WATER AND ENERGY IN THE WEST: THE LEGAL AND INSTITUTIONAL ISSUES THAT AFFECT WATER AVAILABILITY FOR ENERGY-RELATED ACTIVITIES

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1. INTRODUCTION

The West is the nation's "energy breadbasket." It is home to both renewable and non-renewable resources that provide the majority of the nation's energy. All energy activities require water to some extent, including water needed to cool power plants and extract oil, gas, coal, and other fuels, among other uses.

At the same time, much of West is arid and those water supplies that do exist are often limited, already appropriated for other uses, or located away from where it is needed for energy purposes. This raises questions about the interaction between energy and water as well as how access to water will impact energy development in the West, particularly in light of drought, growing populations, and other factors that have placed significant demands on the region's limited water resources.

The Western Governors' Association (WGA) commissioned the Western States Water Council (WSWC) to prepare this report on the legal and institutional issues associated with securing water for energy generation and development in the West. The WGA has long supported the effective management of the West's water resources, as well as an "all of the above" energy approach that includes the development a clean, diverse, reliable and affordable energy supply consisting of both traditional and renewable energy resources.[1]

This report, which was funded in part with grant assistance from the U.S. Department of Energy, is intended to help inform the WGA's water and energy goals. To this end, the report will analyze the legal and administrative issues associated with new permits or transfers of water for energy development in Texas and the states of the Western Interconnection, namely Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, South Dakota, Utah, Washington, and Wyoming. It also includes two case studies, one in Arizona and the other in Texas, that provide state-level examples of how waters supplies are being provided or may be acquired for new energy projects and on how energy development is affecting water supply and management in the West.

This report may also help inform the WGA's Drought Forum, which Chairman Brian Sandoval of Nevada initiated in 2014 to foster a regional dialogue in which states and industry can share case studies and best practices on drought policy, preparedness and management, including management efforts related to energy. To date, the Drought Forum has carried out a number of activities to better understand drought and its impacts, including a September 2014 meeting in Norman, Oklahoma that brought together experts from around the West to discuss how to manage drought in the energy sector. This paper will support the WGA's Drought Forum as it considers drought impacts to energy and other sectors of West's economy.[2]

2. OVERVIEW OF WATER WITHDRAWALS AND CONSUMPTION IN THE WEST

About 70% of the freshwater that is withdrawn in the 17 contiguous western states is for irrigation, followed by public supply/municipal (12%), energy (11%), aquaculture (3%), industrial (2%), domestic (0.83%), livestock (0.77%), and mining (0.40%). However, irrigation with reuse of return flows accounts for about 90% of water consumption in the West.[3]

Across the West, proposed traditional and renewable power plants are projected to be a major driver of new water demand in the coming decades. In many parts of the West, oil companies are also acquiring senior irrigation water rights for a number of energy-related activities. In particular, oil-shale development and hydraulic fracturing – or "fracking" – in which water and chemicals are injected underground to extract trapped hydrocarbons, have generated significant discussion about the practice's potential impacts on water supplies and water quality. Colorado's 2012 water use for fracking was miniscule at less than a tenth of a percent, but was projected to rise by 35% over five years in a 2012 study by that state.[4] These and other growing energy demands will likely mean that the amount water withdrawn and consumed for energy purposes will increase, which raises questions about what such an increase means for other water uses and about how to supply water for these growing demands.

It is also important to note that there many different types of water that can be used, or are otherwise related to energy production and extraction. These include:

- Freshwater: Naturally occurring water located on the Earth's surface in rivers, streams, lakes, ponds, and underground as groundwater in aquifers and in underground streams. Freshwater is generally characterized as having low concentrations of dissolved salts and other total dissolved solids. Freshwater can be used for potable and non-potable uses with minimal treatment.

- Brackish Groundwater: Groundwater that has more salinity than freshwater but is often less saline than seawater. Despite its salinity, brackish groundwater is becoming an increasingly important source of new water supply in certain parts of the West. For instance, Texas has an estimated 2.7 billion acre-feet of brackish groundwater. If used for potable purposes, brackish groundwater needs to be treated (desalinated) or blended with other waters to reduce the concentrations of total dissolved solids and other compounds. However, brackish groundwater can be directly used for a number of energy purposes, including providing cooling water for power generation, with pre-treatment, as well as for drilling and hydraulic fracturing.[5]

- Reclaimed Water and Effluent: Former wastewater that is treated to remove solids and certain impurities. Within an energy context, reclaimed water can be used for power plant cooling purposes and energy extraction, often providing a reliable, drought-resistant water supply for municipalities in arid parts of the West where freshwater supplies are limited.

- Produced Water: Produced water is a byproduct in oil and gas development. Because produced water has been in contact with hydrocarbon-bearing formations, it typically has some of the chemical characteristics of the formation and the hydrocarbon itself. It may also include chemicals added during the drilling, production, and treatment processes. Historically, produced water has been considered an industrial waste disposed of in large evaporation ponds. However, environmental concerns about this disposal method and increasing demands on available freshwater supplies have created incentives to find uses for produced waters, such as direct reuse of untreated water for non-potable purposes and treatment to a higher standard before discharging the treated water into a surface water source. Direct reinjection also represents a possible, or even common, disposal method.

As discussed below, the laws and regulations that govern the use of these water resources for energy and other purposes vary from state to state and different provisions often apply to each source of water.

3. STATE LEGAL AND REGULATORY FRAMEWORKS

Congress and the U.S. Supreme Court have consistently recognized the primacy of state water law in the allocation and administration of water rights, which means that states play the primary role in administering the laws and institutional programs that govern the allocation and appropriation of water for energy development.[6]

Water also holds a unique place in western law, being both a commodity subject to private ownership and a form of community property that no one can fully own.[7] In the West, state constitutions declare water to be a common resource that the states hold in trust for the public. At the same time, state laws provide mechanisms for the private use of water, including methods to secure a property interest through new water rights and transfers of existing water rights. While interests in water are considered to be private property, states retain ownership of the water itself and such rights are usually a usufructuary right, or a private right to the use of a public resource.

3.1 The Prior Appropriation Doctrine

Western water law relies on the doctrine of *prior appropriation* to allocate privately held water rights. While states may define and utilize this doctrine somewhat differently, three elements are common to all western states: (1) an intent to apply the water to a "beneficial use" (e.g., energy, agricultural, domestic, mining, industrial, commercial, and other uses); (2) an actual diversion of water from its source to the place of use; and (3) timely application of the water to a beneficial use.[8]

Prior appropriation also subjects water rights to a number of conditions , including the principle of "first in time, first in right," in which the date a water right is established (priority date) determines who receives water in times of shortage. Under this concept, users with senior priority dates will receive their full apportionment while junior users who may have sufficient water in a normal year may receive no water at all.

Another key condition is the concept of "use it or lose it," which requires right holders to use water as prescribed or lose the right to its use through abandonment, forfeiture, or prescription. [9] After water has been lost, it returns to the public domain to be appropriated for another's use. These requirements are intended to encourage maximum beneficial use of water by limiting speculation and avoiding the granting of rights that would otherwise be unused.

Further, since water often returns to a river, stream, or aquifer, the next appropriator can "reuse" the water. State laws prohibit waste and require that water be returned in good condition. This allows scarce water resources to be used and reused multiple times and also means that changes in water rights can impact other users.

It is also important to note that most western states use similar processes under the prior appropriation doctrine to regulate both surface and groundwater, which means that those seeking to appropriate surface or groundwater for energy purposes must first obtain a water right from the state.

A few states, however, use other doctrines to allocate and administer groundwater resources. For instance, the rule of capture governs groundwater allocation in Texas, meaning that groundwater is private property over which the state has limited control compared to other states. [10] Moreover, not every state regulates groundwater on a statewide basis as evidenced by Arizona, where the state only issues groundwater rights and permits in certain designated areas known as active management areas (AMAs). Nevertheless, this does not mean that groundwater is unregulated in these states and some controls do exist, including groundwater control districts in Texas that provide some local limitations on the means of extracting groundwater to provide accountability and avoid conflicts between pumpers.

3.2 State Appropriation Processes

In most cases, those seeking to appropriate water must file an application with the proper state authority, typically a state engineer or a water court in Colorado, which will process the application pursuant to formal or informal procedures. These procedures involve the consideration of a number of factors in evaluating the application. The most common require that water be available for appropriation and that new uses "not injure" other existing water rights.

Most states will also issue public notice of a proposed appropriation and provide the public with opportunities to voice objections to the proposed use. If an application satisfies the necessary criteria, a state will issue a permit specifying the amount of water an appropriator can use, where he or she can withdraw the water (the place or point of diversion), where the water is applied (the place of use), and the purpose of the use.

When applications are approved, the applicant must provide the state with proof that the water has been put to beneficial use before the state will issue a certification of appropriation, thereby completing the appropriation process. Such applications are then often referred to as "certified," "perfected," "vested," "absolute," or some other similar term.[11] Once a use or right is perfected, it is considered to be a constitutionally protect private property right that can be bought, sold, leased, bequeathed, or otherwise transferred.

Some states also recognize different types of rights to distinguish between rights that have been and have not been perfected. For example, Colorado recognizes "absolute" or "conditional" water rights. An absolute right refers to water that has been diverted and put to a beneficial use. A conditional right is a means of obtaining a right that will be developed in the future while maintaining its priority until the project is complete. Upon completion of the project, the owner of a conditional water right can then go to a Colorado water court and file for an absolute water right, obtaining the appropriation date for which the conditional right was awarded "by relation back."[12]

In those cases where the state denies a water right application, most states allow the applicant to request that the applicable state agency reconsider the application. After exhausting administrative remedies, applicants may appeal the state agency's decision to a state district court.

3.3 Water Transfers

In many parts of the West, most water is fully appropriated, unappropriated water is unavailable, or the water that is available is too junior in terms of its priority to provide a stable and certain supply of water for energy development and power plant operations. Therefore, those seeking water for energy and other purposes must often secure an existing water right with a senior priority date. In most cases, this entails purchasing senior water right through a process known as a "transfer" or "change application," depending on the state in question. As noted previously, agriculture accounts for the vast majority of water withdrawals and consumption in the West, and agricultural water rights are often the most senior, which means that those seeking water for new uses – including energy – often seek to transfer agricultural water to satisfy their needs.

While the sale or lease of a water right itself is a free market transaction not subject to state regulation, states do require those wanting to change the point or place of diversion, place of use, or purpose to which an existing water right is put to use to file an application and obtain approval from the appropriate state authority. These authorities will then review the application to ensure that it satisfies a number of conditions. Although these conditions vary considerably across the West, most transfer processes must make many of the same determinations used to review applications for a new appropriation, requiring that changes of water rights must not injure other vested water rights with the added condition only the amount of water consumptively used, not the amount withdrawn can be transferred.[13]

States may also employ different mechanism or requirements to regulate permanent and temporary transfers. In Colorado, temporary and permanent water right changes are typically accomplished through the state's water courts. However, under some circumstances, the State Engineer may approve a water rights transfer for one year or less.[14] Although the majority of western states utilize the same state agency to review and approve both permanent and temporary transfers, this is not always the case.

Some state laws may also provide additional provisions or conditions for temporary transfers. In Montana, a temporary transfer must meet the criteria of a permanent change, but can be made for a period of 10 years. If the transfer is not renewed at the end of the term, the underlying water right will automatically revert back to the permanent purpose, place of use, point of diversion, or place of storage.[15] In other states, the duration of a temporary transfer is often much shorter. Such is the case in New Mexico where water right owners can apply for temporary changes of no more than one year and no more than three acre-feet per year to a different location or to a different use, or both. New Mexico's State Engineer will approve the proposal if it will not "permanently impair any vested rights of others." If the change might result in impairment, the State Engineer will provide notice and conduct a hearing.[16]

3.4 Other Factors Affecting the Appropriation and Transfer of Water Rights

In addition to the above factors and procedures, state appropriation and transfer review processes typically include consideration of a number of other factors. While most of these factors are not specific to energy, they may still affect the availability of water for energy activities in the West.

3.4.A *Public Interest Reviews*

Most western states prohibit the appropriation of water and the transfer of an existing right if doing so will be detrimental to the public interest. What states consider to be in the public interest varies considerably, with some states lacking a definition of what qualifies as the "public interest," while others follow detailed statutory, administrative, or judicial definitions of what qualifies as being in the "public interest."[17]

Nebraska, although not part of the Western Interconnection, provides a notable example of how western water laws define the public interest. Specifically, Nebraska law lists eight factors that must be considered when determining whether a transfer is in the public interest, including considerations related to the economic benefit of the proposed use, effects on interstate compacts or decrees, and the availability of alternative sources of water, among others.[18] The legal frameworks of other states may not provide specific criteria on how to determine whether a transfer is in the public interest, leaving this determination to state courts and water agencies.[19]

3.4.B *Environmental Protections*

The legal frameworks for most states provide protections for environmental values. For example, the California Water Code requires that temporary transfers must not "unreasonably affect fish, wildlife, or other instream beneficial uses." [20] Oregon will also deny a transfer application if the Oregon Department of Fish and Wildlife cannot issue a "consent to injury" for upstream point of division transfers that occur within reach of an instream water right.[21] With respect to instream flows, Texas has the ability to mitigate impacts to environmental values by placing flow restrictions on interbasin surface water transfers[22] and on amendments to changes in use, place of use, or diversion location if the amendment would cause a greater adverse impact on the environment than the current permit when fully exercised.[23]

3.4.C *Area-of-Origin Protections*

Western states vary considerably with respect to protections for areas-of-origin, or those areas where the water in a transfer originates. States that do consider such impacts utilize a range of approaches for various types of transfers. For instance, in Texas, surface water interbasin transfers require an evaluation of the projected economic impact of the transfer in the basin of origin and the receiving basin. Transfer authorizations in Texas can also include mitigation or compensation requirements for basins of origin.[24]

Other examples of area-of-origin protections include:

- Long-standing statutes in California to protect designated water source areas from the effect of out-of-basin exports;[25]

- Provisions in Nevada law that allows the county of origin to impose an annual fee of $10 per acre-foot on certain transfers; and[26]

- Considerations in Wyoming regarding the economic loss posed by a transfer to the community and the state, the extent to which the new use will offset this loss, and whether other water sources are available for the new use.[27]

A number of western states do not have specific area-of-origin statutes or regulations. Instead, many of these states often rely on public objections, the influence of local water districts, and requirements limiting transfers to historic consumptive use to protect areas-of-origin. For instance, New Mexico allows acequia[28] or qualifying ditch companies to adopt bylaws requiring their approval as a condition to surface water transfers.[29] Likewise, Arizona requires the written approval of a water users' association, agricultural improvement district, or irrigation district for the transfer of surface water rights from lands within their boundaries.[30] Arizona also maintains that no right to the use of water on or from any watershed or drainage area that supplies or contributes water for the irrigation of lands within the boundaries of such organizations can be transferred without the consent of their governing bodies.[31] Thus, under these frameworks, it is unlikely that water transfers will receive the consent of potentially impacted parties without minimizing or mitigating impacts.

3.4.D *Use Preferences*

Most western states delineate priorities for certain uses. Generally, these preferences are applied as a factor in weighing competing applications for appropriative rights when there is insufficient water to support all applied-for uses.

However, some states also utilize these preferences to determine priority among actual uses, allowing a higher use to condemn an existing use even if the existing use has an earlier priority date.[32] For instance, Article XV Section 3 of the Idaho Constitution states "…priority of appropriation shall give the better right as between those using water; but when the waters of any natural stream are not sufficient for the service of all those desiring the use of the same, those using the water for domestic purposes shall have the preference over those claiming for any other purpose."

While use preferences vary from state to state, there are two general observations that appear to apply in most states. First, domestic and municipal uses are generally preferred over other uses, while agricultural and manufacturing uses also tend to have fairly high preferences compared to other uses. Second, uses like power generation, navigation, and recreation tend to have relatively lower preferences.[33]

However, there are a number of differences in how states utilize their preferences. For instance, Nevada's use preference only applies to groundwater and does not apply to surface water.[34] Other states have provisions specifying that certain transfers can only be made for equal or higher uses,[35] such as South Dakota, which does not have a use preference list but specifies that an irrigation water right may only be transferred to domestic use or use within a water distribution system.[36] Moreover, some states have preferences that apply only to the application process, while others have preferences that apply to both the application process and the use of existing rights. States like Utah and Oregon have use preferences that only apply in times of drought or shortage.[37]

Some states specify energy as a use preference. New Mexico law states that water for "power generation" has a third tier preference behind domestic and municipal water supplies, irrigation, and manufacturing, among other uses.[38] In Texas, "hydroelectric power" is fourth in a list of preferred uses, behind domestic and municipal uses, agriculture, and mining, but ahead of navigation, recreation, and other beneficial uses.[39]

However, energy extraction or development is often not listed as a use preference. This raises questions about how and whether such activities fit within delineated use categories. For instance, does water used to grow corn-based ethanol qualify as an agricultural use or does it qualify as an industrial or other use?

3.4.E *Effluent*

Effluent – or wastewater from municipal wastewater treatment plants – represents a relatively reliable source of cooling water for power plants. If a power plant is located near a municipal population center, relying on municipal effluent may be one way of avoiding many of the social and environmental impacts associated with the use of freshwater supplies for cooling purposes. However, when plants are far from human populations, such as many industrial scale solar power plants, connecting to wastewater treatment plants can be cost prohibitive.

While the legal and regulatory structures that govern the use of effluent for energy purposes vary by state, most states have provisions that allow for the use of effluent for energy purposes, particularly for power plant cooling purposes. For example, the California Water Code recognizes cooling for thermal electric power plants as a beneficial water use for wastewater.[40] Similarly, in Nevada, the appropriation of effluent water for a beneficial use may be authorized[41] if it does not jeopardize public health, safety, or welfare, and if it does not interfere with federal obligations to deliver water of the Colorado River.[42]

In Arizona, effluent is a specific type of water, recognized under state law. Further, the use of effluent belongs to the entity generating the wastewater until it is discharged to a public waterbody, such as a perennial or ephemeral stream.[43]

3.4.F *Miscellaneous Permitting Requirements*

In addition to the above, some states also have other requirements regarding the appropriation of water or the transfer of a water right that may apply to energy-related activities.

For instance, in Utah, the State Engineer must consider whether there is "reason to believe" that a water right or change application is physically and economically feasible, and whether the applicant has the financial ability to complete the proposed works.[44] In 2012, the State Engineer considered these factors in approving an application to transfer water rights for a proposed nuclear power plant from two agricultural irrigation districts.[45]

A Utah district court later upheld the decision in a case that addressed the State Engineer's consideration of these factors, finding: (1) that the project is physically feasible because its proposed site "meets all of the criteria necessary for the construction of the proposed works;" (2) notwithstanding high construction costs, that there is reason to believe the plant will be economically feasible once operational based on energy demands in the area, the availability of other energy technologies, and future cost projections, among other considerations; and (3) that the project developer is not required to have "the entire project financed to completion" and had shown that it has the financial ability to complete the proposed power plant by demonstrating an ability "to secure funding and capital as needed, on a step-by-step basis to capitalize the project and has a plan to continue capitalizing the project."[46]

3.5 Interstate Authority

There are 26 interstate agreements, or compacts, that allocate water resources between multiple states and involve at least one western state. Water allocation compacts typically divide interstate waters pursuant to a variety of mechanisms, including long-term delivery obligations, storage maximums, a specified percentage or volume of water, or minimum flows. Each of these mechanisms has the potential to affect the amount of water available for energy purposes in the West.[47]

For example, upstream states with delivery or minimum flow requirements typically must allow a specified amount of water to flow downstream to satisfy their compact obligations. Thus, it is possible for some rivers to have a significant amount of flow but have little, if any, water available for energy or other uses because the flows are needed to satisfy a state's delivery obligations, or senior downstream water rights.[48]

Each compact's structure is unique to the states involved. Circumstances vary with respect to how each compact affects water allocation, although there are a few common principles across the existing western agreements. First, states enter into compacts pursuant to the Compact Clause of the U.S. Constitution, which requires Congressional approval. Once Congress has approved a compact, the agreement becomes federal law and binds the signatory states to its terms and conditions. [49]

Second, fifteen of the compacts involving western states have created some form of commission to help regulate the waters at issue. The structure and degree of control these commissions have over water availability varies, but they typically include an equal number of representatives from each signatory state and a federal representative, who typically does not have a vote.[50]

Third, the federal government can play a significant role in some compacts. In particular, the Boulder Canyon Project Act of 1928 ratified the Colorado River Compact of 1922, but also allocated water in the Lower Colorado River Basin between Arizona, California, and Nevada. The Secretary of the Interior serves as the water master in the Lower basin, which creates a different set of requirements than the process typically used to secure water rights for beneficial uses. For instance, in Arizona, the Arizona Department of Water Resources (ADWR) will make a recommendation to the Secretary regarding the allocation of water from the Colorado River, including transfers of mainstream Colorado River water delivery contracts. The Secretary will then make the final decision regarding whether to approve the use after considering ADWR's recommendation.[51]

Lastly, because ratified compacts are federal law, most related disputes between the signatory states must be resolved through the federal court system. The U.S. Supreme Court has original jurisdiction to hear such disputes and usually assigns a "special master" to take evidence and prepare a recommendation for the Court. These legal disputes can affect a compact's interpretation and, in turn, the amount of water a state receives under the compact, including water for energy purposes.

3.6 State Energy Commissions

State public utility commissions can affect the water availability for certain power projects. While these entities do not have the authority to approve applications to appropriate water or transfer existing water rights, they may have authority to implement statewide policies involving the types of water available for power plant cooling purposes or require certain water-related conditions in approving a specific power plant.

For example, the California Energy Commission (CEC) is California's primary energy policy and planning agency, and is the lead agency responsible for overseeing the siting of new power plants that are 50 megawatts or larger.[52] In determining whether to approve proposed power plants, the CEC staff will analyze a number of factors, including the effects of the energy project's proposed use of water on the environment and other water users, a plant's access to water supplies throughout the life of the project, and the impacts on the proposed water source.[53] Among other things, staff will also review: (1) the feasibility of alternative water sources and cooling technologies; (2) the impacts on water quality and wastewater disposal; and (3) the granting of required water supply agreements.[54] After completing these reviews, staff may recommend water use mitigation measures if necessary.[55]

Similarly, in Arizona, the state's public utility commission, the Arizona Corporation Commission (ACC), will take a number of considerations into account when determining whether to approve a proposed power plant. Among other things, it strives to balance the state's need for energy with the environmental impacts of the project, including impacts to water supply, water quality, wetlands, and ecological values. It places the burden on the applicant to prove that the proposed water supply is sustainable and also to establish how the project will mitigate the water quality impacts, if any. [56] As discussed in greater detail in the case study section below, the ACC has on at least one occasion required a proposed power plant to rely on effluent for its cooling water purposes and denied the use of groundwater.

3.7 State Policies Affecting Water Use for Energy

In some cases, states may enact policies regarding the use of water for energy purposes, particularly for power plant cooling needs and technologies. These policies can apply to a specific region or statewide and often pertain to the type of water that can be used.

This is particularly true in California where the regulatory climate has shifted away from using freshwater sources for power plant cooling purposes to dry cooling and wastewater. In 1975, California's State Water Resources Control Board (SWRCB) adopted Resolution No. 75-58 regarding the use and disposal of inland waters used for power plant cooling. The resolution encourages the use of wastewater for power plant cooling purposes and sets forth the following order of preferences: (1) wastewater being discharged to the ocean; (2) ocean water; (3) brackish water or irrigation return flows; (4) inland waste water of low total dissolved solids; and (5) other inland waters. The CEC later reiterated certain principles from Resolution No. 75-58 as part of its 2003 Integrated Energy Policy Report, which states that it will approve the use of fresh water for cooling purposes only where alternative water supply sources, alternative cooling technologies, and "zero-liquid discharge" technologies are "environmentally undesirable" or "economically unsound."[57]

Additionally, in 2008, California and the Department of Interior formed a Renewable Energy Action Team (REAT) to facilitate permitting issues with specific renewable energy projects, such as concentrated solar.[58] REAT ultimately issued a best management practices and guidance manual in 2010 that said that renewable energy power plants "will use air-cooling technologies for thermal power plant cooling."[59] The document further stated that if this and the other recommendations were not addressed, "it is very likely that environmental review and decision-making will take additional time."[60]

In some cases, a state may not necessarily adopt a statewide policy, but may indicate a preference for certain technologies through regulatory decisions and other actions. This appears to be the case in Nevada, where the State Engineer has expressed an increasing preference for solar powered plants to use dry-cooling technologies that use significantly less water for power plant cooling purposes than wet-cooled power plants, denying applications for wet-cooled power plants or expressing reservations over the use of groundwater for cooling purposes.[61] In one notable decision, the State Engineer stated:

> Technology is available which can produce significant amounts of electricity using air-cooled systems. This technology uses significantly less quantities of waters. The State Engineer…does not believe it is prudent to use substantial quantities of newly appropriated ground water for water-cooled power plants in one of the driest places in the nation, particularly with the uncertainty as to what quantity of water is available from the resources, if any.[62]

The State Engineer's office has further indicated that it will likely rely on the precedents established in these rulings when determining whether to grant new water rights for solar energy plants in southern Nevada.[63]

4. FEDERAL LAWS RELEVANT TO WATER ALLOCATION FOR ENERGY PURPOSES

In addition to state laws and regulations, there a number of federal laws that can affect the availability of water for energy purposes. While these laws typically defer to state water rights and water allocations, they nevertheless impose a number of requirements that may affect the availability or feasibility of using certain water supplies for energy purposes. The following section describes these laws.

4.1 Clean Water Act

The Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), creates the primary legal framework for the regulation of the nation's surface water quality. The CWA establishes a system of cooperative federalism, in which the states work as co-regulators with federal agencies, namely the Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers ("the Corps"), to administer the CWA.[64]

4.1.A *CWA Jurisdiction*

The CWA applies to "navigable" surface waters, which it defines as the "waters of the United States [WOUS], including the territorial seas."[65] Federal regulations further define this term and have historically asserted an almost unlimited interpretation of CWA's authority to regulate surface waters. However, the U.S. Supreme Court's decisions in *SWANCC v. U.S. Army Corps of Engineers* and *Rapanos v. U.S.* have narrowed the CWA's reach, finding that the extent of its jurisdiction is not without limit. At the same time, the Court's plurality decision in *Rapanos* set forth two differing jurisdictional tests without a clear majority for either test, creating confusion regarding the full extent of the CWA, particularly with respect to its authority to regulate activities affecting isolated wetlands, ephemeral and intermittent streams, and certain headwaters and their associated wetlands.[66]

States, federal agencies, and stakeholders have diverging perspectives regarding the true extent of the CWA and the Court's *Rapanos* decision. Some believe the Court correctly curtailed the extent of the CWA's jurisdiction while others believe the Court incorrectly narrowed the reach of the act. A number of bills to "restore" the CWA's jurisdiction to its previous "status quo" have been introduced, as has opposing legislation to prevent an "expansion" of jurisdiction beyond the limits set by the Supreme Court. So far, neither of these strategies has been successful.[67]

Notably, the EPA and the Corps are pursuing rulemaking as of the date of this report to clarify the extent of CWA jurisdiction under the Court's *SWANCC* and *Raponos* decisions. A final rule is expected in 2015, although it will likely be challenged in court following its promulgation. Legislation to prevent or alter the rulemaking is also expected.

Notwithstanding the uncertainty regarding the extent of CWA jurisdiction over surface water, the CWA does not apply to groundwater, the regulation and protection of which is left to the states.

4.1.B *Section 402 – National Pollutant Discharge Elimination System*

The CWA prohibits the discharge of a pollutant from a point source, or a discrete conveyance of pollution such as a pipe, into waters subject to CWA jurisdiction without a National Pollutant Discharge Elimination System (NPDES) permit under Section 402.[68] To date, a total of 46 states and 39 federally-recognized tribes have delegated authority to administer their own NPDES permits. Nearly every western state has NPDES permitting authority, with the exception of Idaho and New Mexico, where EPA is the permitting authority.[69]

The CWA requires NPDES permits for a range of industrial activities, including thermoelectric generation plants that discharge wastewater to surface waters. In most cases, energy-related dischargers must secure individual NDPES permits, which are subject to notice and comment requirements. However, EPA has elected in some situations not to require individual permits for certain types of widespread activities that have similar characteristics. In these instances, EPA will issue a "general permit" that sets forth terms and conditions that satisfy individual permitting requirements without an application and review process, so long as the underlying terms and conditions are satisfied.[70]

Technology-based effluent limitations for discharges from point sources provide the basis for state or EPA-issued NPDES permits.[71] With respect to energy activities, EPA has established specific effluent limitations for oil and gas exploration and extraction, coal mining, petroleum refining, and steam electric power generation for fossil fuel and nuclear thermoelectric plants, among other activities. These limits do not require the use of specific technologies, but set forth the pollutant limits that can be achieved by best available control technology, and require the permit to reflect these limits. In certain cases, these requirements can impact water quantity, including effluent limits that require water recycling and closed-loop technologies.[72]

Notably, the CWA specifies that NPDES permits are not required for discharges from stormwater runoff from "mining operations or oil and gas exploration, production, processing or treatment operations or transmission facilities" where the discharge is comprised entirely of flows that are not "contaminated" with or in contact with raw materials, overburden, products, byproducts, or waste products.[73] The 2005 Energy Policy Act further specified that this provision applies "whether or not" the oil and gas field activities could be considered "construction activities."[74]

4.1.C *Section 404 – Permit Program*

Section 404 of the CWA creates a permitting program that is separate and apart from the NPDES program to regulate the discharge of "dredge and fill" materials to jurisdictional waters. Administered by the U.S. Army Corps of Engineers under EPA guidance, the 404 program applies to dredge and fill activities, including activities associated with the construction of thermoelectric generating facilities if such facilities involve dredge and fill activities that impact jurisdictional waters. In general, Section 404 regulations require the avoidance of unnecessary fills, minimization of the remaining impacts, and compensatory mitigation for unavoidable impacts. Section 404 determinations apply to rivers, streams, lakes, and adjacent wetlands, as well as other bodies of water found to be jurisdictional. [75]

Although the CWA authorizes states to assume 404 permitting authority, only Michigan and New Jersey have done so. Therefore, the Corps is the sole 404 permitting authority in the West.

Similar to EPA's issuance of Section 402 general permits, the Corps has adopted "nationwide permits" that set forth standard conditions for frequently occurring activities that it has determined are "similar in nature, will cause only minimal adverse environmental effects when performed separately and will have only minimal cumulative adverse effects on the environment."[76]

4.1.D *Designated Uses and Water Quality Standards*

Water quality standards are important for energy activities under the CWA, and are established by states with federal guidance to protect water quality within their borders. These standards identify designated uses or uses to be made of certain waters, such as drinking water, recreation, or fisheries. They also create an "anti-degradation" policy to protect waters that currently meet or exceed levels needed to cover designated uses. With respect to energy, particularly wastewater discharged from power plants, water quality standards include thermal criteria that must be sufficient to ensure the "protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife." Such standards also consider heat and head loadings and consider normal water temperatures, flow rates, seasonal variations, existing sources of heat input, dissipative capacity of the identified waters, and a margin of safety.[77]

4.1.E Section 303(d) – *Impaired Waters*

Section 303(d) of the CWA requires states, territories, and authorized tribes to prepare lists of waters that do not meet water quality standards, and to periodically submit lists of "impaired waters" to EPA. These lists, commonly known as "303(d) lists," also characterize waters as being "fully supported" or "threatened" for beneficial uses.[78]

Impaired waters are too polluted or otherwise degraded to meet the water quality standards that states, territories, or authorized tribes have established. Under the CWA, these jurisdictions must establish priority rankings for waters on 303(d) lists and develop Total Daily Maximum Loads (TMDLs) for these waters. A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards.[79] If EPA disapproves the TMDL or the state fails to submit one, the CWA authorizes EPA to develop the TMDL.[80]

As applied to energy, waters that are categorized as "impaired" on a 303(d) list could be off limits for certain types of discharges from energy activities, including wastewater discharges from power plants. Moreover, if a state develops a new or revised TMDL for a water body where a power plant is located, the plant may face more restrictive limits when it seeks to renew its NPDES permit. In some cases, a plan may need to modify its wastewater treatment practices and technologies or employ new ones to achieve compliance.[81]

4.1.F *Section 401 – Water Quality Certification*

Section 401 of the CWA requires applicants for a federal license to secure state certification that potential discharges from their activities will not violate state water quality standards. Until states have certified the action, no federal license or permit may be issued, though there are some provisions for waivers.[82]

States may rely on this tool in their efforts to work with federal agencies and private partners to address a number of environmental needs, including Endangered Species Act (ESA) requirements, or develop TMDLs for pollutant discharges into state waters in order to bring them into compliance with federal water quality standards. States have used certification conditions to require minimum bypass flows restricting water diversions or storage. States coordinate their 401 review actions with the Corps of Engineers' 404 permit program activities.[83]

The states' mandatory 401 conditioning authority plays a particularly important role in the licensing of hydropower projects. Specifically, the Federal Energy Regulatory Commission (FERC) requires applicants for non-federal hydropower facilities licenses to first acquire Section 401 certification from the state. Any related terms and conditions are then included without change in the FERC license.[84]

It is also worth noting that the states' mandatory conditioning authority has been a point of contention with FERC and the hydropower industry, and the U.S. Supreme Court has twice addressed FERC hydropower licensing and state authorities.[85] In 1990, the Court issued its decision in *California v. FERC* (also known as the "Rock Creek Case"), unanimously affirming FERC's exclusive jurisdiction to determine minimum bypass flows for federally licensed hydropower projects to protect fish and wildlife, and invalidating California's claim of authority to impose additional requirements under Section 27 of the Federal Power Act (FPA) of 1920.[86] That section states:

> Nothing contained in this chapter shall be construed as affecting or intending to affect or in any way to interfere with the laws of the respective states relating to the control, appropriation, use or distribution of water used in irrigation or for municipal or other uses, or any vested right acquired therein.

Notably, 49 states provided amicus support for California's interpretation of Section 27 as protecting states' rights. However, the Court ruled against this interpretation and distinguished its reasoning from prior holdings regarding deference to state water law in other federal acts, including Section 8 of the Reclamation Act of 1902, by finding that the FPA envisions a broader and more active oversight role for FERC in hydropower development.[87]

However, in 1994, the Court issued its decision in *PUD No. 1 of Jefferson County v. Washington Department of Ecology*, affirming a Washington Supreme Court holding that the anti-degradation provisions of the state's water quality standards allowed the imposition of minimum stream flows, and that Section 401 authorized the stream flow condition and delegated to states power to consider all state action related to water quality in imposing conditions on 401 certificates. The U.S. Supreme Court agreed, finding: "Washington's minimum stream flow requirement is a permissible condition of a Section 401 certification."[88]

As it now stands, states must certify that federal actions, including FERC licensing, are consistent with their state water quality standards. States may also impose mandatory license conditions, which FERC must include its licenses.[89]

4.2 Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) aims to protect public drinking water supplies against contaminants that pose a risk to human health. Under the SDWA, contaminants include "any physical, chemical, biological, or radiological substance or matter in water."[90] The law also established regulatory authority over a number of activities, including some that pertain to the extraction of oil and gas, and uranium, as well as the extraction of oil shale and tar sands.

4.2.A *Public Drinking Water Systems*

The SDWA authorizes EPA to regulate contaminants in public water systems, which it does by determining those contaminants that raise public health concerns. EPA will set safe levels for these contaminants and establish the maximum contaminant levels that are allowed in public drinking water supplies.[91]

EPA is required to develop "national primary drinking water regulations" for contaminants: (1) that may have an adverse effect on human health; (2) are likely to occur in public water supplies; and (3) the regulation of which may reduce risks to public health.[92]

4.2.B *Groundwater Wellhead Protection Areas*

Under the SDWA, states must submit to EPA a program that protects public waters system wellhead areas from contamination that might adversely affect public health. These areas are defined as "the surface and subsurface areas surrounding a water well or well field supplying a public water system through which contaminations are reasonably likely to move toward and reach such water well or wellfield."[93] State wellhead protection area programs are subject to certain minimum standards, including identifying contaminant sources, establishing appropriate measures to protect the water supply, and determining the protection area for each wellhead. Every western state has a wellhead protection program.[94]

In 1996, Congress amended the SDWA to create a new "source water assessment program" that requires states to identify land areas that provide water to each public drinking water source. States must also inventory the existing and potential sources of contamination in those areas and determine how susceptible each public water source is to contamination. The SDWA's "sole source aquifer protection program" further authorizes EPA to designate aquifers that are the sole or primary source of drinking water for areas and which would create a significant health hazard if contaminated.[95] After publication of notice in the Federal Register, federal financial assistance through a grant, contract, loan guarantee, or other means cannot be provided for any project that may contaminate the aquifers through a recharge zone so as to create a significant hazard to public health. However, funding may be provided under other provisions of federal law to plan or design the project so that it will not contaminate the aquifer.[96]

4.2.C *Underground Injection Control Program*

The purpose of the SDWA's Underground Injection Control (UIC) program is to protect groundwater from contamination from injection wells. In particular, the UIC program establishes minimum standards for construction, operation, permitting, and closure of injection wells that place fluids underground for storage or disposal. Thirty-four states have primacy over the UIC program, while another seven share responsibility for the program with EPA, which directly administers the program in the remaining states.[97] In the West, EPA has shared UIC program responsibility with Alaska, California, Colorado, Montana, and South Dakota and directly administers the program in Arizona.[98]

States cannot issue permits unless the applicant shows that underground injection from an injection well will not endanger underground sources of drinking water. The UIC's permitting provisions also establish five categories of injection wells, with different regulations that apply for each class based on its potential to contaminate drinking water sources.[99]

The UIC program applies to a number of injection wells used for oil and gas activities. Specifically, in Class II wells, injected fluids may include "waste fluids produced from downhole in connection with primary production of oil and gas, some fluids generated in the field in connection with oil and gas production…or fluids used for enhanced recovery of oil and gas."[100] While fluids that are produced downhole can be injected in Class II wells, unused oil field chemicals cannot.[101]

However, there are a few important energy-related exceptions to UIC programs. First, the 2005 Energy Policy Act specified that the term "underground injection" in SDWA does not include the "injection of fluids or propping agents, other than diesel fuels, pursuant to hydraulic fracturing operations related to oil, gas, or geothermal production activities."[102] Known as the "Haliburton Exemption," this provision has received criticism from hydraulic fracturing opponents for effectively exempting the practice from regulation under the SDWA. Consequently, legislation has been introduced in recent sessions of Congress to do away with this exemption, but has been unsuccessful so far.[103]

Second, EPA is prohibited by law from prescribing state UIC minimum program requirements:

> …that interfere with or impede the underground injection of brine or other fluids which are brought to the surface in connection with oil or natural gas production or natural gas storage operations, or any underground injection for the secondary or tertiary recovery of oil or natural gas unless such requirements are essential [to prevent endangerment of a UDSW].[104]

In sum, like the CWA, the SDWA can affect energy activities, particularly with respect to the disposal of wastewater produced during energy extraction activities. In some cases, the additional effort needed to comply with SDWA requirements may increase costs. However, due to the number of exemptions related to oil and gas activities, the nature and extent of these impacts will depend on the nature of the energy extraction activity in question.

4.3 Endangered Species Act

The ESA protects and requires the recovery of plant and animal species that the U.S. Fish and Wildlife Service (FWS) has determined, or "listed," as "threatened" or "endangered." Such listings often require actions that can limit the amount of water available for energy development.

Section 9 of the ESA specifies that it is illegal for any person or entity to "take" a listed or endangered species.[105] Section 7 of the ESA further prohibits federal agencies from funding, authorizing, or carrying out any action that could jeopardize a listed species' existence or result in the "destruction or adverse modification" of its "critical habitat." This requirement directs the relevant agency to "consult" with the FWS (or the National Oceanic and Atmospheric

Administration for marine species) to ensure that the action in question will not jeopardize a listed species or habitat.[106]

Many listed species have water needs that include the quantity and temperature of the water needed to ensure their survival and the survival of their habitat. When water use – or the issuance of a permit for water use – would conflict with a listed species' needs, result in a take, or adversely modify its habitat, the ESA can limit water use, even at the expense of a valid state-issued water right. The ESA also may prescribe the exercise of such rights. [107]

In some cases, this requirement may impact water availability for energy and other uses. For example, if a listed species requires a certain amount of stream flow, the ESA can require certain minimum flows to protect the species, and limit the amount of water that can be withdrawn from the stream. Further, water infrastructure projects needed to deliver water can also be affected if their operations could harm a listed species. This is particularly evident in the ongoing disputes in California's Bay-Delta, where federal court orders have restricted the amount of water that can be pumped out of the Delta and delivered to other parts of California because the pumping may impinge the needs of the ESA-listed Delta smelt and other species.[108]

4.4 Federal Land Policy and Management Act

The Federal Land Policy and Management Act (FLPMA) is the principal law that governs the management of federal lands, particularly by the Bureau of Land Management (BLM) but also the U.S. Forest Service (USFS). Because the federal government owns large swaths of land in the West, many energy-related activities take place on federal land and therefore must comply with FLMPA requirements.

Under the FLPMA, federal land managers must prepare and maintain land-use plans pertaining to the protection, management, development, and enhancement of federal lands. These plans apply the principles of sustainable yield and multiple uses and consider both present and potential uses of federal lands.[109] As such, land use plans can allow for a range of uses, including energy extraction and the construction of power plants. Industrial-scale solar power plants are often sited on federal lands in the desert Southwest due to their requirements for large amounts of land and ample sunshine. However, these plans must allow for the use of public resources in a way that best meets the current needs of the American people and the long-term needs of future generations. When developing land use plans, agencies like BLM must consider the value of resources located on federal lands without necessarily promoting those uses with the greatest economic return. Importantly, the FLPMA also requires federal land managers to ensure the protection of the environmental resources it manages and to provide "habitat for fish and wildlife."[110]

In recent years, much of the installation of industrial solar plants has taken place on lands the BLM managers. In these instances, BLM authorizes rights-of-way for such projects under Title V of the FLPMA. In order to authorize a right-of-way, BLM must determine on a case-by-case basis whether the project is consistent with its land use planning priorities, and entities receiving a right-of-way must comply with the terms of the authorization and pay fair market value for the use of federal lands.[111] BLM also assesses a project's potential impacts on environmental values, including water, in accordance with applicable federal environmental laws such as the CWA and the SDWA.[112] The FLPMA requires BLM to honor state laws and coordinate with applicable state and local governments when authorizing rights-of-way on public lands. To this end, BLM rights-of-way must include terms and conditions that:

> [R]equire compliance with applicable air and water quality standards established by or pursuant to applicable Federal or State law… [and] State standards for public health and safety, environmental protection, and siting, construction, operation, and maintenance of or for rights-of-way for similar purposes if those standards are more stringent than applicable Federal standards.[113]

4.5 Forest Service Organic Administration Act of 1897

The Organic Act governs the USFS's administration of the National Forest System (NFS). It authorizes the President to establish national forest on public domain lands for the purpose of improving and protecting the forest or to secure "favorable conditions of waterflows" and to furnish a continuous supply of timber.[114] The Act also authorizes the U.S. Department of Agriculture to make regulations and establish the services needed to regulate the occupancy of NFS lands and preserve them from destruction.[115]

USFS occupancy and use regulations for NFS lands under the Organic Act allow for NFS lands to be used for a number of energy-related activities, such as powerlines and hydropower projects.[116] However, to use NFS land, one must obtain a special use permit from the USFS authorizing the use for a specific period of time.[117] The USFS may also require certain conditions or actions, usually to mitigate adverse impacts to the public resources it manages.

The USFS reviews an application for a special use permit to determine how the activity will affect the public's use of NFS land, and permits are generally not authorized if the applicant's overall needs can be met on nonfederal land. Requests for a special use permit must also be comply with state and federal law. Thus, to obtain a permit to construct and operate a hydropower facility on NFS land, the project's sponsor would need to obtain the necessary state-issued water rights and comply with FERC licensing requirements, among other things.[118]

4.6 National Environmental Policy Act[119]

The National Environmental Policy Act (NEPA) requires federal agencies that are contemplating a "major Federal action significantly affecting the quality of the human environment" to study the possible environmental impacts of its actions. This includes federal leases, permits, funding, and other approvals, as well as actions taken by the federal government. A number of energy actions can trigger NEPA compliance, including BLM approval of a right-of-way application to site a power plant on federal lands, oil and gas or alternative energy leases under the Mineral Leasing Act, and the issuance of a CWA Section 404 permit, among other actions. NEPA requires federal agencies to prepare what is known as an "environmental assessment"(EA) for proposed actions. If the EA finds that no environmental impacts will occur, including impacts to water, it will make a finding of no significant impact (FONSI). However, if significant environmental impacts are likely, federal agencies must prepare a detailed environmental impact statement (EIS) that considers the environmental impacts of the proposed action, as well as social and economic impacts and all reasonable alternatives, including a "no action" alternative.[120] According to some reports, the cost of completing environmental impact studies can reach up to $6 million.[121]

Federal agencies may also use NEPA to develop lease stipulations and to provide information to carry out requirements set forth in federal regulations regarding leasing fuel minerals on federal lands, such as oil, gas, coal, and phosphate under the Mineral Leasing Act, or to approve plans of operations under the General Mining Law, for such things like uranium. These may affect water use, water withdrawals, and water quality.[122]

5. CASE STUDIES

This section will describe two case studies that will provide specific examples of how legal and institutional considerations can affect water availability for power plants and energy extraction. The first case study will discuss efforts to secure cooling water for a concentrated solar project in Arizona, while the second will discuss how Texas regulates water used for oil and gas activities – particularly hydraulic fracturing – within its borders.

5.1 The Hualapai Valley Solar Project in Arizona[123]

The now-scuttled Hualapai Valley Solar Project in Mohave County, Arizona illustrates some of the ways in which public opinion and concerns over water use can impact a proposed power plant's design and ultimate approval. It also shows how state utility commissions can affect the availability of water for power plant cooling purposes.[124]

The Hualapai project was designed as a concentrated solar project (CSP). CSP plants concentrate the sun's energy to create heat, which they then use to generate electricity. Every type of CSP plant requires some amount of water and wet-cooled CSP plants typically require more water than most other forms of energy production. A number of CSP plants have been proposed in Arizona and other parts of the Southwest due to the region's ample sunlight. However, the direct sunlight that makes the Southwest so appealing also means that many of the most profitable locations for CSP sites are some of the most water-scarce areas of the country.[125]

When originally proposed, the Hualapai project would have been located over 27 miles north of Kingman, Arizona and 100 miles south of Las Vegas on approximately 4,000 acres of raw, undeveloped private land. It was initially proposed to be a wet-cooled plant that would have required 3,000 acre-feet of water per year for all uses, of which 2,400 acre-feet of groundwater would have been pumped from the Hualapai Valley Aquifer for cooling purposes. Notably, the proposed site is not located within one of Arizona's Active Management Areas (AMAs), which as discussed in greater detail below, means that it did not require the acquisition of a groundwater right from the state. Although the proposed project site had not been irrigated, the land had previously been designated for agricultural purposes and irrigating the land for agricultural purpose could have consumed over 20,000 acre-feet of groundwater per year, according to some estimates, or much more than the plant's proposed use.[126]

The project's developer Hualapai Valley Solar LLC (HVS) wanted the plant to rely on wet cooling instead of other less water intensive cooling technologies due to concerns the desert's high ambient temperatures would hinder the efficiency of a dry-cooling system. In proposing the project, Hualapai Valley Solar argued that temperatures over 100°F could result in output reductions of over 20% and that dry cooling would result in an additional cost between 7% and 9%.[127]

To minimize the project's groundwater usage, HVS sought an agreement to purchase treated wastewater from Kingman and then pipe it to the project site to reduce the plant's water usage. At the time of HVS's proposal, the city's treatment plant was capable of producing 1,600 acre-feet of water per year. Initial negotiations between HVS and the city centered on a possible 10-year contract to provide 900,000 gallons of A+ effluent per day at $0.64 per thousand gallons (1,008 acre-feet per year), with the possibility of renewal every 5 years after 2020.[128] The city also estimated that its treatment plant would produce around 2,300 acre-feet per year by 2016,[129] and hoped to be able to eventually supply all of the plant's water as the city's population grows and its sewer system expands to connect residents currently relying on septic systems.[130]

5.1.A *Arizona Groundwater Law*

Arizona's Groundwater Code governs the water issues associated with the Hualapai project. Under the Code, the extent to which groundwater is regulated depends on the area of the state in which the groundwater is withdrawn. The most extensive regulation occurs in the five areas of the state designated as Active Management Areas (AMAs). In those areas, with certain exceptions, a person generally may withdraw groundwater only if he or she holds a grandfathered groundwater right or obtains a new groundwater withdrawal permit from ADWR. Groundwater withdrawals outside of an AMA and Irrigation Non-expansion Area (INA) do not require a permit from ADWR, but the water use must be reasonable and beneficial. AMA's may also impose increasingly strict conservation requirements need to achieve "safe yield."[131]

In addition to obtaining the necessary water rights, a CSP project may also need to obtain a Certificate of Environmental Compatibility (COEC) from Arizona's public utilities commission, the Arizona Corporation Commission (ACC). The ACC is responsible for approving thermal utility scale (<100 MW) power projects.[132] For plants located within the service area of a city or town in an AMA, the Committee must consider "the availability of groundwater and the impact of the proposed use of groundwater on the management plan... for the active management area."[133] Although the ACC is not required to evaluate water use for plants located outside of an AMA, it generally considers water rights, water availability for the life of the power plant, and the environmental effects of groundwater pumping around the plant. The Committee may also ask about planned water sources and whether alternative cooling technologies or water sources are available for plants located within and outside of AMAs and INAs. Based on this information, as well as the plant's feasibility and potential economic and environmental impacts, the ACC will issue a recommended COEC.[134]

5.1.B *Public Response: Opposition and Support*

In November 2009, HVS filed an application for a COEC with the ACC. The application generated a significant amount of opposition, much of which focused on water. Those concerned about the project generally supported solar energy development but opposed the project's use of wet-cooling technology due to potential impacts on local water resources. In particular, opponents argued that the Hualapai Valley Aquifer was already in a state of depletion and that the project would have de-watered local wells. Opponents also cited estimates that depletions at the time totaled 10,000 acre-feet per year while recharge was between 2,000 and 2,400 acre-feet.[135]

Although opponents generally supported the project's proposed use of effluent use for cooling, they expressed concern over whether HVS would be able to finalize an agreement with Kingman for effluent and would ultimately need to rely on groundwater to satisfy all of its cooling needs. Many opponents argued that the plant should be dry cooled, noting that similar CSP plants proposed for other parts of the Southwest would rely on dry cooling and would therefore have the same competitive posture.[136]

Conversely, HVS cited groundwater models and studies that indicated that there was sufficient available groundwater for the project without impacting other groundwater users. HVS further argued that wet cooling was appropriate because both groundwater and effluent were available, unlike other CSP plants in the Southwest, and that dry or hybrid cooling would represent an unnecessary and significant cost increase that would put the project at a disadvantage with other approved wet-cooled power plants in the region.[137] Project supporters, including the Mayor of Kingman, other city officials, the Kingman Downtown Merchants Association, and the Kingman/Golden Valley Association of Realtors, argued that the project would provide significant contributions to the local economy.[138]

5.1.C *ACC Provisional Approval*

In April 2010, the ACC granted a provisional COEC that approved the project as being in the public interest and found that its "contribution to meeting the need for an adequate, economical and reliable supply of renewable electric power" outweighed its environmental impacts. With respect to water, the certificate limited the total water use for the project to 3,000 acre-feet per year from all sources and to 2,400 acre-feet of groundwater per year for cooling purposes. Condition No. 4 of certificate also required HVS to "make all reasonable efforts" to minimize the use of groundwater during the construction and operation of the project, and to use effluent for cooling and all other non-potable water uses "to the extent it is made available by the City of Kingman … and can be transported at [HVS'] expense to the Project site." Moreover, Condition No. 4 gave HVS two years to enter into a contract with Kingman to supply effluent to the project and authorized the plant to use groundwater when effluent was not available from Kingman or when transmission from the treatment plant to the project site is interrupted. [139]

5.1.D *Public Reaction to ACC Provisional Approval*

Opponents objected to the provisional certificate, arguing that Condition No. 4 did not provide a fail-safe means of ensuring that the project would use effluent because it only required HVS to make a "reasonable effort" to minimize groundwater use and only mandated the use of effluent to the extent that it is available from Kingman's treatment plant. Some members of the community also expressed concerns about the possibility that Kingman's projected population growth may not take place, which would mean that the city's treatment plant would not be able to provide all of the cooling water needed for the plant. Thus, to the extent that effluent was not available, opponents argued that the ACC should require HVS to use dry cooling technology.[140]

Conversely, HVS argued that Condition No. 4 was sufficient, noting that the condition needed to be flexible in order to ensure that HVS was "not at the mercy of contingencies beyond its control." Namely, HVS argued that it would have no way of influencing how much effluent Kingman's treatment plant would produce or when it would operate because it did not own the facility. HVS also responded to arguments that the ACC should require HVS to use only effluent for its wet-cooling needs, expressing concern that such a requirement could result in situations where the plant could shut down if it did not receive enough effluent for its cooling needs.[141] HVS further noted in an August 2010 pleading that its negotiations for a power purchase agreement and construction contract were based on the project using wet cooling and that requiring the project to use dry or hybrid cooling "would cause serious problems with obtaining financing, primarily because there are no utility-scale solar thermal dry- or hybrid-cooled plants operating in the world today."[142]

5.1.E *ACC Amendment of Project Water Mitigation Requirements*

In November 2010, the ACC agreed with the opponents' concerns and amended Condition No. 4 to read:

> Applicant shall utilize all available effluent supplies from the City of Kingman …and to the degree that Applicant is unable to procure enough effluent for the operation of the entire HVS project, Applicant should utilize dry or hybrid cooling technology in the construction of its facilities as a condition of receiving this [COEC]. The Applicant cannot operate the plant using groundwater for cooling. If the Applicant determines that not enough effluent will be available for the operation of the plant without using groundwater, it may proceed with construction of the plant using dry or hybrid cooling technology.[143]

In reaching this decision, the ACC determined that the previous language for Condition No. 4 "leaves too much to chance" because the project would rely on groundwater "in an area that is known for its aridity and water scarcity." The ACC further reasoned:

> However, even more compelling…is the recent trend by other states and federal agencies toward encouraging and even requiring dry or hybrid cooling technology for thermal plants…. [D]ry cooling is a technology that is currently available to energy developers, and will be used by CSP developers in both Nevada and California, where desert conditions led the project developers and regulators to choose the more environmentally sensitive cooling technology.[144]

With respect to HVS' concerns regarding the cost of dry cooling, the ACC found that the developer had provided no evidence why it would be unable to rely on this technology when "most similarly situated CSP plants that either have or are undergoing siting review have chosen to move forward with this technology." The ACC also found that the 3%–8% increase in the price premiums associated with dry cooling was "a reasonable tradeoff for Mohave County's groundwater supplies."[145]

Of further note, the decision marked the first time the ACC has required dry cooling for a power plant. Then ACC Chairman Kris Mayes, who sponsored the amendment, also expressed concerns that the project would use Arizona groundwater to export energy to Nevada at a time when CSP plants in Nevada are being required to use dry-cooling technology. "Why should Arizona rate-payers, taxpayers, and residents have to sell their water to Nevada," she was quoted as saying in an October 2010 news article describing a hearing on the amendment.[146]

5.1.F *Current Status*

Following the ACC's amendment, HVS' plans to build the project appear to have stalled indefinitely.[147] HVS has not yet contracted with Kingman to supply treated wastewater and questions remain over how HVS would transport water to the site, including the exact cost and length of a pipeline as well as the acquisition of the necessary rights-of-way.[148] Furthermore, funding for the project has collapsed.[149] It is uncertain exactly what role the ACC's dry-cooling amendment played in the financing challenges associated with the project.

Notably, while the ACC required dry cooling for Hualapai, it did approve the 280-MW Solana Project in Gila Bend, Arizona, which is wet-cooled and was designed to use about 1,600 acre-feet of water per year. However, unlike the Hualapai project, the Solana project received relatively little public opposition, due in part to the fact that it is being built on previously irrigated farmland rather than raw, un-irrigated land. It is also estimated to consume 75%–85% less water than the previous agricultural uses.[150]

5.1.G *Observations*

The Hualapai project shows that public concerns regarding water use can play a significant role in the siting of a power project, particularly if the project is wet cooled and located close to a population or agricultural center on raw, previously un-irrigated land. The project also illustrates the growing trend toward the use of technologies that minimize freshwater use, including dry cooling and the use of effluent (when feasible), and shows that concerns about the impacts of CSP development on water resources can trump economic benefits in some cases.

Of further note, the project demonstrates the important role that utility commissions can play in addressing and mitigating the potential impacts of CSP plants on water resources. This is especially true for cases in Arizona where the proposed plant is sited outside of an AMA and therefore does not require a water right permit. While most state water right approval processes typically focus on the availability of water and injury to other water right holders, the ACC's decision to require dry cooling and the use of effluent for the Hualapai project shows that some utility commissions can have authority to impose additional restrictions on a project's water use that might not be available through traditional water right permitting processes.

5.2 Water Use for Oil and Gas Activities in Texas

Texas has long been one of the nation's leading producers of oil and gas. As such, it has decades of experience regulating and addressing the various issues associated with oil and gas development, including issues involving water quantity and quality. This case study will discuss some of the notable legal and institutional issues that can arise within the context of securing the water needed for oil and gas activities in Texas, with a particular focus on the water issues associated with hydraulic fracturing.

5.2.A *Overview of Oil and Gas in Texas*

The first Texas oil boom began in earnest around the turn of the 20th Century, followed by other discoveries between 1910 and the mid-1920s. Production later peaked in 1951 and again in 1972, with many believing that all major on-shore oil fields had been discovered. However, new techniques were later developed that have facilitated the extraction of oil and gas from shale play formations that had long been considered inaccessible, leading to a second energy "boom" in the state in recent years, making Texas an epicenter for shale gas development.[151]

Much of the reason for this boom is due to a well stimulation technique known as hydraulic fracturing, or "fracking," in which hydraulically pressurized liquid comprised of water, sand, and chemicals is injected underground to fracture formations, thereby allowing for the release of trapped hydrocarbons. The process was developed in the 1940s and has been used in Texas for over 60 years. Furthermore, recent advancements, including the combination of fracking with horizontal drilling (first used in Texas) and higher pressures have greatly facilitated the extraction of oil and gas previously considered to be unrecoverable.[152]

In light of these factors, oil and gas development has grown exponentially in Texas in recent years. For instance, the Eagle Ford Shale in the southern part of Texas has seen rapid increases in drilling activities, including a 77% increase in 2012, with much of this activity relying on fracking. Other shale plays also cover much of the state, including the Barnett Shale in the north, the Haynesville Shale in the east, the Cline and Wolfcamp shales in the west.[153]

The economic benefits associated with these activities are substantial. According to some studies, energy production in the Barnett Shale has resulted in a $65 billion economic impact since 2001 and supports 100,000 jobs.[154] Other studies have found that similar activities in the Eagle Ford Shale contributed $25 billion in revenue in 2011 and supported 47,000 full-time jobs, a number expected to increase to 117,000 by 2021.[155]

5.2.B *Water Use for Oil and Gas Activities in Texas*

Oil and gas exploration and production requires water during the process of drilling wells and extracting oil and gas. Hydraulic fracturing also requires certain amounts of water, the majority of which is consumed during the early stages of the process for drilling purposes and fracking fluids.[156] The amount of water needed for a given well varies and depends on the geologic formation where the fracking is taking place as determined by the type of well, the rock properties involved, pressure, temperature, depth, and fluid ability, among other factors.[157]

For example, a report prepared by the Texas Water Development Board (TWDB) regarding water use development for oil and gas activities in 2008 found that water use associated with such activities varied from 1 to 10 million gallons per well in the Haynesville Shale. The report also found similar ranges in the other shale plays, including the Barnett Shale, where water consumption can reach 3 to 4 million per horizontal well and 1.3 million per vertical well.[158]

A more recent 2012 report prepared for the Texas Oil & Gas Association found that water use for oil and gas activities in Texas has increased due to the boom in fracking. The report found that statewide oil and gas industry water usage totaled approximately 102,500 acre-feet of water in 2011, of which 81,500 acre-feet were used for hydraulic fracturing and 21,000 acre-feet were used for other oil and gas industry purposes. The report also found that the amount of water used for hydraulic fracturing had increased from 2008, when approximately 36,000 acre-feet of water had been used for the process. At the same time, Texas also saw an increase in the use of recycled and brackish water for fracking operations – approximately 17,000 acre-feet in 2011 – which has conserved a large amount of freshwater resources.[159]

According to TWDB data presented in the 2012 Texas Water Plan, "mining water use," which includes water used in the exploration, development, and extraction of oil, gas, coal, and other materials, represented 1.0% of the state's total water use in 2009 and is projected to increase slightly over time to 1.3% by 2060, although percentages may be larger in some localized areas.[160] In contrast, the plan states that irrigation and municipal water use collectively represented about 83% of water used in the state in 2009.[161] Water demands as a fraction of total use for municipal use, manufacturing, and steam-electric power generation are projected to increase by 2060, from 40.6% to 58.8%. Irrigation is expected to decline from 55.9% to 38.1%.[162] Thus, the total amount of water used for oil and gas activities, including water used for fracking, is a statistically small portion of the state's overall water use.

Water needed for hydraulic fracturing can come from a variety of sources, including surface water, groundwater, municipal water supplies, brackish water, wastewater, and recycled water.[163] The type of water needed depends upon the geological requirements of the formation in question, as well as the hydrocarbon yield that a particular type of water will produce.[164] Oil companies will also consider cost and legal and regulatory factors in determining the type of water to use in their fracking operations.

Groundwater is generally the most common type of water used for fracking in Texas. For instance, a 2012 study prepared for the Texas Oil and Gas Association found that groundwater comprises about 100% of the water used for oil and gas activities in the Permian Basin and 90% in the Eagle Ford Shale.[165] The study also found that groundwater constitutes most of the water used in other basins and shales, with some exceptions.[166]

Further, most hydraulic fracturing operations in Texas rely on freshwater, although the amount of freshwater used in a particular play depends upon local conditions and can vary, being as low as 20% in Far-West Texas or nearly 100% in East Texas.[167] As discussed in greater detail in Section 5.2.F below, this is due primarily to the fact that freshwater is often cheaper in many areas when compared with other types of water, such as brackish groundwater and recycled water.[168]

It is also important to note that hydraulic fracturing can also produce water. In particular, some of the water used during the process can "flow back" along with additional underground water that is released as a result of the production of oil and gas. Much of this water is oilfield brine with varying levels of salinity that is found in the same geologic formations that produce oil and gas. Nevertheless, small quantities of substances used in the drilling, completion, and production operations of a well may also be found in this wastewater.[169]

5.2.C *Railroad Commission of Texas Jurisdiction*

In general, Title 3 of the Texas Natural Resources Code and Chapters 26 and 27 of the Texas Water Code give the Texas Railroad Commission (RRC) jurisdiction over activities associated with the exploration, development, or production of oil, gas, and geothermal resources. As such, the RRC permits oil and gas exploration wells and develops many of the rules regarding well drilling, well spacing and design, operational safety, and groundwater protection in fulfillment of its dual mission to ensure responsible production of Texas' energy resources while also protecting the environment and ensuring public safety.[170]

The RCC's only direct authority over water use lies in the permitting of wells associated with oil and gas activities that draw brackish water for enhanced recovery from formations below the base of usable water quality. As discussed in greater detail below, non-RRC regulations apply for fresh water wells drilled above the base of usable quality water.[171]

Notwithstanding its relatively limited authority over water use, RRC oversees a number of activities that can affect water. Specifically, it monitors the entire process associated with the construction and completion of an oil and gas well, requiring layers of steel casing and cement, as well as tests before producers "frack" a well to ensure that the well and related equipment are functioning properly.[172] Among other requirements, the RRC requires producers to supply data on production results, the amounts of fracking fluid and sand used, and the installation of wellbore casings.[173]

In recent years, the RRC has developed a number of important regulations. In 2011, Texas became the first state to require the public disclosure of the volume of water and the chemicals used in the fracking of oil and gas wells well when former Governor Rick Perry signed H.B. 3328, the Texas Hydraulic Fracturing Fluid Disclosure Bill, into law.[174] H.B. 3328 directed the RRC to develop regulations that allow producers to protect chemical ingredients or compounds that are proprietary by using a process that assigns oversight of proprietary information to the Texas Attorney General, a feature that has been a part of Texas law for decades. The law also instructed the RRC to create a process for appealing a company's decision not to disclose information that it considers to be proprietary.[175] In February 2012, the RRC finalized these rules in the Texas Administrative Code as Statewide Rule 29 (Title 16, Part 1, § 3.29).

Further, in 2013, the RRC enacted changes to its "well integrity" rule (Rule 13) to clarify and update existing requirements regarding cementing, well casing, steel piping, and other specifications regarding fracking.[176] These updates are intended to further ensure that fracking activities do not lead to water contamination, given that faulty well construction is the primary cause of contamination associated with oil and gas activities.[177] While water contamination does occur in some instances, such cases appear to be rare, as indicated by a 2011 study from the Groundwater Protection Council that found that faulty well construction was responsible for only ten groundwater contamination violations in Texas between 1993 and 2008.[178] Moreover, the RRC's records do not include a single documented case of groundwater contamination that is associated with hydraulic fracturing itself despite tens of thousands of instances in which hydraulic fracturing has been used in Texas.[179]

With respect to the disposal of water produced during hydraulic fracturing, RRC rules require the disposal of such water and flow back fluid in a manner that will not cause or allow for the pollution of surface or subsurface waters. While this water can be reused or recycled for other hydraulic fracturing treatments, most of it is disposed via injection into underground formations thousands of feet below the surface through injection wells. The RRC permits these wells through its EPA-delegated UIC program under the federal SDWA.[180]

5.2.D *Surface Water Regulation in Texas*

In Texas, the state owns the water that flows in streams, rivers and bays. Any party that seeks to divert such water must obtain a water right from the Texas Commission on Environmental Quality (TCEQ). This requirement applies to parties seeking to withdraw surface waters for mining, construction, and oil or gas activities.[181] Under the Texas Water Code, such parties can apply for a temporary water right permit for the short-term use of up to 10 acre-feet or less for less than a year at a TCEQ Regional Office. Those seeking to use more than 10 acre-feet of water or who want to use the water for more than one year must apply through TCEQ's Water Rights Permitting Team in Austin.[182] Recycled wastewater represents another source of water the can be used in oil and gas activities, and TCEQ has issued several authorizations to allow for the use of this type of water for these purposes.[183]

5.2.E *Groundwater Regulation in Texas*

Groundwater rights in Texas are subject to regulation and control by the courts and the Texas Legislature.[184] Texas also does not have a statewide regulatory program for groundwater.[185] Importantly, the term "groundwater" means "water percolating below the surface of the earth,"[186] and groundwater is presumed to be "percolating" unless proven otherwise.[187] Moreover, groundwater in Texas does not include the underflow of a stream, river, or confined channel. These types of subterranean streams are owned by the state and subject to TCEQ's surface water permitting.[188] In contrast, percolating groundwater belongs to the owner of the surface estate and is treated in a similar manner as oil and gas, with some exceptions.[189]

Texas law uses the rule of capture to allocate percolating groundwater, which means that landowners can generally pump as much water as they choose from beneath their land without incurring liability to nearby landowners absent willful and wanton waste or negligence.[190] In addition, the Texas Supreme Court recently recognized that a landowner's stake in groundwater is "ownership in place," and that landowners have a vested property right in the groundwater beneath their land that is worthy of constitutional protection in takings actions.[191]

Nevertheless, while Texas may not regulate groundwater at the state level, Chapter 36 of the Texas Water Code provides for the creation of local groundwater conservation districts (GCDs) that have authority to control groundwater withdrawals and uses within their jurisdictions.[192] These GCDs are the state's preferred method of groundwater management and are charged with providing for the conservation, preservation, protection, recharge, and prevention of waste of the groundwater located within their boundaries.[193]

GCDs have three primary legislatively-mandated duties: permitting water wells, developing a comprehensive management plan, and adopting the necessary rules to implement the management plan. Of these, a GCD's permitting authority represents its principal power and permitted wells are subject to GCD rules regarding spacing, production, drilling, equipping, and completion or alteration. Notably, Chapter 36 of the Texas Water Code provides that GCDs may not require permits for the drilling of a water well used solely to supply water for a rig that is actively engaged in drilling or exploration operations for an oil or gas well that the RRC has permitted, provided that the holder of the permit is responsible for drilling and operating the well and the well is located on the same lease or field associated with the drilling rig.[194] Moreover, Chapter 36 provides that GCDs may not deny an application for a permit to drill and produce water for the production of hydrocarbon activities if the application satisfies the rules the district has promulgated.[195]

Notwithstanding these provisions, GCDs have a number of authorities under the Texas Water Code that they can use to regulate oil and gas wells. Specifically, GCDs can:

- Require such wells to be permitted and comply with all GCD rules if the purpose of the well is no longer to solely supply water for a rig that is actively engaged in drilling or exploration operations for an oil or gas well permitted by the RRC.[196]

- Require that water wells used for oil and gas activities be registered in accordance with GCD rules and be equipped and maintained in conformance with GCD rules requiring the installation of casing, pipe, and fittings.[197]

- Require well drillers to file a log for exempted wells.[198]

- Require owners and operators of exempted wells to report groundwater withdrawals.[199]

Some GCDs have also required permits and imposed limits on the amount of water that can be used for hydraulic fracturing, reasoning that the process is separate from the drilling and exploration activities exempted under Section 36 of the Texas Water Code. For instance, the Evergreen Underground Water Conservation District has applied existing restrictions limiting pumping to two acre-feet per year to fracking in 2008.[200]

Because GCDs are local entities and have discretion to enact differing types of regulations, the nature and type of regulations they adopt will vary. Moreover, GCDs only have authority over activities that fall within their boundaries, which means that water withdrawals located outside of a GCD, including withdrawals for oil and gas activities, are not subject to GCD regulation.[201]

It is also important to note that Texas municipalities have enacted regulations on gas drilling. These regulations vary and range from banning the use of city water for fracking (as required by the city of Grand Prairie) to placing caps on water usage. [202] Notably, voters in the City of Denton approved a controversial referendum in November 2014 to ban hydraulic fracturing within city limits.[203] The ban will face legal challenges and has raised questions about the extent of authority that Texas cities and municipalities have in regulating hydraulic fracturing, with some experts opining that the ban is unconstitutional and that cities lack the authority to completely ban fracking.[204] The ban may also prompt state legislation to clarify the extent of city authority over hydraulic fracturing, including potential bills that may seek prohibit cities from enacting bans.[205]

5.2.F *Notable Developments and Issues*

The water use associated with hydraulic fracturing in Texas has generated a number of policy and legal questions. This section will highlight four issues that illustrate some of the major issues associated with fracking-related water use in Texas.

5.2.F.i Drought

The severe drought that has plagued Texas over the last few years has generated questions about how water used for hydraulic fracturing and other oil and gas operations will impact water supplies.[206] While the amount of water used for oil and gas activities is less than 2% at a statewide level, this percentage can be much larger at the local level, rising into the double digits in some areas, some of which have experienced significant reductions in their water supplies due to drought.[207] This has led to concerns among some water users, including farmers and ranchers, about the potential impact of fracking on limited water supplies. While many farmers and ranchers sell water to oil and gas operators at a profit, concerns about the potential impact on non-oil and gas activities remain.[208]

These concerns have prompted GCDs and municipalities to enact various regulations to protect water resources, as noted above. Additionally, legislation has been introduced in recent years to address perceived ambiguities regarding the ability of GCDs to regulate the water use associated with hydraulic fracturing, including differing proposals that would require GCDs to issue permits for water withdrawals related to fracking operations or exempt fracking-related water wells from permitting but require well operators to comply with other GCD requirements.[209]

5.2.F.ii Water Quality

Fracking has generated some discussion in Texas about potential impacts to water quality and drinking water supplies. These concerns are due, in part, to a December 2010 endangerment order that EPA issued against Range Resources, contending that two of its Barnett Shale wells caused or contributed to the contamination of two residential wells. However, a subsequent RRC investigation found that Range Resources' hydraulic fracturing activities did not contribute to the contamination of any domestic wells and EPA later withdrew its order and a related lawsuit.[210] Among other things, the RRC found that gas production from water wells in the area was not uncommon and had occurred in years prior to gas development in the Barnett shale, and that many water wells had penetrated a shallow gas-bearing formation, which was the most likely source of the gas found in the domestic wells.[211]

In addition, a recent study by researchers from five universities found that the shale gas boom has contaminated drinking water wells in the Barnett Shale.[212] However, the study finds that the contamination is not due to drilling or hydraulic fracturing, but to defective casing and cementing in gas wells.[213] As one of the study's authors noted:

> This is relatively good news because it means that most of the issues we have identified can potentially be avoided by future improvements in well integrity.[214]

Notably, the RRC has found that hydraulic fracturing has been "an environmentally safe process" for over 60 years in Texas.[215] Further, as noted in Section 5.2.C. above, the RRC's records do not indicate a single documented water contamination case associated with the process of hydraulic fracturing itself.[216] According to the RRC, part of the reason why there have not been any documented cases of water contamination is due to the agency's regulatory framework.[217] Another reason is due to the state's geology in which fracking operations typically occur a mile or below aquifers, with thousands of feet of rock separating fresh water and the hydrocarbon-bearing zones that are hydraulically fractured.[218]

5.2.F.iii Disposing and Recycling Produced Water

The proliferation of hydraulic fracturing in Texas has raised questions about how best to dispose of flow back and produced wastewater. In some cases, this water is re-injected through injection wells into the same reservoir from which the fluid originated for secondary or enhanced oil recovery. Operators may also transport wastewater away from where it is produced to be injected via disposal wells into underground formations that are not productive or oil and gas. According to the RRC there are over 50,000 permitted oil and gas injection and disposal wells in Texas.[219]

While there appear to be relatively few instances of water contamination due to disposal and injection wells, hydraulic fracturing has resulted in an increase in the use of disposal wells, which in turn has raised questions about the possible impacts associated with wastewater disposal. Specifically, the use of disposal wells has generated some concern about increased truck traffic, accidents, and the possibility for spills and groundwater contamination, including the potential for injected fracking fluids to infiltrate abandoned oil wells.[220] In addition, the injection of wastewater has prompted questions about a possible connection between wastewater injection and earthquakes.[221]

To address these concerns, particularly those relating to earthquakes, the RRC amended its regulations for disposal and injection wells in October 2014.[222] Specifically, the amendments:

- Require disposal well permit applications to include seismic activity data;
- Authorize the RRC to modify, suspend or terminate a disposal well permit if scientific data shows that a well is likely to or is determined to contribute to seismic activity;
- Provide for more frequent monitoring and reporting; and
- Authorize the RRC to require disposal well permit applications to provide additional information to show that disposal fluids will remain confined in those instances where the well is located in an area where conditions may increase the risk that the fluids many not be confined.[223]

In adopting the amendments, the RRC noted that few earthquakes have been documented relative to the large number of disposal wells in operation, but that "seismic events have infrequently occurred in areas where this is coincident to oil and gas activity."[224] To this end, the amendments are intended to allow for the further examination of how human activity may affect seismic activity in Texas, while allowing for responsible energy development to continue.[225]

Additionally, the RRC has taken regulatory action, where appropriate, to protect Texas' water resources from possible impairments associated with disposal activities. Among other things, the RRC may deny or delay injection and disposal well permits in light of concerns about a well's location near water sources and may revoke permits in those relatively few instances where well operators act in bad faith and fail to comply with Texas law.[226]

5.2.F.iv Technological Advancements

The growth in the use of hydraulic fracturing in Texas has coincided with an increasing number of technological efforts aimed at reducing or recycling the amount of water needed for the process. Such efforts are focused on reducing the costs associated with recycling and reusing wastewater, finding ways to carry out "waterless" fracking with other substances such as propane, and better utilizing brackish groundwater. However, these technologies are relatively more costly and less efficient than freshwater, which has limited their utilization.[227]

For instance, while large amounts of brackish groundwater are found throughout Texas, using such water is generally more costly because it contains salts and other elements like boron, which can harm the fracking process and be costly to remove.[228] In addition, brackish groundwater is typically located beneath fresh water aquifers, meaning that it is deeper and typically more expensive to tap.[229]

Recycling water used in hydraulic fracturing for further use in oil and gas operations can also be more expensive because such water often contains sand, chemicals, and minerals that must be removed before it can be reused for fracking operations.[230] Another reason why using freshwater is often less expensive pertains to the relatively large number of permitted oil and gas injection and disposal wells found throughout Texas, which make it relatively less expensive for operators to dispose of wastewater compared to the cost of recycling such water.[231]

Nevertheless, TWDB reports that there is "rapid development of technological advances" within the oil and gas industry that will make recycling more common and improve the ability to use more brackish groundwater.[232] As a result, the TWDB reports that the use of brackish groundwater and recycled water will increase over time due to these technological advances and improved efficiencies, ultimately reducing the among of freshwater needed for oil and gas operations.[233]

From a policy perspective, a number of bills have been introduced over the years in the Texas Legislature to encourage, incentivize or otherwise facilitate oil field recycling.[234] The RRC also amended its commercial and non-commercial recycling rules in 2013 to, among other things, eliminate the need for a permit if operators recycled fluid on their own leases or transfer their fluids to another operators lease for recycling.[235]

Some questions have also arisen in Texas regarding how to use produced and brackish groundwater for non-oil and gas activities, including potentially desalinating brackish groundwater for "man camps" that are often attendant to oil and gas activities, as well as using existing oil and gas water wells for industrial purposes. Such questions, especially those regarding potable municipal use, raise a number of policy, legal, and logistics issues, including the application of a different set of state and federal statutes and regulations. For instance, while the RRC has jurisdiction over oil and gas wells, re-purposing such wells for municipal use would place them under TCEQ's authority and subject them to the federal SDWA. Moreover, wells constructed for oil and gas purposes are built in compliance with a different set of standards than the ones TCEQ and the SDWA require.[236]

5.2.G *Observations*

Texas' experiences with hydraulic fracturing demonstrate many of the challenges and questions that are associated with the process across the West, particularly with respect to concerns about possible impacts to scarce water resources, water quality impairments, and the disposal of flow-back and produced wastewater. However, Texas' long history of regulating oil and gas activities to protect water quality and other environmental values, as well as its ability to adapt to new developments through effective regulations, show that states have the authority and the ability to protect water resources while also allowing for responsible oil and gas development.

6. FINAL OBSERVATIONS AND CONCLUSIONS

The growing demands associated with the West's scarce water resources will likely place an increasingly intense focus on the water issues associated with energy-related activities. From a water supply standpoint, it is likely that drought, population growth, other stressors will further incentivize technological advancements and polices aimed at decreasing the amount of water needed for energy generation and extraction. As noted above, a few key developments that are already occurring in some parts of the West that may become more widespread in coming years include:

- Statutory, regulatory, and policy changes at the state and/or federal level to encourage or require energy extraction and production to reduce freshwater withdrawals and consumption in light of growing concerns about drought;

- Policies, preferences, or requirements aimed at minimizing the amount of freshwater needed for power plant cooling and other energy activities, including dry cooling and the use of non-potable and/or recycled water;

- Technological improvements and related policies and requirements regarding water recycling, brackish water desalination and other treatment activities to minimize freshwater use associated with energy, particularly hydraulic fracturing and other energy extraction activities; and

- Increased public attention and possible concern about the impact of energy-related activities on water supplies and water quality, which may lead to public opposition and/concern for certain projects and activities as well as related public support for policies and regulations to address these concerns.

States are already effectively regulating the water issues associated with energy activities, while allowing for responsible energy generation and development. Given the significant variability in water and energy resources found across the West, states primacy over the allocation and administration of the water located within their borders is essential. This gives states flexibility to develop polices and solutions to address their state-specific water and energy needs. For this reason, redundant or contrary federal policies that infringe on the states' primacy over the management of their water resources are unnecessary and will likely be counterproductive. Instead, relevant federal agencies should collaborate and consult with their state partners to identify collaborative ways to work within existing state legal and institutional frameworks to address energy-water challenges.

Nevertheless, persistent drought in many parts of the West will likely create additional pressure for states to ensure that water used for energy purposes is used efficiently and appropriately. As states work to protect and administer their scarce water resources, the WGA's Drought Forum represents a key resource that states and other policymakers can use to address the impacts of drought on energy development and production. In particular, the Forum will provide an online resource library with a collection of drought resources, while also serving as a venue for policymakers to share drought-related information, best management practices, and experiences regarding the impacts of drought on energy and other sectors of the West's economy and landscape.[237]

Similarly, the WSWC has a long and extensive history with the energy-water nexus and represents an additional, complimentary venue in which western water managers can collaborate with one another and share information regarding the interaction between drought and energy.

ENDNOTES

[1] Western Governors Association, Policy Resolution 2013-09: Energy and Transmission (June 5, 2013) (stating: energy development in the West takes an all-of-the-above approach, including energy efficiency and controlling emissions, while protecting the environment, wildlife, and natural resources), available at: http://www.westgov.org/policies/302-energy/619-energy-and-transmission-wga-resolution.

[2] WESTERN GOVERNORS ASSOCIATION, WESTERN GOVERNORS' DROUGHT FORUM, http://westgov.org/drought-forum.

[3] U.S. GEOLOGICAL SURVEY, ESTIMATED WATER USE IN THE UNITED STATES IN 2005, 7 (Oct. 27, 2009), http://pubs.usgs.gov/circ/1344/; U.S. GEOLOGICAL SURVEY, ESTIMATED USE OF WATER IN THE UNITED STATES IN 1995, 1 and 19 (1998), http://pubs.usgs.gov/circ/1998/1200/report.pdf. The USGS stopped including estimates of consumptive use in its reports on estimated water use reports after its 1995 report. Thus, USGS's 1995 water use report is the agency's most recent report on consumptive use.

[4] COLORADO DIVISION OF WATER RESOURCES, THE COLORADO WATER CONSERVATION BOARD, AND THE COLORADO OIL AND GAS CONSERVATION COMMISSION, WATER SOURCES AND DEMAND FOR THE HYDRAULIC FRACTURING OF OIL AND GAS WELLS IN COLORADO FROM 2010 THROUGH 2015 (JAN. 2012).

[5] TEXAS WATER DEVELOPMENT BOARD, WATER FOR TEXAS (Feb. 2013), http://www.twdb.state.tx.us/publications/shells/desal_brackish.pdf

[6] *California v. U.S.,* 438 U.S. 645, 653 (1978) *(*finding: "The history of the relationship between the Federal Government and the States in the reclamation of the arid lands of the Western States is both long and involved, but through it runs the consistent thread of purposeful and continued deference to state water law by Congress.").

[7] Norman Johnson, *Western State Water Right Permitting Procedures*, W. STATES WATER COUNCIL, 2 (Nov. 1992).

[8] Craig Bell and Jeff Taylor, *Water Laws and Policies for a Sustainable Future: A Western States' Perspective*, W. STATES WATER COUNCIL, 67 (June 2008), http://www.westgov.org/wswc/laws%20&%20policies%20report%20%28final%20with%20cover%29.pdf.

[9] Abandonment occurs when a water right holder no longer uses the right and no longer intends to use it. In contrast, forfeiture does not require intent and results when a right holder loses his or her right after not using it beneficially for a specific period of time. Prescription refers to the adverse possession of water resources.

[10] In general, the Rule of Capture allows landowners to pump as much groundwater as they can put to beneficial use. It also provides that landowners are not liable for withdrawing water that would otherwise be available to a neighboring property owner.

[11]Johnson, *supra* note 7, at 3.

[12] *Id.* at 16.

[13] Examples of other factors that states consider include whether: (1) the transfer would interfere with a more beneficial use of the water (Utah); (2) the proposed means of diversion, construction, and operation of the appropriation works are adequate for the transfers (Montana); (4) the underlying water right is valid and has been put to continuous beneficial use (Washington); and (5) whether the application was filed in good faith or for purposes of monopoly or speculation (Utah). Carlee Brown, Nathan Bracken, Tom Iseman, Tony Willardson, *Water Transfers in the West*, W. Govs. Ass'n., 95 – 118 (June 2012) (describing state water transfer processes), http://www.westgov.org/component/docman/doc_download/1654-water-transfers-in-the-west?Itemid=.

[14] Brown et al., *supra* note 13, at 99 (describing Colorado's water transfer process).

[15] MONT. CODE ANN. § 84-2-407.

[16] N.M. STAT. ANN. § 72-12-7(B).

[17] Bell and Taylor, *supra* note 8 at 119.

[18] NEB. REV. STAT. § 46-683 (LexisNexis 2012).

[19] Bell and Taylor, *supra* note 8, 119.

[20] CAL. WATER CODE § 1725 (LexisNexis 2012).

[21] OR. ADMIN. R. 690-380-5050.

[22] TEX. WATER CODE § 11.085.

[23] *Id.* §11.122(b).

[24] *Id.* § 11.085(k).

[25] CAL. WATER CODE § 1810(d).

[26] NEV. REV. STAT. § 533.438(1).

[27] WYO. STAT. ANN. § 41-3-104(a).
[28] An acequia is a community-operated watercourse used historically in Spain and its former colonies, including New Mexico.
[29] N.M. STAT. ANN. §72-5-24.1.
[30] ARIZ. REV. STAT. § 45-172(A)(6).
[31] *Id.*§ 45-172(A)(5).
[32] Robert E. Beck, *Use Preferences for Water*, 76 N.D.L.REV. 753, 770-1 (2000) (citing Alan D. Gross, *Condemnation of Water Rights for Preferred Uses – A Replacement for Prior Appropriation?*, 3 Willamette L.J. 263 (1965)).
[33] *Id.*
[34] NEV. REV. STATE. ANN. § 534.120(2) (2014).
[35] Beck, *supra* note 32, at 768 (Winter, 2010).
[36] S.D. CODIFIED LAWS § 46-5-34.1. The property from which the transfer is made can no longer be irrigated from any source.
[37] UTAH CODE ANN. § 73-3-21 .1 (2013) and OR. REV. STAT. §536.750(c) (2013).
[38] N.M. STAT. ANN. § 73-14-47(I) (2013).
[39] TEXAS WATER CODE ANN. § 11.139 (2013).
[40] CAL. WATER CODE § 462.
[41] NEV. REV. CODE. § 533.440(3).
[42] *Id.* § 533.024(a).
[43] Nathan Bracken, *Water Reuse in the West: State Programs and Institutional Issues*, 18 WEST-NORTHWEST J. ENVT'L L & POL'Y 2, 458 (Summer 2012).
[44] UTAH CODE ANN. § 73-3-8 (2013).
[45] UTAH DEPARTMENT OF NATURAL RESOURCES, PRESS RELEASE: STATE ENGINEER APPROVES APPLICATIONS TO USE GREEN RIVER WATER FOR NUCLEAR POWER PLANT, (Feb. 9, 2102), http://www.waterrights.utah.gov/pressRelease/greenRiverNuclearPowerPressRelease.pdf.
[46] *Heal Utah v. Kane Co. Water Conservancy Dist.*, No. 120700009 (7th D.Ut, Nov., 27, 2013).
[47] Adam Schempp, *Mapping the Energy-Water Policy Landscape,* ENVTL LAW INST., 6 (Aug. 2010), http://www.eli.org/research-report/mapping-energy-water-policy-landscape.
[48] Nathan Bracken, Legal Counsel, Remarks at the Colorado River Water Users Association's Legal Colloquium (Dec. 2012).
[49] *Schempp*, *supra* note 47, at 6.
[50] Bracken, *supra* note 43.
[51] BONNIE COLBY ET AL., UNIV. OF ARIZ., ARIZONA'S WATER FUTURE: CHALLENGES AND OPPORTUNITIES, 61 (2004), http://wrrc.arizona.edu/sites/wrrc.arizona.edu/files/publications/townhall/intro_toc.pdf.
[52] BUREAU OF LAND MGMT., CALIFORNIA: WATER RIGHTS FACT SHEET (2001), http://www.klamathbasincrisis.org/waterrights/blmwaterrightsfactsheet101609ca.htm.
[53] GOVERNMENT ACCOUNTABILITY OFFICE, ENERGY-WATER NEXUS: IMPROVEMENTS TO FEDERAL WATER USE DATA WOULD INCREASE UNDERSTANDING OF TRENDS IN POWER PLANT WATER USE, REPORT TO THE CHAIRMAN, COMMITTEE ON SCIENCE AND TECHNOLOGY, HOUSE OF REPRESENTATIVES, 63 – 65 (Oct. 2009), http://www.gao.gov/new.items/d1023.pdf. The CEC's analysis for CEQA and other Laws, Ordinances, Regulations, and Standards (LORS) is not limited to water used only for cooling (email from Jim Bartridge, Advisor to CEC Commissioner Carla Peterman, to Nathan Bracken, WSWC Legal Counsel (Aug. 27, 2012) (commenting on CEC permitting process).
[54] *Id.* at 64.
[55] *Id.*
[56] *Id.*
[57] CALIF. ENERGY COMM'N, INTEGRATED ENERGY POLICY REPORT, 41 (2003), http://www.energy.ca.gov/reports/100-03-019F.PDF.
[58] Id.; Renewable Energy Action Team Report, Best Management Practices and Guidance Manual: Desert Renewable Energy Project, 1 (Sept. 2010).
[59] *Id.* at 3.
[60] *Id.*

[61] GOVERNMENT ACCOUNTABILITY OFFICE, *supra* note 53, at 36 (describing Nevada State Engineer concerns over groundwater use for cooling purposes).
[62] Nevada State Engineer, Ruling No. 5115, 24 – 27 (April 18, 2002), http://images.water.nv.gov/images/rulings/5115r.pdf.
[63] Email from Jason King, Nevada State Engineer, to Nathan Bracken, WSWC Legal Counsel (Sept. 14, 2012) (on file with author). *See also* Memorandum from Jonathan B. Jarvis, Regional Director, Pacific West Region, U.S. National Park Service, to Amy Leuders, Acting State Director, Nevada Bureau of Land Management (Feb. 5, 2009) (stating that a Deputy State Engineer indicated that the rulings would help formulate future decisions regarding water rights for solar development at a Dec. 1, 2008 meeting with federal land management agencies), http://www.peer.org/docs/nps/09_20_04_jarvis_solar_memo.pdf.
[64] *See generally* Schempp, *supra* note 47, 8 – 12 (describing the CWA).
[65] *Id.*, at 8 (citing 33 U.S.C. §1251(g).
[66] *Id.*
[67] *See generally* Clean Water Restoration Act, S. 787, introduced by Senator Russ Feingold (D-WI) on April 2, 2009.
[68] Schempp, *supra* note 47, at 10 (describing Section 403). Section 502(14) of the CWA defines a point sources as "any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged."
[69] ENVIRONMENTAL PROTECTION AGENCY, NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM – STATE PROGRAM STATUS (April 14, 2003), http://cfpub.epa.gov/npdes/statestats.cfm.
[70] Schempp*, supra* note 47, at 10.
[71] *Id.*
[72] *Id.* at 9 – 10 (citing 40 CFR Part 400-467)
[73] *Id*. (citing 33 U.S.C. §1342(l)(2)).
[74] *Id.* (citing Pub. L. No. 109-58, § 323, 119 Stat. 694, codified as amended at 33 U.S.C. § 1362(24)).
[75] *Id.* at 12 (citing 33 CFR Parts 320-332, 40 CFR parts 230-233).
[76] *Id.* at 9 (quoting 33 USC §1344(e)).
[77] *Id.* A heat load is the amount of heat needed to maintain a desired temperature.
[78] *Id.* at 11. "Fully supported" water bodies are those that currently attain water quality standards and are expected to satisfy water quality standards the next time the state must submit its 303(d) list. EPA defines a "threatened" water body as on that "currently attains water quality standards, but for which existing and readily available data and information on adverse declining trends indicate that water quality standards will likely be exceeded by the time the next list of impaired or threatened waterbodies is required to be submitted to EPA. ENVIRONMENTAL PROTECTION AGENCY, WATER: TOTAL MAXIMUM DAILY LOADS (303D) GLOSSARY (March 6, 2012), http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/glossary.cfm#t.
[79] ENVIRONMENTAL PROTECTION AGENCY, IMPAIRED WATERS AND MAXIMUM DAILY LOADS (Apr. 9, 2014), http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/.
[80] *Schempp*, *supra* note 47, at 11.
[81] John Veil, *Impacts of TMDLs on Coal-Fired Power Plants*, NAT'L ENERGY TECH. LABORATORY – DOE/NETL-2020/1408, 13 (April 2010), http://www.veilenvironmental.com/publications/pp/TMDLreport-66629.pdf (describing the impacts of TMDLs on coal-fired power plants).
[82] *Id.*
[83] Memoranda from Tony Willardson, Executive Director, Western Sates Water Council, to the Western Governors' Association (Sept. 20, 2013) (on file with author) (describing the western states' actions and interests as related to FERC hydropower licensing).
[84] *Id.*
[85] *Id.*
[86] 495 U.S. 490 (1990).
[87] Willardson, *supra* note 83.
[88] 511 U.S. 700 (1994).
[89] Willardson, *supra* note 83.

[90]Schempp, *supra* note 47, at 12 (quoting 42 U.S.C. § 300f(6).
[91] *Id. at 13.*
[92] *Id.* (citing 42 U.S.C. 300g-1(b)(1)(A)). EPA must also publish a list of contaminants that are not subject to NPDWRs but may require regulation at a future date because of public health concerns. EPA reviews this list every five years to determine whether the listed contaminants require an NPDWR. *Id.* (citing 42 U.S.C. §§ 300g-1(b)(1)(A), (B)). For each contaminant subject to an NPDWR, EPA will use a "maximum contaminant level goal" (MCLG) that establishes the level of a given contaminant below which anticipated adverse risks to public health are unknown. EPA will then establish a maximum contaminant level (MCL) for each contaminant, which must be established as close to the MCLG as feasible. *Id.* (citing 42 U.S.C. § 300g-1(b)(1)(A)).
[93] *Id.* (citing 42 U.S.C. § 330h-7).
[94] *Id;* 42 U.S.C. § 330h-7; Environmental Protection Agency, Wellhead Protection Program (May 5, 2014), http://www.epa.gov/region1/eco/drinkwater/pc_wellhead_protection.html.)
[95]Schempp, *supra* note 47, at 13 – 14 (citing 42 U.S.C. 300h-3(e).
[96] ENVIRONMENTAL PROTECTION AGENCY, SOLE SOURCE AQUIFER PROTECTION PROGRAM (March 6, 2012), http://water.epa.gov/infrastructure/drinkingwater/sourcewater/protection/solesourceaquifer.cfm.
[97] Schempp*, supra* note 47, at 14 – 15 (describing the UIC program).
[98] Environmental Protection Agency, Water: Underground Injection Control Program Primacy (Apr. 7, 2015), http://water.epa.gov/type/groundwater/uic/Primacy.cfm.
[99] Schempp*, supra* note 47, at 14 – 15 (describing the UIC program)
[100] ENVIRONMENTAL PROTECTION AGENCY, TECHNICAL PROGRAM OVERVIEW: UNDERGROUND INJECTION CONTROL REGULATIONS, EPA 816-R-02-025 (2001).
[101]Schempp, *supra* note 47, at 15.
[102] *Id.* at 14 (citing 42 U.S.C. 300h(d)(1)).
[103] *See generally* the Fracturing Responsibility and Awareness of Chemicals Act (FRAC Act), S. 1135 and H.R. 1921 introduced during the 113th Congress.
[104] Schempp, *supra* note 47, at 15 (quoting 42 U.S.C. § 300h(b).
[105]*Id.* at 17 (citing 16 U.S.C. § 1532). The term "take" means to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.
[106] *Id.* at 18.
[107] *Id.*
[108] U.S. FISH AND WILDLIFE SERVICE, BAY-DELTA FISH AND WILDLIFE OFFICE (March 17, 2015), http://www.fws.gov/sfbaydelta/species/delta_smelt.cfm (describing the Delta smelt's listing status as "threatened").
[109] Sustainable yield means "the achievement and maintenance in perpetuity of a high-level annual or regular periodic output of the various renewable resources of the public lands consistent with multiple use." 43 U.S.C. § 1702(h).
[110] Sarah Pizzo, *When Saving the Environment Hurts the Environment: Balancing Solar Energy Development with Land and Wildlife Conservation in a Warming Climate*, 22 Colo. J. INT'L L. & POL'Y 123, 142 – 143 (Winter 2011) (quoting quoting 43 U.S.C. § 1201(a)(8)).
[111] BUREAU OF LAND MGMT., U.S. DEP'T OF THE INTERIOR, BLM FACT SHEET: RENEWABLE ENERGY AND THE BLM: SOLAR (July 2012),
[112] Robert L. Glicksman, *Solar Energy Development on the Federal Public Lands: Environmental Trade-offs on the Road to a Lower-carbon Future*, 3 SAN DIEGO J. CLIMATE & ENERGY L. 107, 130 (2011).
[113] 43 U.S.C. § 1765(a)(iii) – (iv)).
[114] John Fedkiw, Managing Multiple Uses on National Forests, 1905-1995, 3 (1998), http://www.foresthistory.org/ASPNET/Publications/multiple_use/.
[115] U.S. Forest Service, Heritage Program: Federal Laws, http://www.fs.usda.gov/detail/r2/recreation/?cid=stelprdb5356576 (describing USFS statutory authorities).
[116] Fedkiw, *supra* note 114, at 1.
[117] U.S. Forest Service, Obtaining a Special-Use Authorization with the Forest Service, http://www.fs.fed.us/specialuses/documents/broch.htm.

[118] *Id.*
[119]Schempp, *supra* note 47, at 17.
[120] Pizzo, *supra* note 110, at 142 – 146
[121] Doug McMurdo, *Solar Projects Take Home of Hoover Dam Back to Future*, LAS VEGAS REVIEW JOURNAL (Feb. 6, 2012).
[122]Schempp, *supra* note 47, at 17 – 18 (citing 30 U.S.C. § 181 et seq.; and 43 CFR Part 3100).
[123] The WSWC initially prepared this case study to fulfill the terms of a separate but related grant contract with WGA regarding the water issues associated with concentrated solar power. The original version of this case study was published by the Joint Institute for Strategic Energy Analysis in March 2015. *See* NATHAN BRACKEN AND JORDAN MACKNICK, CONCENTRATING SOLAR POWER AND WATER ISSUES IN THE U.S. SOUTHWEST, JOINT INSTITUTE FOR STRATEGIC ENERGY ANALYSIS, TECHNICAL REPORT NREL/TP-6A50-61376, vi – viii (March 2015), http://www.nrel.gov/docs/fy15osti/61376.pdf.
[124] Hualapai Valley Solar, Project Status, http://hualapaivalleysolar.com/.
[125] BRACKEN AND MACKNICK, *supra* note 123, vi-vii.
[126] James Chilton, *P&Z OKs Hualapai Valley Solar Plan*, DAILY MINER (Sept. 18, 2009) (interviewing project developers regarding project's water usage), http://www.kingmandailyminer.com/main.asp?SectionID=1&subsectionID=1&articleID=33644.
[127] *Id.*
[128] Suzanne Adams, *No Deal Yet on Using Wastewater,* DAILY MINER (Sept. 2, 2010) [hereinafter Adams No Deal], http://www.kingmandailyminer.com/main.asp?SectionID=1&SubsectionID=797&ArticleID=39813.
[129] *Id.*
[130] Chilton, *supra* note 126.
[131] ARIZ. DEP'T OF WATER RES., ARIZONA WATER ATLAS VOLUME 1, APPENDIX C: SUMMARY OF ARIZONA WATER LAW AND MANAGEMENT, 127 (Sept. 2010), http://www.adwr.state.az.us/AzDWR/StatewidePlanning/WaterAtlas/documents/appendix_c.pdf; Tom Whitmer, *Water Management in Arizona*, 2 BACKYARDS AND BEYOND 5 (Spring 2008), http://cals.arizona.edu/backyards/archive/2008/08spring.pdf.
[132] GOVT. ACCOUNTABILITY OFFICE, *supra* note 53, at 61, at 59 – 61.
[133] ARIZ. REV. STAT. § 40-360.13.
[134] *Id.*
[135] BRACKEN AND MACKNICK, *supra* note 123, at 54.
[136] *Id.*
[137] *In the Matter of the Application of Hualapai Valley Sollar LLC*, Ariz. Corp. Comm'n, Reply in Support of Applicant's Application to Lift Stay, L-00000NN-09-0541-00151, 10 – 11, http://edocket.azcc.gov/.
[138] Letter from Christopher P. Durkin, President, Kingman Downtown Merchants' Ass'n, to Ariz. Corp. Comm'n, (April 1, 2010) (on file with author); Letter from Keith Walker, City Councilman, City of Kingman, to Ariz. Corp. Comm'n. (March 29, 2010) (on file with author); Letter from Lola Franklin, Chief Executive Officer, Kingman/Golden Valley Association of Realtors, to Ariz. Corp. Comm'n. (March 30, 2010) (on file with author) (expressing support for Hualapai Solar Project).
[139] *In the Matter of the Application of Hualapai Valley Sollar LLC*, Ariz. Corp. Comm'n, Decision No. 71648, Docket No. L-00000NN-09-0541-00151, 5, 10 (Nov. 1, 2010), http://edocket.azcc.gov/.
[140] *In the Matter of the Application of Hualapai Valley Sollar LLC*, Ariz. Corp. Comm'n, Intervenor Bensusan's Response to Application to Lift Stay, L-00000NN-09-0541-00151, 10 – 11, http://edocket.azcc.gov/.
[141] *In the Matter of the Application of Hualapai Valley Sollar LLC*, Ariz. Corp. Comm'n, Reply in Support of Applicant's Application to Lift Stay, L-00000NN-09-0541-00151, 10 – 11, http://edocket.azcc.gov/.
[142] *Id.* at 10.
[143] *In the Matter of the Application of Hualapai Valley Sollar LLC*, Ariz. Corp. Comm'n, Decision No. 71957, Order Amending Decision No. 71648, 3 (Nov. 1, 2010), http://edocket.azcc.gov/.
[144] *Id.* at 2.
[145] *Id.*

[146] Suzanne Adams, *Hualapai Must Be Dry to Fly,* DAILY MINER (Oct. 21. 2010), http://www.kingmandailyminer.com/main.asp?SectionID=1&SubsectionID=1&ArticleID=40780.
[147] Suzanne Adams, *Red Lake Solar Project Stalled*, DAILY MINER (May 24, 2011), http://www.kingmandailyminer.com/main.asp?SectionID=1&subsectionID=798&articleID=44743.
[148] *Id.*
[149] *Id.*
[150] CleanEnergy Action Project, Solana Generating Station Case Study, http://www.cleanenergyactionproject.com/CleanEnergyActionProject/CS.Solana_Generating_Station___Energy_Storage_Case_Study.html.
[151] Hannah Wittmeyer, *Fracking Regulations in Texas*, FRACKWIRE (July 9, 2013), http://frackwire.com/texas-regulations/.
[152] *Id.*
[153] *Id.*
[154] Texas Commission on Environmental Quality, *Texas in Vanguard of Nationwide Oil and Gas Energy Boom*, NATURAL OUTLOOK, 1 (Aug. 2012), https://www.tceq.texas.gov/publications/pd/020/2012-NaturalOutlook/texas-in-vanguard-of-natiowide-oil-and-gas-energy-boom.
[155] *Id.*
[156] Trace Blair, Emma Cano, Benjamin Smolij, *You Never Miss the Water 'Til the Well Runs Dry: The Competing Uses for Water in a Shale Play*, SOUTH TEXAS COLLEGE OF LAW: 25[TH] ANNUAL ENERGY LAW INSTITUTE FOR ATTORNEYS AND LANDMEN, 4, (Aug. 2012); Douglas Caroom and Susan Maxwell, *Texas Water Law Overview*, 2014 TEXAS WATER LAW INSTITUTE, 2 – 3 (Nov. 2014), https://utcle.org/elibrary/download/af/57622/p/1.
[157] *Id. at 5;* SCOTT TINKLER, CURRENT AND PROJECTS WATER USE IN THE TEXAS MINING AND OIL AND GAS INDUSTRY, 58 – 59 (June 2011), https://www.twdb.texas.gov/publications/reports/contracted_reports/doc/0904830939_MiningWaterUse.pdf.
[158] Tinkler, *supra* note 157, at 58 – 59.
[159] RAILROAD COMMISSION OF TEXAS, EAGLE FORD SHALE TASK FORCE REPORT, 36 (March 2013) [hereinafter Eagle Ford Shale Task Force], http://cryptome.org/2015/01/eagle-ford-task-force-report.pdf; JEAN-PHILIPPE NICOT ET AL., OIL AND GAS WATER USE IN TEXAS: UPDATE TO THE 2011 MINING WATER USE REPORT, i-ii, 36 – 37 (Sept. 2012), https://www.twdb.texas.gov/publications/reports/contracted_reports/doc/0904830939_2012Update_MiningWaterUse.pdf) (discussing the water use associated with oil and gas activities in Texas).
[160] TEXAS WATER DEVELOPMENT BOARD, 2012 STATE WATER PLAN, 136 – 139 (Jan. 2012), https://www.twdb.texas.gov/publications/state_water_plan/2012/2012_SWP.pdf.
[161] *Id.*
[162] *Id.*
[163] Taelor Allen, *The South Texas Drought and the Future of Groundwater Use For Hydraulic Fracturing in the Eagle Ford Shale*, 44:487 ST. MARY'S L. J 491 – 496 (Jan. 2013) (citing API ENERGY, WATER MANAGEMENT ASSOCIATED WITH HYDRAULIC FRACTURING 13 (June 2010) (discussing water use for hydraulic fracturing), http://www.shalegas.energy/gov/resources/HF2-e1.pdf).
[164] *Id.* at 496.
[165] Nicot et al., *supra* note 159, at 56.
[166] *Id.*
[167]*Id.* at 54 – 56; *see also* Kiah Collier, *Texas' Second Oil Boom Costs Precious Water*, STANDARD TIMES (June 26, 2011) (describing why oil and gas producers use freshwater for hydraulic fracturing operations).
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[169] Railroad Commission of Texas, Saltwater Disposal Wells (last visited (March 4, 2015) [hereinafter Railroad Commission of Texas – Saltwater], http://www.rrc.state.tx.us/about-us/resource-center/faqs/oil-gas-faqs/faq-saltwater-disposal-wells/.

[170] Railroad Commission of Texas, Eagle Ford – Water Use: Water Use in Association with Oil and Gas Activities Regulated by the Railroad Commission of Texas (April 9, 2014) [hereinafter Railroad Commission of Texas – Eagle Ford], http://www.rrc.state.tx.us/oil-gas/major-oil-gas-formations/eagle-ford-shale/wateruse/; Railroad Commission of Texas - FAQs, Oil and Gas FAQs: Hydraulic Fracturing (last accessed March 2, 2015) [hereinafter Railroad Commission of Texas - FAQs, http://www.rrc.state.tx.us/about-us/resource-center/faqs/oil-gas-faqs/faq-hydraulic-fracturing/. *See also* Wittmeyer, *supra* note 150); Elizabeth Ames Jones, *Clearing the Air on Hydraulic Fracturing Laws in Texas*, Forbes.com (Dec. 9, 2012), http://www.forbes.com/sites/realspin/2012/12/09/clearing-the-air-on-hydraulic-fracturing-laws-in-texas/(describing the RRC and its authority).

[171] *Id.*

[172] *Id.*

[173] *Id*.

[174] Jones, *supra* note 170 (discussing H.B. 3328).

[175] *Id.*

[176] Railroad Commission of Texas, Summary of Amendments to Statewide Rule 13 (Oct. 24, 2014), http://www.rrc.state.tx.us/oil-gas/compliance-enforcement/rule-13-geologic-formation-info/summary-of-amendments-to-swr-13/.

[177] Railroad Commission of Texas – Eagle Ford, *supra* note 170.

[178] Groundwater Protection Council, State Oil and Gas Agency Groundwater Investigations and Their Role in Advancing Regulatory Reforms (Aug. 2011), http://www.gwpc.org/sites/default/files/State%20Oil%20%26%20Gas%20Agency%20Groundwater%20Investigations.pdf.

[179] Eagle Ford Shale Task Force, *supra* note 159, at 35 (March 2013).

[180] Railroad Commission of Texas – FAQs, *supra* note 170.

[181] Texas Water Code § 11.023.

[182] Railroad Commission of Texas – Eagle Ford, *supra* note 159; Texas Commission on Environmental Quality, *supra* 154, at 3 (describing TCEQ's surface water permitting program).

[183] *Id.*

[184] *Id*.

[185] Tex. Water Code §36.001 *et seq.*

[186] *Id.*

[187] *Pecos County WCID No. 1 v. Williams*, 271 S.W.2d 503 (Tex. Civ. App. 1954) (holding that groundwater is water located under the land surface that is not the underflow of a surface stream or river). S*ee also Denis v. Kickapoo Land Co.*, 771 S.W.2d 503 (Tex. App. 1989) (stating that groundwater is presumed to be percolating waters).

[188] Tex. Water Code § 11.021(a) (defining "state water").

[189] Blair, note 14356, 7 – 9 (discussing groundwater regulation in Texas).

[190] Allen, *supra* note 163 at 497 (citing API Energy, *supra* note 162).

[191] *Edwards Aquifer Authority v. Day*, 369 S.W.3d 814 (Tex. 2012) (holding that that landowners have a vested property right in the groundwater beneath their land that is worthy of constitutional protection in takings actions).

[192] Texas Commission on Environmental Quality, What is a Groundwater Conservation District (last accessed March 9, 2015) (describing GCDs), https://www.tceq.texas.gov/assets/public/permitting/watersupply/groundwater/maps/gcd_text.pdf.

[193] *Id.* GCDs can be created in a number of ways, including through legislative action, landowner petition, and TCEQ actions in certain circumstances. New territory can also be added to an existing district, if the existing district is willing to accept the addition. As of April 2014, there were 101 GCDs in Texas.

[194] Tex. Water Code §36.117(b)(2).

[195] *Id.* §36.117(g).

[196] *Id.* §36.117(d)(2).

[197] *Id.* §36.117(h).

[198] *Id.* §36.117(i).
[199] *Id.* §36.111.
[200] Mike Lee, *Parched Texans Impose Water-Use Limits for Fracking Gas Wells*, BLOOMBERG NEWS (Oct. 6, 2011), http://fuelfix.com/blog/2011/10/06/parched-texans-impose-water-use-limits-for-fracking-gas-wells/; Wittmeyer, *supra* note 150 (discussing regulations that GCDs have adopted for hydraulic fracturing).
[201] Blair, *supra* note 156, at 14.
[202] Wittemeyer, *supra* note 151.
[203] Max Baker, *Denton Voters Approve State's First Ban on Hydraulic Fracturing*, Star-Telegram (Nov. 4, 2014), http://www.star-telegram.com/news/politics-government/article3906359.html.
[204] *Id.*
[205] *Id.*
[206] Galbraith Concerns, *supra* note 168 (discussing drought-related concerns associated with hydraulic fracturing).
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(discussing the issues associated with using brackish and recycled water for hydraulic fracturing in Texas).

[228] Galbraith Concerns, *supra* note 168; Galbraith Recycled Water, *supra* note 168; Galbraith Brackish Water, *supra* note 168 (discussing the issues associated with using brackish and recycled water for hydraulic fracturing in Texas).

[229] *Id.*

[230] *Id.*

[231] RAILROAD COMMISSION OF TEXAS, *supra* note 168; *see also* Galbraith Concerns, *supra* note 168; Galbraith Recycled Water, *supra* note 168; Galbraith Brackish Water, *supra* note 168 (discussing the issues associated with using brackish and recycled water for hydraulic fracturing in Texas).

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[237] WESTERN GOVERNORS ASSOCIATION, *supra* note 2.