are broadly tradable including both the ability to sell captured water and the ability to alienate the right to capture itself. Water taken from the ground in these jurisdictions is also transferable and does not undergo any impact analysis. The right to capture is also transferable separate of land ownership. The ease of trading and transferring captured water accounts for what limited amount of market activity is observed in rule of capture jurisdictions.

Existence of Healthy Water Markets. Rule of capture jurisdictions are not, on their face, well suited to healthy water markets. Along these lines, Hardberger (2016) outlines a number of examples of market transactions in water and water rights in Texas, much of which employs the rule of capture. However, the lack of provision for environmental and other public values means that many of these transactions are not *healthy* market transactions as that term is used in this paper. However, Hardberger (2016) also details the case of the Edwards Aquifer in Texas. In the Edwards Aquifer case lawsuits under the federal Endangered Species Act addressed concerns for species that relied on springs that are being dried up due to excessive groundwater pumping. In response, Texas placed restrictions on groundwater extraction in the Edwards. This led to what could be described as a healthy water market, in the sense of a cap and trade system in groundwater permits that is designed to protect the water from springs needed by aquatic species. In turn, these restrictions have led to a series of challenges under the Fifth Amendment to the US Constitution. The final disposition of these issues remains to be seen but this case highlights the potential difficulty posed by the US Constitution's bar on depriving private property in water rights through regulation on extraction.

7.3 Correlative Rights (Stored Water, Western US)

Scarcity. Water in storage that is managed based on a correlative framework in the western US is inherently scarce. There is only as much water as the storage facility can hold. Further restrictions may also be in place if the storage facility has other uses such as recreation or flood control. Scarcity is present and contributes to enabling market activity in correlative rights to stored water in the western US

Secure, Well Defined, and Flexible Rights. Correlative rights to stored water and or contracts for stored water held by the federal government are also generally secure and well defined. These rights are often given out for long durations or easily renewable terms and they are commonly defined and shared volumetrically according to current availability. Both of these factors contribute to enabling markets in stored water. Correlative rights to stored water may also be flexible depending on the specific rules of the river above and below the storage facility. Generally speaking, stored water can be used for any allowable purpose downstream of the facility. Whether a use is allowed depends both on the general rules of the regime (i.e. the concept of beneficial use for storage in Prior Appropriation jurisdictions) and on the rules set by the storage facility owner/operator. For example, in the case of reservoirs owned by the US federal government, uses are defined by the act of Congress that authorized and funded construction of the reservoir. Flexibility therefore can, but does not always hamper healthy markets for correlative rights to stored water in the western US

Tradability and Transferability. Correlative rights are broadly tradable and transferable, making market transactions in stored water potentially simple propositions. Transferability of correlative storage rights is enhanced by the fact that the primary impact analysis is applied not to individual transfers of the stored water, but rather to the original right to store the water in the first place. Correlative rights to storage are also often volumetrically quantified. Much like the NWI framework then, transfers need not go through detailed ad-hoc reviews because potential impacts have already been accounted for in allowing for filling the reservoir and creating volumetric rights.

Existence of Healthy Water Markets. Enabling conditions for healthy water markets are largely present for correlative rights to stored water in the western US and markets typically exist in such systems when and where water is physically scarce. The primary variable is whether the flexibility to provide water for environmental and other public values is also present. Because correlative rights to stored water in the western US are nested within the Prior Appropriation Doctrine, this variable is controlled by the laws of the specific state combined with the rules of owner/manager of the stored water. Therefore, while enabling conditions for water markets are generally good in these systems, healthy markets are not uniformly present.

7.4 Prior Appropriation

Scarcity. The Prior Appropriation Doctrine imposes a unique type of scarcity. While water rights may be issued for more water than is naturally available during some times of year, thereby creating an illusion of unlimited water rights, the number of highly and fully reliable water rights is made scarce by the first in time, first in right principle. In many states, more water rights are issued than there is naturally available water suggesting that there are more potential uses of water than water available and that water is scarce. Water users that require high reliability water rights then, must have senior water rights, of which there is a definite scarcity. In systems with conjunctive management (i.e. systems where this scarcity cannot be overcome by drilling a groundwater well), Prior Appropriation's version of scarcity is sufficient to enable water markets to develop. In systems where surface and groundwater are allocated and managed as separate resources, there is a race to the bottom as those with junior or no rights mine groundwater to meet their needs. Addressing groundwater allocation and adopting conjunctive management is therefore of the utmost priority and would likely increase market activity in surface water rights.

Secure, Well Defined, and Flexible Rights. Appropriative water rights are very secure. The combination of their perpetual nature and the enforcement of all rights by state regulators makes these water rights some of the most secure of all the regimes analyzed in this paper. However, Prior Appropriation water rights suffer from problems of definition and lack of flexibility to changes in water management policies. Since beneficial use is the primary mechanism for quantifying Prior Appropriation water rights, and since these rights may be limited to what has historically been used under a right, it can be difficult to quantify any individual right without time-consuming and expensive site-specific analyses. This is in stark contrast to volumetrically quantified water rights and presents a major brake on water market activity. Similarly, Prior Appropriation regimes struggle with incorporating emerging new uses such as environmental uses. While environmental water rights can be created in most Prior Appropriation jurisdictions, the doctrine itself was not designed to accommodate these rights. Additionally, reducing water available to rights, for example by setting aside a consumptive pool that leaves water for the environment and other public values, is extremely difficult in light of constitutional issues. In sum, the Prior Appropriation regime's strength is the security of rights, but the definitional, and flexibility thresholds for enabling healthy water markets remain problematic in all but a handful of states.

Tradability and Transferability. Prior Appropriation regimes also meet minimum thresholds for enabling healthy water markets in terms of tradability and transferability. But transferring water to new uses and places of use is often so difficult as to make water markets a proposition of last resort (i.e. after groundwater is mined) in these jurisdictions. Perhaps no single legal element hampers market activity

more than Prior Appropriation's ad hoc approach to reviewing the types of changes in water rights that are required to effectuate trade. Prior Appropriation's area-based water rights, where each right is unique in reference to its use and location leads to a situation where any change in a water right can require a painstaking, time consuming, and expensive process. In this context, markets struggle for adequate pace and scale. This is not to say that such process is not required to protect the rights of Prior Appropriation right holders. The nature and interrelatedness of water use in Prior Appropriation regimes demands this type of review. The difficulty for ensuring healthy water markets is fully incorporating environmental needs into the rights system and the review, as well as ensuring that impacts are reviewed with respect to their hydrologic connection between surface and groundwater.

Existence of Healthy Water Markets. Healthy water markets are not impossible to achieve under the Prior Appropriation regime, but they are difficult. Where they exist, their presence is often due to the political will to overcome the various hurdles encountered or favorable historical circumstances with regard to the many potential imperfections that can impede market activity. For example, the state of Oregon uses a lower threshold for analyzing impacts of temporary changes of use, allowing such changes to take place under the condition that if impacts are observed, the change can be immediately modified or undone. One result of this is more than a thousand temporary changes of water rights from an existing use to an environmental use since 1987 (Szeptycki et al. 2015). Further examples of healthy water markets can be found around the western US but all of them have, in one way or another, required agreement and creativity to get around the deficiencies in enabling conditions present in the Prior Appropriation regime.

7.5 Australia's NWI Framework

Scarcity. Scarcity is imposed within the NWI framework through an explicit limit on consumptive water use resulting from a planning process that includes science-based analysis and public participation (Dyson 2016). Further, the integrity of the limit is protected by ensuring that take from connected resources is also accounted for, including through integrated management of connected systems. It is critical to point out that imposing such limits across Australia is enabled by, among other things, the authority of Australian states to reduce access to water for existing rights holders without fear of a constitutional challenge. Also, unlike some other regimes, where the health in *healthy* water markets is an afterthought, the NWI framework uses extraction and diversion limits to specifically provide for environmental and other public values for water.

Secure, Well Defined, and Flexible Rights. As with scarcity, Australia's NWI framework enables healthy markets from the perspectives of security, definition, and flexibility of water rights. Under the NWI framework, water rights are statutory rights enforced by the relevant state jurisdiction (Dyson 2016). Compared to Prior Appropriation rights, rights under the NWI framework do have more potential variability over time. There are two possible sources for this variability.

First, decisions on how much volume to allocate to water rights each year are based on the size of the consumptive pool in a particular year. The size of the pool is a function of models that are designed to achieve a specific limit on consumptive use as a long-term annual average. Annual allocations are therefore affected by the physical inflows to the system in each year, combined in some jurisdictions with a decision about how water is shared among different priority classes of water rights. As NWI rights are correlative in nature, at least within broad bands of priorities (or security classes), shortages are shared and so natural hydrologic variability impacts the amount of water allocated to rights. When there is enough water to fill the environmental/public set aside as well as the consumptive pool, all water rights receive their full allocation. When water availability is less than that amount, the volume allocated to water rights can be reduced either across the board or variably based on priority (security) classes. Rules setting out the different priority classes and the distribution of water between them are, under the NWI framework, to be set out in statutory water plans. Despite this feature of potential annual variability, NWI rights are well

defined because, even in years where allocations to water rights are less than the nominal value of the water right, allocations are made in a clear and transparent manner so that all water right holders have enough information to plan. Additionally, years of historical records provide an accurate picture of the relative reliability of different water rights categories.

Second, the NWI framework calls for periodic reviews through a planning process of the amount of water dedicated to consumptive use and that which is set aside for environmental and other public benefit uses. This raises the possibility that the consumptive share can increase or decrease with new water plans. While this feature of the NWI affects the security of water rights, it increases the flexibility of the regime as a whole and fosters annual trade as some water users seek to shore up water short entitlements in any given year.

It is worth pointing out that the NWI does specify how the cost of any reductions in water available to users resulting from changes in a water plan is to be shared. After 2014, reductions made necessary because of changes in knowledge about sustainable water yield will be shared between users, state and federal governments, with governments accepting the largest share of the cost. Any reductions caused by changes in government policy (e.g. new environmental objectives) are to be borne by governments, generally by purchasing the necessary additional water from rights holders either directly or by funding projects that result in water savings.

Water rights under the NWI framework are also clearly defined as a right for up to a specific maximum *consumptive volume* of water in any year. The water right does not carry constraints about the area, or crop type, to which the water may be put to use. The amount under the right available for trade is thus extremely well defined.

Tradability and Transferability. Here again, the NWI framework regime excels at enabling efficient water markets. Under the NWI, both the underlying right (water entitlement) and annual quantity (allocation) can generally be easily reassigned, sold, or leased. Because water rights under the NWI framework are allocated in consumptive volumes and because they are not tied to a particular use in any one place, water rights are largely independent of one another. This feature of the NWI framework greatly facilitates trade in water rights. As mentioned before, impact reviews for transfers of water rights for use at new locations are largely front-loaded in the water planning process (including through the use of trading zones and trading rules) so that individual changes can be accomplished with less need for site-based impact analysis than in Prior Appropriation regimes. Australia's NWI framework provides excellent tradability and transferability. This reflects the explicit design of the water rights system as one that favors trade.

Existence of Healthy Water Markets. Tradable and transferable water rights have been a feature of Australian water law since the mid 1980s. As Australian states move toward fully adopting NWI framework principles, active water markets are becoming more the norm than the exception. Perhaps the most high profile water markets are in the Murray-Darling Basin. Water trade in the Basin accounts for 95% (by volume) of all water traded in Australia. The bulk of surface water resources within which trade occurs are managed within caps that were imposed in the mid-1990s. More recent analysis indicates that the health of the rivers in the Basin requires more environmental water to be set aside, so those caps have been reduced, to take effect from 2019. The gap between original caps and the new sustainable extraction limits will be bridged primarily by the purchase of water rights and dedication to environmental use by the federal government. The existence of water markets, including the ability for water rights to be held for environmental purposes, has been critical to its ability to achieve the environmental water recovery. A recent assessment by Australia's National Water Commission concluded that the establishment of contemporary water markets and trading arrangements had been generally successful, with water trading now 'a vital business tool for many irrigators in providing flexibility to respond to variable water availability and other market factors' (NWC 2014a).

In the case of the NWI framework the question of markets being healthy or not is somewhat moot, given the partitioning of the resource and the intersectoral allocation that occurs before the market is called on to facilitate reallocation between commercial and largely agricultural users.

It is worth pointing out that given the significant physical scarcity, the year-to-year variability of water supply and the correlative nature of water rights, it is not surprising that annual (and permanent) trade in water rights in Australia is substantial. As pointed out in Part 1 the setting and history of a basin must drive policy responses and not the other way around. It is also reasonable to posit that the setting and history may suggest a likely level of water market activity, which in turn is hindered or fostered by policy. In the case of Australia and the Murray-Darling Basin these have combined to foster high levels of trade. It is instructive, however, to recall that this is in part a product of the history and setting, and therefore is not a level of trade that should be expected in every basin, no matter the location.

7.6 Chilean Water Code

Scarcity. Chile's water code requires the DGA to issue water rights for free when water is available. Additionally, it wasn't until 2005 that Chile's water code included any consideration for the public interest in issuing water rights and by that time the vast majority of water rights had been granted (Bauer 2016). Chile's constitution also protects water rights as private property and bars any reduction in rights without full compensation, an action that has not ever been taken (Bauer 2016). In theory however, Chile does not issue water rights when water is not physically available which creates a limit on water rights in a given system that traces natural hydrologic variability. It is also worth noting that Chile has created a second class of water rights called *non consumptive* rights intended to spur growth in hydropower development (Bauer 2016). Because these rights are primarily intended to be developed in mountain and foothill tributaries and to not effect downstream consumptive uses, it is not clear that there is any true scarcity in the availability of these types of rights. For consumptive uses however, water and water rights are scarce enough to enable water market activity.

Secure, Well Defined, and Flexible Rights. Chilean water rights present an interesting case in terms of security, definition, and flexibility. In many ways, Chilean water rights are secure. They are defined as private property and are perpetual. However, in other ways, Chilean water rights are not secure, or are not universally secure. There is very little if any oversight and enforcement of rights by the state. Enforcement is generally left to water user associations and, when rights come into conflict, the judicial system. This creates a relatively high degree of security for water right holders in water user associations and insecure rights for individual users outside of these associations. Additionally, Chilean water law makes no provision for sharing or prioritizing water rights during shortage, leaving this task to individual negotiation and, where that doesn't work, to the judicial system. Chile also does not conjunctively manage connected ground and surface water sources meaning that surface water rights are at risk of being undermined by groundwater pumping that impacts the surface water source.

For the most part, Chilean rights are well defined. Chile's water code requires that new water rights be expressed as specific volumes of water. Some customary rights exist that are not expressed volumetrically and there is a process for these rights to be "regularized" into volumetric rights, but this process is incomplete. Finally, Chile's water code does offer the kind of broad flexibility that can enable healthy water markets. Very little provision is made for emerging public uses of water. There are no environmental set asides and, while environmental rights might be created as a kind of *non consumptive* right, Chile charges an annual fee on owners of water rights who do not use them, which is a distinct disincentive to creating environmental water rights. While Chile's water code enables water markets in some ways, and in fact was created with that as one of its primary motivations, it does not appear to broadly enable healthy water markets. Very little provision is made for either the environment or disadvantaged water users (for example individual water users who share a source with an influential

water user association), and the uneven security of water rights calls into question how broadly the Chilean water code in fact enables markets.

Tradability and Transferability. Water rights are freely tradable and transferable in Chile. The only type of water right change that requires DGA approval is a change in the point of diversion from a shared water source. While in theory changes in water rights are not allowed to injure other water users, injured users only options for redress are negotiation and, failing that, judicial action. In other words, the free tradability and transferability of Chilean water rights may in some instances come at a high cost in terms of the overall health of water sources. Here again Chile's water law appears to enable water markets, but fall short of encouraging these markets to be *healthy*.

Existence of Healthy Water Markets. Chile's water code is a relatively modern free market system intended to encourage private property-like trading of water rights. However, its laissez-faire approach does not lend itself to *healthy* water markets. The Chilean case exposes the problem of leaving water governance and management to the market. Relying purely on a market to mediate between supply and demand, within and across water sectors is unlikely to result in sustainable water management due to the public good nature of water. In other words, such a market would have to be highly regulated to be *healthy*. However, as water transfers in Chile are not regulated by the state, this system provides little in the way of guidance towards healthy water markets. The larger lesson here is that treating water as a purely private good is not an appropriate basis for governing the full suite of water uses. But more specifically with regard to markets, forcing an unregulated market to manage water across out-of-stream uses, and leaving environmental uses unaccounted for, is unlikely to provide satisfactory outcomes for stakeholders, perhaps with the exception of powerful institutional and economic interests.

8. Discussion: Role of Water Markets in Water Management

Before concluding, this section turns to an important discussion that runs through each of the three parts of this final report. While the focus of the final report is on the political economy of healthy water markets, and the focus of this paper is on the role of law specifically in enabling such markets, it is important to keep sight of the bigger picture. In the big picture, healthy water markets are just one element of water management. The consequence of failing to recognize this is placing too great a burden on markets to achieve goals they are not well suited to achieve. This section therefore steps back and examines the roles that markets play in water management in the legal regimes – both the role they are suited to play, as well as some of the roles they are asked to play but for which they are a not a good fit. The Riparian Doctrine, the Chilean water code, the rule of capture for groundwater and the Prior Appropriation Doctrine are analyzed with this question in mind below.

The consequence of failing to recognize that water markets are just one element of water management is placing too great a burden on markets to achieve goals they are not well suited to achieve.

Riparian Doctrine. The common law Riparian Doctrine evolved in a particular setting, one in which water was plentiful. Not surprisingly, this regime is not just incapable of accommodating market reallocation of water rights, but in general is poorly suited to managing water in the presence of water scarcity. It is therefore not surprising to see that as the scarcity of surface waters increase in the US, that the direction of change in the eastern states (where common law riparianism is common) is towards grafting appropriative rights onto riparian systems and in western hybrid systems converting/subsuming riparian rights into/within appropriative rights (Getches 1997). For

eastern states in the US, the interesting question then is what type of appropriative system to pursue. The same would apply to other jurisdictions around the world that, due to their colonial past, were left with riparian systems that prove a poor match to increasing water scarcity.

Chilean Water Code. In theory, the legal regimes analyzed in this paper should exist to govern and manage water. This should be their primary purpose. Creation of a water market should be a subsidiary purpose – a means not an end. However, this is not always the case. The Chilean case provides the best example of an attempt to craft a purely market-based regime. The state creates rights and from there, leaves their management and reallocation to the market, with the judiciary as a dispute resolution system. The Chilean case exposes the drawbacks of leaving water governance and management to the market. As elaborated in Part I of this final report, freshwater and related ecosystem services have public good characteristics and relying purely on the market to mediate between supply and demand, within and across water sectors, is unlikely to result in sustainable water management (Aylward et al. 2016). In other words, such a market would have to be highly regulated to be *healthy*. However, as water transfers in Chile are not regulated by the state, this system provides little in the way of guidance towards healthy water markets or indeed healthy water management (Bauer 2016). But more specifically with regard to markets, forcing an unregulated market to manage water across out-of-stream uses, and leaving environmental uses unaccounted for, is unlikely to provide satisfactory outcomes for stakeholders, perhaps with the exception of powerful institutional and economic interests.

Rule of Capture. The rule of capture system is somewhat analogous to the Chilean system in that on its own it presumes no effective regulation of water use. The choice of how much water to use is an economic one that is left to the landowner. Further, the ability to market water that is captured introduces a spatial disconnect between the land and the water underneath it, allowing distant economic drivers to influence pumping rates. In the absence of a regulatory cap on extraction this system may lead to extraction at a

rate that is either faster than that which represents sound economic use of water, or that leads to negative impacts on connected surface waters and associated freshwater ecosystems. However, as seen in the Edwards Aquifer case, rule of capture in the presence of a regulatory cap may foster an active and healthy water market. This is a positive development and points to the way forward for this regime. The potential for rule of capture to transition to ownership in place, however, appears to be a development that simply increases the degree of difficulty of applying regulatory caps as a means to constrain usage and drive a water market.

Australia's NWI Framework. The Australian NWI framework presents an opposing bookend from the Chilean laissez-faire regime. To some extent the question of whether markets in Australia are healthy or not is obviated by the water rights allocation regime that sets aside water for environmental and social needs prior to defining the consumptive water available for allocation and trade. To the extent that this planning and set-aside process works and provides appropriate entitlements and allocations to non-consumptive needs, the governance process effectively solves the collective action problem by first providing for the public good and then creating a set of rights to water as a private good. In such a setting, providing market rules that promote efficient trading are then sufficient to move the system towards economic outcomes. In many ways, the Australian regime is just as pro-market as the Chilean regime. The difference is that the Australians assign the market a limited role. Instead of relying on the market to mediate between all sectors and users, the market is designed to balance supply and demand only for agricultural and other commercial uses.

While the theoretical advantages of the Australian NWI approach are clear, it is worth pointing out that this change of venue for intersectoral allocations from the market to a regulatory planning process does not at all reduce the socio-political and technical difficulties of making such allocations. The potential for controversy and dysfunction in the marketplace is simply moved to the planning process. Indeed it appears, that the major concerns with the Australian approach are economic and social in origin, emerging, for example, during the basin planning process in the Murray-Darling Basin (Dyson 2016). A consequence of this resistance by agricultural and rural interests is the recent cessation of federally funded agricultural buy-backs orchestrated to effectuate further reductions in the consumptive pool and/or provide additional water for the environment. In other words, these communities saw the market as unhealthy. This as the deep pockets (real or perceived) of government funding continued to erode rural access to water for agriculture. In such a setting, private efforts to deploy funds to carry on with such buy backs may engender the same opprobrium.

Prior Appropriation. With regard to the role that the market is asked to play, Prior Appropriation in the western US resembles Chile. The water market is left to mediate supply and demand within and between sectors, especially between traditional and new uses such as environmental water uses. This leads to a series of challenges that Prior Appropriation has evolved to address, perhaps well and perhaps badly, depending on the jurisdiction. As described in Part II of this report, Prior Appropriation in the western US generally suffers from a number of deficiencies that reduce the efficiency of water markets (Aylward, Pilz, and Sanchez 2016). That said there are locales where these problems either do not occur (in part due to different settings) or have been addressed through policy reform, leading to active markets. In other locales, progress is stymied by institutional inertia and the political economy of achieving successful reform. In simple terms, the prospect that an active and efficient market will move water from existing to new (and different) uses can drive this inertia due to fear and resistance to change on the part of existing water users and established water management institutions. In such cases politics, not economics locks or unlocks the market. For efficient markets to emerge then, political will is critical.

On the environmental side, a number of western states have established a clear path forward through the market by which environmental buyers can incentivize water conservation and purchase water for the environment, thereby at least partly addressing the cumulative effects of the Prior Appropriation of out-of-stream water rights. In such states, environmental restoration is underway where basin stakeholders value such activity and can marshal the funds and the political agreements to this end. With regard to resource

sustainability and water markets, gaps in effective regulation and lack of limits on groundwater in many jurisdictions is a primary cause of market failure and over-extraction of groundwater.

Like Australia, Prior Appropriation does enable the state to regulate the granting of additional allocations of water and the transfer of existing rights. Inherent to Prior Appropriation are the necessary protections to ensure that market transfers do not affect existing rights. The difficulty in some states is simply that environmental and some household/community uses are not permitted users or rights, and therefore are not accounted for in this assessment. However, there is nothing inherent in Prior Appropriation that drives this outcome. In other words, policy and institutions can and have been used to address these problems within Prior Appropriation.

In sum, Prior Appropriation is not in and of itself a system that leads to unsustainable water management. The regime emerged out of a particular historic context and development imperative. In this regard it has proved an elegant and highly effective regime for organizing and regulating the withdrawal of water for human use. In the process – and in combination with other development policies and practices – water codes in the western US have led to the dewatering of freshwater ecosystems, along with adverse impacts to water quality, recreational uses, and aquatic habitat and species. Over time the setting has evolved as values have changed, leading to policy reform aimed at retrofitting the regime to meet new demands and address past shortcomings. While water markets can and do now play a role in many Prior Appropriation jurisdictions, it is critical to temper expectations for what markets can accomplish. In particular the reallocation of water between historic and new uses such as the environment should not be left to the market to direct. The market may facilitate this reallocation, but the direction must come from the political system, that is the people and their representatives.

9. Conclusions

This paper compared six different legal regimes for managing water based on the degree to which they either foster or hamper *healthy* water markets. A healthy water market is one that is efficient in balancing supply and demand but also promotes equitable access to water and supports environmental sustainability. This paper did not attempt to pick the best regime for healthy water markets or to advocate for any specific changes in any of the regimes. Rather the purpose here was to examine the strengths and weaknesses of each of the six regimes in relation to healthy water markets and understand how different legal elements in each regime enable healthy water markets within the larger water management setting. The approach to this analysis was to break three enabling conditions (scarcity, secure, well-defined rights, an tradable rights) into component legal elements and compare each of these legal elements across all of the six regimes.

Several conclusions emerge from this analysis. At a high level, it is vital to ask what role any legal regime is asking markets to play. Regimes, such as Chile's water code and the Prior Appropriation Doctrine, where the market is one of if not the sole mechanism to effectuate reallocation from traditional to emerging (and public) uses, are likely to struggle with developing healthy markets because markets alone are not the best way to provide for public goods. Australia provides the perfect counter to this: in Australia, it is the planning process and the setting aside of water for public and environmental benefit through regulation, and not the market alone, that puts the health into Australia's water management regime. Asking markets to do too much is a recipe for failure.

Reform efforts are likely to fail if they do not recognize the importance of context.

Second, examining the three enabling conditions for markets alone does not fully illuminate the extent to which any of the legal regimes in this paper enable healthy water markets. Looking at the legal elements that make up each of the enabling conditions is a critical additional step to a detailed analysis of the extent to which any regime fosters or hampers healthy water markets. There are different variations on each of the enabling conditions and exactly what form the enabling conditions take in each regime has

a major impact on the existence of healthy water markets. For example, scarcity is not a uniform concept. There are a number of ways scarcity arises in legal regimes for water management: Prior Appropriation creates a scarcity of high and full reliability rights through the first in time first in right system combined with natural scarcity of water; Australia's NWI framework, also implemented in the context of sometimes severe natural water scarcity, creates a scarcity of water available for consumptive use by setting aside water for the environment; access to water in the Riparian Doctrine is inherently limited due to the small amount of land adjacent to water bodies. The same goes for secure, well-defined and tradable rights. There are numerous ways to enhance security, definition, and tradability of water rights.

The third conclusion is the critical importance of setting and history (context) in influencing legal rules for water rights and by extension the importance of context in enabling healthy water markets. All of the legal regimes analyzed in this paper are creatures of a specific set of circumstances and a specific course of evolution over time. This creates a sort of *path dependency* – a limitation on modern choices imposed by choices and factors in the past – that is very difficult to overcome. The important lesson from this observation is that, while it is possible to identify legal elements in one or more of the regimes that have demonstrated success at enabling healthy water markets, it is extremely difficult to implement these elements ad-hoc and out of context. For example, it is tempting to say that if healthy water markets are the goal, then every regime should replicate Australia's NWI framework. Indeed, there are efforts to do just that in some Prior Appropriation jurisdictions in the US.

However, the final and most important conclusion that emerges from the analysis in this paper is that such efforts are likely to fail if they do not recognize the importance of context in shaping the legal elements that make up enabling conditions for healthy markets. This conclusion suggests one possible approach to reforming legal regimes to better enable healthy markets: understand the history and context that the regime inhabits and then propose context-appropriate reforms to better enable healthy water markets. It is not productive to simply try to reform one regime to mirror another. For example, Australia's NWI framework cannot be replicated in Prior Appropriation contexts in the US. Rather, if making Prior Appropriation more Australia-like is a goal, then the reform approach proposed here is to mimic some of the outcomes of the NWI framework in ways that fit within Prior Appropriation.

An example is instructive. The primary reason that volumetric quantification helps enable market activity in Australia is that it can reduce the need for case-by-case analysis of water right changes. It greatly increases the efficiency of water right trades. Inefficient trading due in large part to case-by-case analysis of changes is one of Prior Appropriation's Achilles heels. But rather than advocating for a wholesale shift to volumetric quantification in Prior Appropriation, perhaps similar results might be obtained by standardizing and simplifying the review process for water right changes. Building basin specific models of water use and water rights and using these models to analyze and approve changes of water rights could help accomplish this and could mimic some of the benefits of volumetric quantification; namely it could help increase the efficiency of water right changes. This approach to reform is not a panacea. However, it may represent a realistic pathway toward better legal conditions for healthy markets.

One reading of this paper is that each regime is stuck where they are today thanks to the choices of the past. This is a reasonable conclusion and one that is familiar to anyone involved in trying to reform water management. However, it is not the only reasonable conclusion. A more optimistic reading of this paper is that comparing legal elements of enabling conditions for healthy water markets across a range of different legal regimes is fertile ground for new ideas and insights. This is certainly the reading the authors intend. From the Riparian Doctrine to Chile's water code, the six regimes analyzed in this paper present a fascinating cross section of different approaches to water management and water markets. And in these critical differences, as well as a number of similarities identified in this paper, are a host of valuable lessons about the political economy of healthy water markets.

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