Sacramento Valley Water-Sharing Investment Partnership

A Comprehensive Feasibility Assessment

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A Group Project submitted in partial satisfaction of the requirements for the degree of Master of Environmental Science & Management for the Bren School of Environmental Science & Management at the University of California, Santa Barbara.

May 25, 2017

CHUBB

Acknowledgements

We would like to thank the many people who provided support, guidance, and assistance in researching and writing our report. We are especially grateful for the following people:

Faculty Advisor

Jim Salzman

PhD Advisor

Andrew Ayres

Client – The Nature Conservancy

Brian Richter
Paul Spraycar
Emily Powell
Catherine Burns
Siobhan King
John Gearen
Jordan Wellwood
Lauren Ferstandig
Jacob Davis
Gregg Werner
Jeanne Brantigan
Ned Washburn

Other Support

Gary Libecap, UCSB Bren School
Sean Fitzgerald, UCSB Bren School
Andy Sawyer, California State Water Resources Control Board

Funding

Chubb Insurance

Abstract

The wetlands in California's Sacramento Valley provide historically critical resting habitat for birds of the Pacific Flyway migration, but 95 percent of the wetlands that existed in the Valley have been lost due to agricultural development, land-use change, and intensive management of the Sacramento River. Efforts have been made to set aside water to re-create wetland habitat for migratory birds, but these efforts face legal, financial, and political constraints. Our project client, The Nature Conservancy (TNC), has developed an innovative concept, the Water-Sharing Investment Partnership (WSIP), which combines water markets and impact investing to strategically allocate water for nature without permanently removing it from agricultural communities and without relying on solely philanthropic dollars. This report evaluates the feasibility of establishing a WSIP in the Sacramento Valley to create temporary migratory bird habitat. The two research questions addressed in this report are (1) what is the financial, legal, and logistical feasibility of acquiring water in the Sacramento Valley? and (2) how can acquired water be transferred to meet dual goals of creating temporary migratory bird habitat and generating financial returns for impact investors? This report concludes that a Sacramento Valley WSIP is financially feasible (defined as positive net present value) under specific scenarios in which the acquired water right(s) are sold at the end of the fund. Water transaction(s) necessary for the operation of a WSIP are logistically and legally possible, but due to the complexity of California water law, transactions are likely to be costly and time-intensive. Within the context of implementing a WSIP, this report recommends four specific water acquisition strategies and two water transfer strategies with relatively low transaction costs and small legal barriers.

Table of Contents

List of Acronyms

AF – acre-feet

CDFW – California Department of Fish and Wildlife

CVP – Central Valley Project

CDFW – California Department of Fish and Wildlife

CEQA – California Environmental Quality Act

DOI – Department of Interior

DWR – Department of Water Resource

EDF – Environmental Defense Fund

ESA – Endangered Species Act

ET – evapotranspiration

ETAW – evapotranspiration of applied water

MWDSC – Metropolitan Water District of Southern California

NEPA – National Environmental Policy Act

NREL – National Renewable Energy Laboratory

NRCS – Natural Resources Conservation Service

NRIC – Natural Resource Investment Center

NSR – National Solar Radiation

PVID – Palo Verde Irrigation District

SNWR – Sacramento National Wildlife Refuge

SEIA – Solar Energy Industries Association

SITC – Solar Investment Tax Credit

SWP – State Water Project

SWRCB – State Water Resources Control Board

TNC – The Nature Conservancy

USBR – United States Bureau of Reclamation

USDA – United States Department of Agriculture

USFWS – United States Fish and Wildlife Service

WSIP – Water-Sharing Investment Partnership

List of Tables

List of Figures

Executive Summary

The Problem

California's Sacramento Valley is a crucial rest stop for migratory birds. Every year, birds migrating along the Pacific Flyway – one of the longest migration paths in the world – travel over 8,000 miles, from Alaska to Patagonia and back. Historically, these birds have relied on wetland habitat, created by seasonal flooding of the Sacramento River, as a place to rest, feed, and breed. But today, 95 percent of those historic wetlands are gone due to agricultural development and intensive management of the river.

Migratory birds need more habitat, but the region in question is also now critical for humans – both the farmers whose livelihoods depend on their land, and the millions of people who eat the crops they grow. Bird habitat shortages are linked to both land and water shortages. California supports a population of over 39 million people (World Population Review, 2017) and accounts for 13 percent of the country's agricultural economy (USDA, 2015), while receiving just one percent (22 inches per year on average) of U.S. rainfall (Current Results, 2017). Water in this state is frequently in high demand and short supply, and environmental uses often lose out to competing uses. There are many environmental organizations working on projects to meet the water needs of nature, but the scale of these projects is limited by funding, with many initiatives competing for a relatively small pool of government grants and private donations. How can environmental organizations provide more water for migratory bird habitat in the Sacramento Valley without permanently removing that water from other productive uses like agriculture and without exhausting their limited funds?

A Market-Based Solution

The client, The Nature Conservancy (TNC), has developed a program to address the first part of this question: How can environmental organizations provide more water for migratory bird habitat in the Sacramento Valley? Through the BirdReturns program, TNC pays rice farmers in the Sacramento Valley to flood their fields for several weeks in the spring and fall, creating viable habitat during the critical periods when birds need a place to rest. A private foundation funds BirdReturns, which receives more bids to provide habitat from farmers than the program can afford to accept.

There is a growing appetite in the investment community to fund environmental projects, especially innovative programs like BirdReturns. Between 2004 and 2015, over $8 billion in private capital was committed to conservation projects, but by 2015 $3 billion of that still had not been invested (Field, 2017). This suggests that the barrier to the proliferation and expansion of creative environmental initiatives is not lack of funding, but a lack of investible projects (Field, 2017). Additionally, there is a general lack of environmental initiatives that seek to generate financial returns along with a measured environmental return (a term known as impact investing). TNC is addressing this deficit with a market-based, investor-funded model for allocating water to the environment, known as a Water-Sharing Investment Partnership (WSIP). The WSIP has been successfully launched in Australia's Murray-Darling Basin, and may be applicable in other parts of the world. The basic concept is to use funds raised from impact investors, as well as government grants and private philanthropic donors, to acquire water rights. Rights can be acquired directly through a water market, or indirectly by working with farmers on improving their water-use efficiency. If the concept were to be applied in California, TNC would strategically manage a water rights portfolio to create migratory bird habitat and to generate financial returns for investors by leasing the water to farmers or other water users and ultimately selling the water right at the end of the fund. The relative allocation of water to these two uses can vary year-to-year and season-to-season, depending on shifting environmental and financial needs.

The WSIP concept has the potential to meet environmental water needs, but successful implementation will depend on the specifics of the project location and objective. This report assesses the feasibility of implementing a WSIP in the Sacramento Valley to create migratory bird habitat. As part of this assessment, this report answers two key research questions:

1) What is the financial, legal, and logistical feasibility of acquiring water assets in the Sacramento Valley?
2) How can acquired water assets be transferred to meet the dual goals of creating temporary migratory bird habitat and generating financial returns?

Acquiring Water

This report evaluates two water asset types, post-1914 appropriative water rights and federal Central Valley Project (CVP) contracts. The two water asset types were chosen because they appear to be amenable to acquisition and management via the WSIP model.

CVP contracts are acquired through an agreement with the United States Bureau of Reclamation (USBR). Annually, TNC can expect to pay between $25 and $50 per acre-foot (AF) for CVP contract water, but this water is not a permanent asset (and therefore cannot be sold at the end of the fund). There are two million AF of CVP contract water in the Sacramento Valley, held by 142 contractors (Appendix XII).

Appropriative water rights can be acquired in two ways: purchasing water directly on the market or engaging in on-farm conservation to "unlock" water (which can take the form of joint ventures with water rights holders, or purchasing land with attached water rights and changing farming practices). Broadly speaking, TNC can expect to pay between $500 and $5,000 per AF of permanent, high-priority irrigation water rights (as a one-time cost). Acquired water is a permanent asset that can be amortized in the future. There are one million AF of high-priority irrigation water rights allocated in the Sacramento Valley.

Transferring Water

Once water assets have been acquired for the WSIP, they can be transferred to create migratory bird habitat or leased to generate returns for investors. Water transfers in California are subject to a myriad of regulations depending on the type of water asset, the length of transfer, and potential impacts to other water users. This report identifies short-term water rights leases and CVP-contract accelerated transfers as the two best approaches for balancing ease of transfer and security. Migratory bird habitat can be created by transferring water either to the Sacramento National Wildlife Refuge (SNWR) or to private agricultural lands through TNC's BirdReturns program. While there are transaction and conveyance costs associated with these deliveries, there is nonetheless potential to generate revenue through either type of deployment described here.

An accurate understanding of how much revenue can be generated by leasing water to other users is critical to assessing the feasibility of the WSIP in California (CA). The key months for migratory bird habitat are March, April, September, and October; during the rest of the year water can be leased to other users. Historical prices (1989 to 2009) for short-term leases between agricultural users in California range from below $5 up to $225 per AF; leases from agriculture to urban users range from below $5 up to $2,481 per AF (Libecap & Donohew, 2010). Prices are not disclosed for the short-term transfer of CVP contracts but are likely comparable to short-term leases between agricultural users. These price ranges are so wide because short-term lease prices are highly sensitive to current hydrological, economic, and regulatory conditions. This market uncertainty presents a significant challenge for the WSIP, because returns will be highly variable and subject to physical, regulatory, and political constraints for efficiently deploying water to meet environmental and human needs.

Financial Model

As part of this feasibility assessment, a financial model tool has been built for TNC to evaluate different implementation strategies for the WSIP. The general strategy of the WSIP is to acquire water assets that appreciate over time and can be leased to meet the demands of other water users. This water will be managed strategically to create temporary migratory bird habitat and to generate revenue for WSIP when not being used for habitat creation. The model allows TNC to evaluate all the acquisition strategies and transfer strategies discussed in this report, under multiple fund scenarios, and accounts for possible variability in costs, rates, and revenues, including how water assets can be divided between environmental and financial uses. The model revealed that the acquired water asset(s) must be sold at fund closing to generate positive net present value. A sensitivity analysis identified the discount rate and water right appreciation rate as the most important variables.

Key Partnerships

Developing strategic relationships will be crucial to the success of a WSIP. In this report, the term "partnership" refers not only to investors and donors, but to all entities that would be involved in this project. Partners can be broken down into three general categories: government, local stakeholders, and the private sector. The most important government stakeholders are USBR, the State Water Resources Control Board (SWRCB), and the United States Fish and Wildlife Service (USFWS). The most important local stakeholders are irrigation districts, farmers who participate in BirdReturns, and the California Rice Commission. Within the private sector, impact investors and philanthropic donors are critical funders of the WSIP. Impact investors are individuals or private entities that invest in organizations and projects generating measurable social and/or environmental benefits alongside financial returns. Impact investors are often willing to accept a below-market rate of return due to an expectation of broader social and/or environmental returns (Global Impact Investing Network, 2017).

Feasibility Insights

This report concludes that establishing a WSIP in the Sacramento Valley may be logistically and legally possible, and financially viable under certain conditions. Specifically, financial viability can only be attained when all water rights are sold at the end of the fund, and when discount rates are low and water asset appreciation rates are high (below and above 4 percent, respectively). One of the greatest barriers to the success of a WSIP in this region will be the regulatory requirements for water transfers, because they incur high costs (up to $70,000) and can make transactions extremely time-intensive (up to 5-7 years). New policies and innovative solutions can expedite the process and reduce costs. Policy advocacy for these changes/ partnerships/ innovative solutions will be an important part of implementing the WSIP model.

In building the WSIP portfolio, water acquisitions are likely to be opportunistic deals with TNC's existing contacts and partners. Large exchanges are more efficient, but may face greater opposition and may garner unwanted attention. Permanent water right acquisitions and subsequent short-term lease agreements would be the ideal strategy for the WSIP if the costs associated with the transfer approval process were lower. In terms of the ability to dynamically buy and sell water, and deliver it to different habitat locations, the CVP system is likely the best option. However, because CVP contracts are not a permanent asset, and thus will experience no appreciation that the WSIP could capitalize on, they contribute little to no revenue generation. Due to the shortcomings of both these strategies, it is recommended that TNC use a WSIP portfolio to include an array of water assets to balance the benefits and limitations of each. It may be possible to reach financial viability through some combinations of assets and the financial model tool developed for this analysis is helpful for exploring different possibilities.

Ultimately, this report outlines the best possible water acquisition and transfer strategies to use for the WSIP and identifies the rationale behind those choices. This report also suggests that the WSIP concept can be financially viable, given favorable conditions. Taken together, this project presents a promising opportunity for impact investors and TNC.

Introduction

> *"The Sacramento Valley represents the single most important wintering area for the waterfowl along the Pacific Flyway. The partnerships between the private and public sector, along with the effective management of reliable water supplies, is absolutely key to providing the hundreds of thousands of acres of habitat for migrating birds each year."*
>
> - Stafford Lehr, Deputy Director, Wildlife and Fisheries Division, CDFW[1]

California's Sacramento Valley is a crucial rest stop for migratory birds. Every year, birds migrating along the Pacific Flyway–one of the longest migration paths in the world – travel over 8,000 miles, from Alaska to Patagonia and back. The Sacramento Valley lies in the middle of the migratory pathway, and is one the most important waterfowl resting sites in the world. The Valley supports about 44 percent of Pacific Flyway shorebirds (National California Water Association (NCWA), 2017). Historically, these birds have used the wetland habitat created by seasonal flooding of the Sacramento River to rest, feed, and breed. Today, 95 percent of those historic wetlands are gone[2] due to agricultural development and intensive management of the river (Robbins, 2014).

Prior to the Gold Rush, the 10-million-acre Central Valley contained four million acres of wetlands surrounded by grasslands and riparian areas, prime habitat supporting 20 to 40 million migrating birds annually (USFWS, 2006). As a result of development and land-use change, migratory bird populations have declined and now the remaining 5 percent of intensively managed wetlands and associated agricultural habitats support an average of 5.5 million waterfowl annually (USFWS, 2006).

More habitat is needed to support migratory birds in the Sacramento Valley, but the region is now used intensively for farming operation. This agricultural land is critical both to the farmers whose livelihoods depend on it, and to the millions of people who eat the crops that they grow. In addition to a shortage of land, there is a shortage of water available to create potential waterfowl habitat in the form of wetlands. The state of California accounts for 13 percent of United States agricultural economy (USDA, 2015), but receives only one percent of the nation's average rainfall (Current Results, 2017). Water scarcity is a major issue in this state – California has been in drought for the past five years, and water is over-allocated by 500 percent (Skelton, 2015). Given current water scarcity issues in California, how can water be provided to create more wetland habitat for migratory birds without permanently removing this water from other productive uses like growing food?

The objective of this report is to help the project client, The Nature Conservancy (TNC), answer the above question by evaluating the feasibility of one possible approach, an innovative concept known as a Water-Sharing Investment Partnership (WSIP), in which private investor capital is used to purchase water right(s). This water is then strategically reallocated to serve a dual environmental and financial purpose,

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[1] Source: Daily Democrat, 2016

[2] See Appendix I for maps showing wetland loss

creating temporary habitat and generating financial returns for investors through short-term leases of acquired rights and sale of water right(s) at the end of the fund.

To evaluate the feasibility of the WSIP model for providing migratory bird habitat in the Sacramento Valley, this report focuses on two overarching research questions:

1) What is the financial, legal, and logistical feasibility of acquiring water assets in the Sacramento Valley?
2) How can acquired water assets be transferred to meet the dual goals of creating temporary migratory bird habitat and generating financial returns?

These questions are addressed at length in this report. In addition, they are the building blocks for an accompanying financial model developed for TNC. The model, which allows TNC to analyze the financial feasibility of various water acquisition strategies, is also discussed in detail.

Background

What is a Water-Sharing Investment Partnership (WSIP)?

The WSIP concept was developed in 2014 by Brian Richter, Director of Global Freshwater Strategy at TNC. The WSIP is an "institution that operates with investor capital within existing water markets for the purpose of redistributing water use in a manner that enables water productivity to increase and economic benefits to grow, while returning water to nature" (Richter, 2016). TNC (or a private entity[3]) raises funding from impact investors, government, and philanthropic donors to acquire a portfolio of water assets. The acquired water is then deployed strategically over the duration of the fund to serve the dual purpose of meeting environmental needs and generating returns for investors. The exact environmental use of the water and the ways in which water assets are acquired vary regionally and can be tailored to fit different environmental objectives.

[3] Due to TNC's non-profit status, they cannot have direct fiduciary responsibility of the private investment fund. Noting this, for the sake of brevity TNC will be referred to as the "owner" of the WSIP in this report.

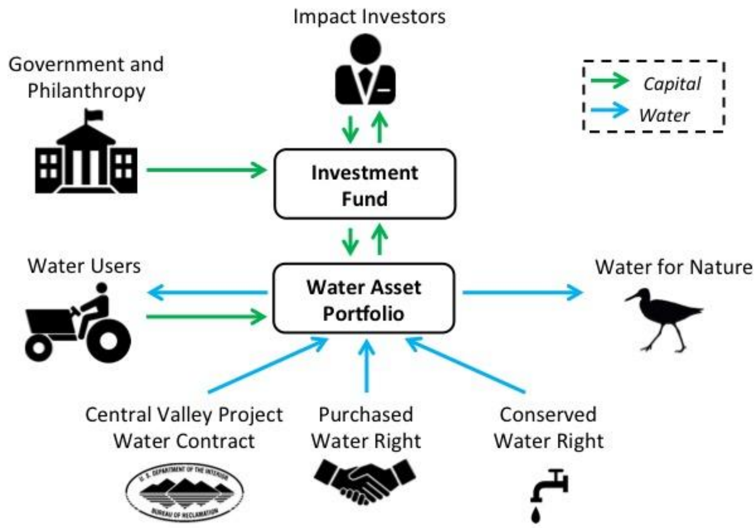

Figure I: Water Sharing Investment Partnership Model.

The objective is to create a financially self-sustaining mechanism for delivering water to nature without permanently removing it from the market and other productive uses. The WSIP can balance the needs of people and nature dynamically, by changing the annual allocation of water to meet shifting environmental and financial objectives.

Pilot Project: Murray-Darling Balanced Water Fund

In 2015, TNC joined forces with the Murray Darling Wetlands Working Group and Kilter Rural Asset Management Group to create the world's first WSIP in the Murray Darling Basin of southeastern Australia. The environmental goal of this WSIP is to deliver water to off-stream wetlands that have value for wildlife (including a species of endangered frog) and Aboriginal culture (Richter, 2016). While there are many differences between the climates, environmental needs, and water rights systems of Australia and California, the successful launch of the Murray Darling WSIP is a proof of concept, and its promising projections suggest that the WSIP could be a valuable tool to use elsewhere in the world.

Ecological Goals

The environmental purpose of implementing a WSIP in the case of this report and project is to create migratory bird habitat in the Sacramento Valley. This region is a linchpin of the Pacific Flyway, one of the longest bird migrations in the world. The fertile wetlands that once dotted the historical landscape provided optimal habitat for the birds. Between agricultural development, intensive management of the Sacramento River, and more recently drought, available habitat has significantly decreased. Over 95 percent of the wetlands have been converted to other uses, and most of that land is now privately owned. The Sacramento Valley is now the most heavily developed landscape that the birds of the Pacific Flyway cross (Robbins, 2014). Lack of resting space for the migratory birds has led to reduced breeding, reduced access to food, and increased incidence of disease, resulting in population decline. Several of the bird species in the Pacific Flyway are listed by the United States Fish and Wildlife Service (USFWS) as "species of concern," such as the Long-Billed Curlew and the Sandhill Crane (USFWS Division of Migratory Bird Management, 2008).

There are two ways TNC can use water from a WSIP to help migratory birds: one is by delivering water to the privately-owned rice fields of participants involved in TNC's BirdReturns program, and the other is by delivering water to the Sacramento National Wildlife Refuge (SNWR) system. These mechanisms can be seen as part of the broader effort spearheaded by the Central Valley Joint Venture (housed within USFWS) to protect migratory bird populations by securing water for "wetland restoration, wetland enhancement, riparian restoration, winter flooded rice, [and] waterfowl-friendly agriculture" (Daily Democrat, 2016).

BirdReturns

BirdReturns is a program that was developed in 2014 by TNC that uses dynamic conservation to create migratory bird habitat on privately owned rice fields. Through a reverse auction, TNC pays rice farmers to provide habitat on their fields for several weeks in the spring and fall, when habitat requirements are greatest. Farmers participating in BirdReturns typically create approximately 10,000 acres of habitat every year. The hope is that these new acres will increase the number of shorebirds that rest in the region from 170,000 to 400,000 (Robbins, 2014).

Currently, landowners participating in BirdReturns provide their own water for habitat, which is part of the cost of program participation. A frequent obstacle is that rice farmers do not have access to water to flood their fields, or the cost of finding extra water increases their bid price beyond what TNC is able to pay. The majority of BirdReturns participants use surface water purchased from an irrigation district to flood their fields. This means that participants typically do not own the water; they pay for use and delivery in addition to their own cost of application (which depends on their irrigation infrastructure) in order to create bird habitat. Also, approximately one quarter of participants use groundwater or some combination of ground and surface water, which typically involves additional costs related to pumping water.

As the number of farmers' bids to BirdReturns has increased, TNC has had to accept a smaller and smaller percentage of offered habitat due to the constraint of their existing budget. In fall of 2016, for example, only 36 percent of offered bids were accepted, meaning that demand for the program exceeded TNC's ability to accept bids. This represents over 15,000 acres of temporary habitat that could have been created and was not (Appendix II). If the price of bids were to decline, TNC could provide more habitat each year with the same level of funding.

One way to expand the reach of the program is for TNC to provide the water, so rice farmers would only need to rent out their land. The cost savings from providing water through the WSIP model would allow TNC to expand BirdReturns acreage within the existing program budget, raising the question of how much water would be required to meet program objectives. The goal of BirdReturns is to provide 10,000 acres of habitat each year, and the flooding requirement for ideal shorebird habitat is two to three inches (J. Barfield, personal communication, July 2016). Factoring in evaporation losses over time and saturation of the soil, this requires approximately six inches (or half an acre-foot (AF)) of water. Thus, a minimum of 5,000 AF of water per year would need to be acquired for the WSIP to meet the 10,000-acre habitat goal of BirdReturns.

Sacramento National Wildlife Refuge
In addition to the temporary habitat created by BirdReturns, the Sacramento Valley also has a network of national wildlife refuges (NWR) that provide vital habitat for migratory birds and may play a role as a recipient of water from the WSIP. The USFWS manages four permanent refuges in the Sacramento Valley – Sacramento NWR, Delevan NWR, Colusa NWR, and Sutter NWR (see Appendix III for map). The refuges are primarily made up of seasonally flooded wetlands, about 85-90 percent of the total refuge area (USFWS, 2009). The seasonally flooded wetlands are "intensively managed, with the timing and depths of water and vegetation manipulated" to create optimal habitat for wildlife, including shorebirds (USFWS, 2009).[4]

Achieving optimal habitat for birds is not always feasible because the refuge network is chronically short of water.[5] The Central Valley Project Improvement Act (CVPIA) of 1992 designates up to 135,000 AF of CVP water to refuges (USFWS, 2009), but this goal has never been fully met. In particular, the Sacramento River refuge is allocated 50,000 AF under CVPIA but currently receives only about 75 percent of that water (USFWS, 2009). Deliveries from a WSIP could help fill this gap. How much water (if any) TNC would provide the refuges would vary yearly depending on how hydrologic conditions impact the refuges' water need and the relative benefits of creating additional, temporary wetlands on privately owned farms.

Spatial Scope
The spatial scope of our project includes nine counties in the Sacramento Valley: Butte, Colusa, Glenn, Nevada, Placer, Plumas, Sutter, and Tehama (see Appendix V for map). The majority of our data collection and analysis was done on a per-county basis then aggregated to generate insights about the region as a whole.

Part I: Water Acquisition

California Water Law and Water Rights
There are two categories of water law in the United States: riparian and prior appropriation.[6] Riparian law is based on users' proximity to a natural body of water, such as a river or lake. Owners of property adjacent to a water source have a right to "reasonable use" of that water so long as other users are not harmed. Reasonable use was historically a judicial balancing test applied during suits between water users. Currently, many riparian systems allow for state agencies to set regulations explicitly defining reasonable uses.

Prior appropriation law is based on the concept of "first in time, first in right" – the right to water is granted based on the time that a user shows intent to divert or appropriate water, an actual diversion is made, and the user puts that water to "beneficial use." All subsequent appropriators are "junior" in right

[4] See Appendix III for historical water deliveries to SNWR
[5] See Appendix IV for wildlife refuge deliveries from 2002 to 2013.
[6] The water law information in the following section is drawn from *Water Law in a Nutshell*, *5th Edition* by David Getches, Sandra Zellmer, and Adell Amos.

to earlier appropriators. In the case of shortage, the most senior users will see their water right filled before junior users, with junior users receiving partial or zero allocations. Prior appropriation is also governed by the concept of "use it or lose it" – if an appropriator fails to divert water for a beneficial purpose, they can lose their water right and seniority. In both cases, riparian and prior appropriation, the right to water is a "usufructuary" right, meaning rights holders are entitled to use the water (subject to that use being reasonable and beneficial), but do not actually own the resource itself.

Generally speaking, the eastern half of the United States adheres to riparian water law, and the western half to prior appropriation; however, California is exceptional in that its water rights system is a combination of riparian and prior appropriation law. Prior to 1855, water users in California adhered to the riparian doctrine. The Gold Rush created challenges for this system, because miners asserted rights to water diverted away from riparian land (which they did not own, in any case, as all land was public domain). The 1855 court case *Irwin v. Phillips* established the new system of prior appropriation. However, those who held riparian water rights prior to this decision were still allowed to keep the rights (and are considered senior to all appropriators), creating a hybrid system. The system of prior appropriation continued in California without institutional structure or enforcement until 1914, when the State Water Commission (now SWRCB) was formed with the power to allocate and enforce water rights through permits, licenses, and regulations (Hanak et al., 2011).

Thus, there are three different types of surface water rights in California, each with its own distinct set of legal characteristics: riparian rights, pre-1914 appropriative rights, and post-1914 appropriative rights. Post-1914 appropriative water rights are the most legally well-defined of the three because they are under the management and regulation of SWRCB. They are also the most prevalent: there are over 15,000 post-1914 rights (SWRCB, 2017a) totaling over 80 million AF of water (Hanak et al., 2011). In comparison, there are only 276 riparian and pre-1914 appropriative rights, totaling 1.2 million AF (Krieger, 2015). Riparian and pre-1914 rights exist largely outside the bounds of California's water regulations,[7] and they make up a much smaller portion of total water rights.

This report focuses only on post-1914 appropriative water rights because in addition to being the most prevalent, they are the most clearly defined, and there is a trusted institution (SWRCB) in place to enforce the rights and facilitate trade. The WSIP is a market-based mechanism, and a critical component to any functioning market is well-defined, enforceable, and transferable property rights (Culp, Glennon, & Libecap, 2014). In other words, in order to have a market for water, participants in the market need to know exactly how much each water right allows them to divert and how they can use it; they need to trust that SWRCB will protect their right and enforce the rules, and that they have the ability to sell the right just like any other property. Additionally, the oldest water rights have the highest priority, and thus are the most secure. Because the WSIP needs secure assets to ensure a return on investment, this report only considers post-1914 water rights allocated before 1920. Water rights are also classified by their designated use (e.g. irrigation, municipal, industrial); because the Sacramento Valley is predominantly agricultural, only irrigation water rights are considered. In summary, the scope of the water rights analysis

[7] This is true with the exception of extreme circumstances, like the 2015 drought in which pre-1914 water rights holders were curtailed for the first time in history (Krieger, 2015).

in the following sections is limited to post-1914 appropriative water rights allocated before 1920 and designated for irrigation.[8]

Water Allocation and the Environment

When California's water rights system was being developed, water users and the government did not consider environmental water needs. There were relatively few users, and water seemed like a boundless resource. Water was not set aside or protected for environmental purposes, and the prevailing mindset of many water users throughout California's history has been that any water not withdrawn for human use is "wasted." The environment was not taken into account legally until 1969, with the passage of the National Environmental Policy Act (NEPA), and the California Environmental Quality Act (CEQA) and Endangered Species Act (ESA) in 1970. NEPA and CEQA both require assessment of the environmental impacts of new water uses and projects, and ESA provides a tool to mandate water deliveries to nature if endangered species are involved. Prior to these laws, most of the water in the state had already been allocated. The intervening decades have been characterized by conflict between advocates of human use and advocates of environmental use of water resources (Hanak et al, 2011).[9]

The WSIP model could be an effective tool for resolving seemingly conflicting human and environmental requirements for water. The first step would be to acquire water rights for the WSIP portfolio using capital raised from impacts investors and other funders and donors. The sections below discuss the legal, financial, and logistical feasibility of acquiring water rights in the Sacramento Valley.

Water Asset Types

This report identifies and evaluates two viable water asset types, which may be viable for the WSIP portfolio, and explores acquisition methods for each of these. The logistical, legal, and financial factors are considered for each mechanism. The first water asset type, as discussed above, is post-1914 appropriative water rights allocated before 1920 and designated for irrigation, referred to as "water rights." There are two mechanisms for acquiring water rights in the region: purchase rights directly on the market, or engage in on-farm water conservation.[10] The second water asset type is Central Valley Project (CVP) water--which is not a property right but instead is a contract between the user and the CVP, often referred to as "CVP contracts." The only mechanism for acquisition of CVP contracts is to work with USBR to receive unused water contracts, as contract holders cannot sell the contracts themselves.

Post-1914 Appropriative Water Rights

Regional Water Rights Analysis

There are one million AF of post-1914 appropriative water rights allocated before 1920 and designated for irrigation in the nine counties within the project scope.[11]

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[8] While acquisition opportunities for water rights outside of this narrow scope should still be given consideration for the SIP, this report focuses in on the prime water rights in the region.

[9] See Appendix VI for a timeline of California water policy development from 1848 to 2010.

[10] On-farm water conservation includes water "efficiency", but also includes the broader set of management regimes that change agriculture and land practices to reduce consumptive use of water.

[11] See Appendix V for map of project scope

County	Number of Rights	Total Volume (AF)	Percent of Rights	Percent of Volume
Butte	6	32,165	15%	3%
Colusa	10	487,349	26%	48%
Glenn	5	82,414	13%	8%
Nevada	1	12,500	3%	1%
Placer	1	54	3%	0.01%
Plumas	0	0	0%	0%
Sutter	13	394,296	33%	39%
Tehama	1	4,582	3%	0.40%
Yuba	3	21,243	8%	2%
Total	39	1,022,102	100%	100%

Table I: Permitted appropriative irrigation water rights in the Sacramento Valley which were allocated during or before 1920 (SWRCB, 2017).

These water supplies are divided among 39 water rights held by a pool of 30 users (SWRCB, 2017). This is a small group of entities and individuals who own rights to large volumes of water. For example, Sutter Mutual Water Company holds six of the 39 rights, which amount to 308,819 AF of water. Similarly, Reclamation District 108 holds two water rights that total 368,217 AF. Both users specify on their water use reports that they are engaged in water conservation efforts. In fact, 77 percent of senior water rights holders in the Sacramento Valley conserve water in some way, indicating that they may have unneeded water that they could be willing to sell. Fifty-six percent of the water rights holders hold another water entitlement, such as a CVP or State Water Project (SWP) contract. Those users who are conserving and/or have other water contracts are a good starting point for TNC's due diligence on acquisition prospects; they are the most likely to have water that they may be willing to sell, even though their current water conservation activities may not meet regulatory requirement for transfer.

Potential Challenges

Permanently acquiring water rights is expected to be the most challenging aspect of establishing of a WSIP. In addition to being expensive and legally cumbersome, permanent sale of water away from agricultural water rights holders is likely to meet strong cultural and political opposition from locals. Culp, Glennon, and Libecap (2014) describe this aptly in the excerpt below (p. 13):

> "Some western water users are extremely hostile to water marketing. Water users staunchly defend their water rights as essential attributes of private property, but they also view local access to water as an inherent entitlement that water rights owners should never bargain away. Local communities across the West routinely resist efforts by cities, industries, and private investors to move water away from its place of origin…"

Setting up a deal to permanently purchase water rights from a farmer or irrigation district will require building trust between parties, which will take time – and this is long before the actual transaction process begins, which is also lengthy. Pilz and Aylward (2013), themselves environmental water transaction practitioners, write that they “measure the effort required to secure a deal in the number of cups of coffee at a water right holder’s kitchen table.” Building personal relationships and establishing trust with sellers in the region will be a time-consuming but essential aspect of building the WSIP portfolio.

In addition to cultural and political hurdles, a second issue to be aware of is the potential discrepancy between the amount of water allocated on paper and the actual amount of water available for use. The right to divert and use water in California is based on historical use of the water (USBR, 2013). An investigation of the historical water use associated with the senior water rights discussed above revealed that while there are 1,000,000 AF of paper water rights, there may be less than half that volume available for diversion (Figure II).

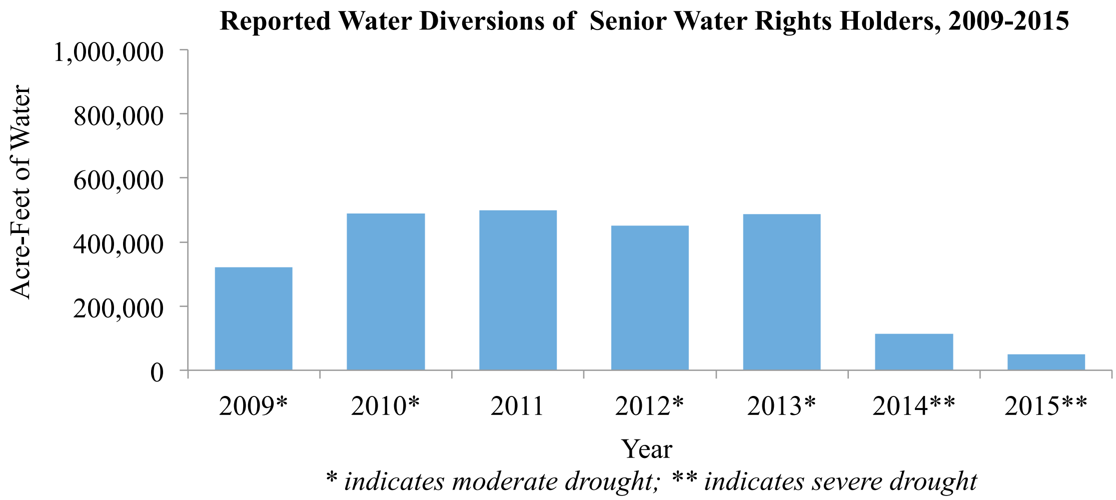

Figure II: Total annual water diversions by senior water rights holders in the Sacramento Valley from 2009 to 2015. Asterisks indicate drought conditions. Data from self-reported forms found on SWRCB’s eWRIMS database.

A related concern is the possibility of curtailment in drought years. While senior water rights possess the least risk of curtailment, they are not immune. In 2015, for example, when the Sierra snowpack was only five percent of normal and California’s major reservoirs were at half-capacity or lower (Stevens, 2015), 15 of the 39 senior rights holders had their water use fully curtailed (SWRCB, 2017a). This presents a risk to using WSIP water supplies for habitat or revenue generation. If a right owned by the WSIP were fully curtailed, revenue cannot be generated in that given year.

Acquisition Methods

This report explores two mechanisms for acquiring appropriative water rights:

1. Direct purchase of water rights.
2. On-farm water conservation.

Mechanism I: Direct Purchase of Water Rights

Purchasing post-1914 appropriative water rights from a current water rights holder entails several distinct costs, explained in the sections below.

Acquisition Cost

While SWRCB maintains records on transactions and changes to water rights, these records do not contain price information. A ten-year annuity based on average lease costs (Appendix VII) was used to estimate the costs of acquiring permanent water rights. That estimate is $2,682.60 per AF.

Legal Process

Once a sales agreement is reached, the first step towards acquiring the right is to notify the SWRCB of a change of ownership. This process, subject to California Code of Regulations, Title 23 § 830-831, is as simple as filling out the change of ownership form on the SWRCB website and sending it in. This can be done in a matter of days.

The second step is to submit a petition for change of use of the water right, subject to California Water Code § 1700. This consists of the following process (SWRCB, 2016):

1. Submit a petition application
   a. Option to couple petitions, allowing for change of multiple aspects of the water rights (e.g. place of use, time of use, and purpose)
2. Initial review of the petition application (30 days)
3. Environmental review (CEQA)
4. Public notice, and protest resolution (if necessary)
5. Hydrologic analysis
6. Issuance of revised water right, subject to the following conditions: the change does not initiate a new water right, can be made without injuring other legal users of water including the environment, and is in the public interest

In its entirety, the review process takes an estimated 5-7 years (SWRCB, 2016). This long timeframe presents a challenge to the establishment of a WSIP, and it is important for TNC to take this lag into account and plan accordingly. The SWRCB states that it may prioritize and expedite petitions in which "the applicant or petitioner has provided documentation showing the application or petition will enhance conditions for fish and wildlife" (SWRCB, 2016). While this is not a guarantee, TNC should fully explain the wildlife benefits of the water right change in their application to increase the chance of expedited review.

Transaction Costs

In addition to the actual purchase price of the water right, which is a cost paid to the previous owner, there are ancillary fees incurred in the petition for change process discussed above. SWRCB charges a change petition fee of $2,000 for any water transfer (SWRCB, 2017b). The applicant also needs to demonstrate no injury to other users, and give public notice, which may result in protests that need to be resolved and the costs of which can vary greatly depending on the number of surrounding water users and whether the petition is protested.

Aside from proving no injury and handling protests, the majority of transaction costs are likely due to environmental review (i.e. CEQA)(see Appendix VIII for CEQA process chart). SWRCB must consult with the California Department of Fish and Wildlife (CDFW) when (re)appropriating water (California

Water Code §1701.2). Of lesser note, CDFW staff requires an $850 fee to review applications to appropriate new sources of water, to change existing uses of water, and to transfer water (California Public Resource Code § 10005). Per Public Resource Code § 10005(d)(4), if the primary purpose of the change is for the benefit of fish and wildlife resources, the CDFW may issue an order to exempt the petition from the fee. It is unclear whether TNC could obtain this exemption; to be conservative this fee is included as a cost in the analysis. There is also a small volumetric change petition fee based on the size of the water right being changed.[12] It should be noted that these significant costs do not even include the legal and other diligence costs, which would add significantly to the costs of any transaction.

Because of large, volume-invariant transaction costs, economies of scale will be important for successful implementation of the WSIP. The per-unit cost of acquiring water decrease as transaction size increases. Figure III shows the estimated per-AF cost of acquiring water, including transaction costs. Per-unit costs are extremely high under 100 AF, and then start to flatten out around 100-300 AF. TNC should take this relationship into account when evaluating acquisition opportunities, and in most cases it will be unwise to permanently acquire a water right that is less than 100-300 AF.

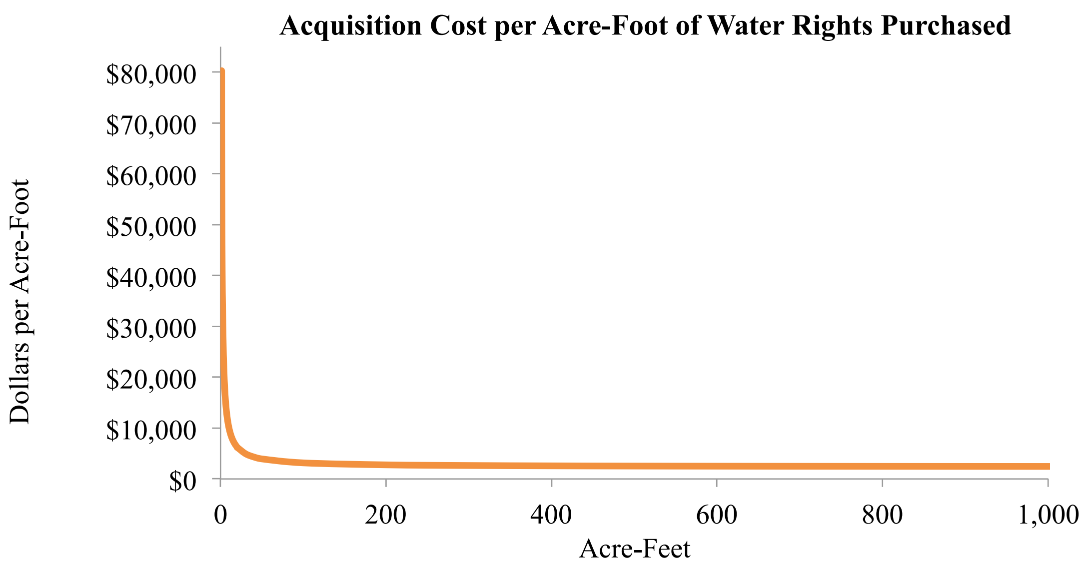

Figure III: This chart shows the effect of quantity on per-unit costs, for high fixed transaction costs. Per-unit cost starts to flatten out around 100-300 AF in a single transaction, so it is recommended that TNC pursues water rights that are at least 200 AF or larger.

Mechanism II: On-Farm Water Conservation

There are two different ways that on-farm conservation projects can be implemented in the context of the WSIP. The first method is to enter a joint venture with a water rights holder to improve the water efficiency of their farming practices. TNC would pay for the costs of switching to a less water-intensive crop and/or improving irrigation infrastructure in exchange for ownership of the water unlocked by these

[12] This fee is $0.30 per every AF over 10 AF, up to $506,145.

changes. By partnering with larger entities like irrigation districts, water companies, and reclamation districts, it may be feasible (although untested) to secure water rights for conservation projects at a larger scale and at a lower cost than dealing directly with each farmer. In such a scenario, the managing entity would reach out to their members to coordinate interest and facilitate the exchange. As different users will have different demands, it is unknown what compensation farmers will seek or how receptive they will be to this type of transaction. Thus, the second way to create a transferable water right through on-farm conservation projects is for TNC to purchase farmland with attached water rights and then implement on-farm conservation projects.

There are a multitude of possible on-farm water conservation projects, each providing different water savings and incurring different costs. Only those projects that reduce the consumptive use of water or prevent water from discharging into an unusable water supply (e.g. salt sink or unusable groundwater basin) make water available for transfer (Department of Water Resources & State Water Resources Control Board, 2015).[13] The primary on-farm conservation approach analyzed in this report is crop switching, though irrigation efficiency is also explored briefly.

Regulatory Context for On-Farm Conservation

Before exploring crop switching opportunities in detail, it is important to have a basic understanding of the laws and regulations related to on-farm conservation as a means of unlocking water to sell or transfer. California appears to be the only prior appropriation state that recognizes a right to transfer conserved water, though this recognition does not appear to have precipitated an increase in transfers. Squillace & McLeod acknowledge that, "California has done more than any other state in removing obsolete legal standards and seeking to overcome the obstacles to transferring conserved water…Notwithstanding these important reforms, California does not seem to have had much success in promoting transfers of conserved water" (pp. 22-23). Because the science of calculating on-farm water use and savings is complex, DWR and SWRCB have stringent rules for transfers using this approach.

Water Use Classification

To determine what practices qualify as water conservation, it is important to understand the difference between reasonable, beneficial and consumptive uses (Figure IV). The beneficial use of water is the amount of water that is required to grow a crop, including water for leaching (salt removal), microclimate control (heat and frost protection), and crop evapotranspiration (Etc or ET).[14] Reasonable uses include all beneficial uses of water, as well as some non-beneficial uses: reservoir and conveyance evaporation, sprinkler evaporation, and water needed to maintain water quality standards. Unreasonable uses occur when water is applied in excess of what is necessary to grow a crop and includes excess percolation or surface runoff. Consumptive use is the portion of applied irrigation water that is lost to the atmosphere,

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[13] Many irrigation efficiency projects, like the lining of canals, help decrease the water that is lost to seepage, but do not generally result in generating water savings which meet current regulatory requirements for transfer. Seepage percolates back into the stream and is not counted against the consumptive use of the farm.

[14] Evapotranspiration (ET) is a term that combines the processes of transpiration from plants and evaporation from soil and wet plant tissue (Sandoval-Solis et al, 2013).

used by the crop for ET or growth, or that is considered irrecoverable and does not return to the system (Sandoval-Solis et al, 2013; Pacific Institute, 2014).

	Reasonable & Consumptive Use	Unreasonable & Non-Consumptive Use
Beneficial Use	- Crop evapotranspiration (Etc) - Water harvested in the crop - Evaporation for cooling - Evaporation for frost protection - ET of beneficial crop plants	- Water for leaching (salt removal)
Non-Beneficial Use	- Soil evaporation - Spray (sprinkler) evaporation - Weed evapotranspiration - Reservoir and canal evaporation - Water needed to maintain water quality standards - Phreatophyte[15] evapotranspiration	- Excessive deep percolation - Excessive tailwater (surface runoff) - Operational spill

Figure IV. Classifications of water uses in California: (un)reasonable, (non-)beneficial, and (non-) consumptive. Adapted from Sandoval-Solis et al, 2013 and Pacific Institute, 2014.

Conserved Water Transfers

The California Water Code dictates that water can be transferred if the water would have been "consumptively used," which is defined as "water which has been consumed through use by evapotranspiration, has percolated underground, or has been otherwise removed from use in the downstream water supply because of direct diversion" (Water Code § 1725). Additionally, water can be transferred if "the use of which has been ceased or been reduced as a result of water conservation efforts" (Water Code § 1011). To determine the quantity of water conserved, DWR looks at the evapotranspiration of applied water (ETAW), which is the portion of applied water that is beneficially transpired by plants, retained in plant tissues and evaporated from adjacent soil surfaces. It does not include applied water from conveyance losses or water lost to deep percolation, unless the water is lost to an unusable groundwater basin or saline sink. ETAW[16] is like Etc but does not include the portion of Etc that is met by precipitation or stored in the root zone prior to the growing season, it is a seasonal estimate. ETAW values are calculated by DWR's Land and Water Use office, which estimates ETAW for a list of 20 crop categories.[17]

[15] Deep-rooted riparian vegetation that may provide important ecological services and could be beneficial in some cases.
[16] The portion of applied water that is beneficially transpired by plants, retained in plant tissues and evaporated from adjacent soil surfaces.
[17] ETAW values averaged from 1998-2000 for this project's scope.

Water conservation projects that create conserved water, can be transferred once it is shown that consumptive use (ETAW) of the current agricultural practice will change following the conservation project. There are four methods for creating conserved water: irrigation efficiency projects, deficit irrigation, rotational fallowing (crop-idling), and crop switching.

Conservation projects that deal with irrigation efficiency (e.g. switching from flood to drip irrigation, decreasing evaporative losses, and lining or replacing canals to decrease the amount of water consumed by riparian vegetation) may be possible if sufficient documentation is provided. However, for these other water conservation techniques, it can be extremely difficult to prove that consumptive use has changed, thus much more uncertainty exists. Consequently, irrigation efficiency projects and deficit irrigation are of secondary importance due to the uncertain water benefits, financial costs, and onerous/uncertain approval process for transfers. Details on irrigation efficiency, deficit irrigation, rotational fallowing, and crop switching, are provided in the following sections.

Agency Guidance and Restrictions on Conserved Water Transfers

In addition to the case-by-case review, DWR and USBR (2015a) also list certain crops that are uniformly ineligible for crop switching to unlock water for short-term transfer. These particular crops are ineligible due to difficulties predicting the amount of new water made available, unreliable ETAW estimates, variability in planting practices, or other crop-specific issues.

Crops Allowed for Transfer			**Crops Not Allowed for Transfer**
Alfalfa	Onion	Sunflower	Alfalfa (Delta, Foothills, or Mountain Areas)
Beans	Pumpkin	Tomato	Pasture
Corn	Rice	Vine Seed	Orchard
Cotton	Sudan Grass	Cucurbits	Vineyard
Melon	Sugar Beets	Wild Rice	Mixed and miscellaneous grasses (ie. Bermuda)
Milo	Safflower (idle only)		

Table II: Crop Shifting/Idling Crop List (DWR & USBR, 2015a).

For example, switching from alfalfa is allowed in the Sacramento Valley but not in other regions (like the foothills). This is because ETAW values differ substantially in other areas due to differences in the rates of seepage and weed growth. Switching from irrigated pasture is not allowed because cultural practices in planting pasture lead to different mixes of weeds that have different consumptive uses. While safflower has a low ETAW, it is only eligible for idling due to its deep roots that tap water stored deeper in the soil profile leading to a potentially high consumptive use. Other prohibitions generally include:

- Removing permanent crops.
- Fields that are historically irrigated by groundwater.
- Idling of crops where groundwater is within five feet of surface or where the crop roots can reach.
- Shifts in cropping pattern that would increase cropped acreage.

- Any idling or shifting that is a normal practice, or part of a transfer to permanent crops or organic agriculture.

However, these blanket restrictions are not necessarily applicable for permanent or long-term transfers, if sufficient evidence of water savings can be provided. Thus, these crops are still included in the crop switching analysis for this report. Overall, limitations and prohibitions may change as technology allows more accurate assessments of baseline conditions and actual consumptive use on a sub-regional basis.

Information, Monitoring and Reporting Requirements

Agencies require a variety of information for transfer proposals and monitoring purposes, in order to accurately determine the quantity of conserved water that is transferred and to ensure that such a transfer will not cause injury. The requirements listed below may be more stringent for long-term transfers. To transfer conserved water, agencies need to determine conditions that would occur without a transfer, to do this a variety of information is required (DWR & USBR 2015a):

- Accurate crop records for the five previous years are required. This crop history needs to include the crops typically grown, the degree of land fallowing that typically takes place, and the crop rotation practices that typically occur.
- Maps showing farm boundary, irrigated fields, fields that are not irrigated or routinely followed, and fields enrolled in conservation, habitat or mitigation programs.
- Acreage that would otherwise remain idle due to shifts to organic or permanent crops will be excluded from the baseline calculation.
- Proof of the water right or contract for use of surface water during the transfer period.
- For individual farm operations or small water districts the five-year crop history is required and the average ETAW values should be calculated based from this history. For large irrigation districts with consistent cropping patterns, the previous year's ETAW and crop records may be sufficient.

Besides the requirements needed to calculate baseline conditions for a transfer proposal, reporting is also required of the transfer proponent. DWR and USBR (2015a) require a monitoring and reporting plan to assure the creation of new water, this plan can include:

- Current and past year(s) cropping data and diversions.
- Map of lands partaking in water transfer.
- Verification of correct crop shift, ETAW calculations, reduction in soil moisture and no water leakages onto idled lands.
- Monitoring and evaluation for land coverage for excessive vegetation on idled fields along with proposed abatement efforts.
- In-field instrumentation may be required to calculate transferable water for certain crops or areas due to variables such as high groundwater or excessive seepage.

Adjustments to ETAW

Calculating transferable water based of ETAW can vary depending on hydrologic conditions and destination of transfer. If the destination of the transfer is south of the Delta, the transfer (which in some years may not be possible due to transfer capacity constraints) will be constrained to consumptive use, measured in this case by ETAW. Thus, only the portion that can be directly exported or stored is eligible for transfer and DWR adjusts ETAW values accordingly (Appendix IX).[18] If the transferor's water supply allocation is reduced when crops are idled or shifted, the ETAW may be reduced if they cannot demonstrate how they would meet full consumptive use based off "historical diversion data, additional recycling or other conservation measures" (DWR & USBR, 2015a, pp. 19). If the transferor cannot make this demonstration then "the baseline for the seller will be based on a calculated ratio of the "district efficiency" or ETAW/diversions" (DWR & USBR, 2015a, pp. 19). This takes their maximum diversion and divides by the past ETAW to get an efficiency, they would then apply this efficiency to the water allocations for the shortage year to calculate the ETAW. Overall, ETAW values used to determine the amount of transferable water will be adjusted in accordance with the conditions of each transfer.

Crop Switching Analysis

As previously mentioned, crop switching refers to the shift from growing one type of crop to another on a parcel of land. In the context of water transfers, crop-switching projects change crops from water-intensive to water-efficient crops to yield conserved water. According to DWR, for crop switches to result in conserved water that is transferrable, the crop that a producer switches to must reduce the surface water use by having an ETAW that is lower than the crop grown in absence of the water transfer (DWR & USBR, 2015a). Crop switches that harm legal users of the water (downstream users) or that cause unreasonable harm to the environment cannot legally result in transferable conserved water (DWR & USBR, 2015a).

Crop switching for the purposes of transferring conserved water can be complex. In addition to the requirements set forth by DWR and the ETAW of crops, the likelihood of a crop switching projects taking place is also dependent on the agricultural, economic, and cultural landscape of the region. The crops farmers choose to grow in the Sacramento Valley are the result of several different factors including: water availability, market demand, price, soil type, social factors, access to processing facilities and availability of the equipment and expertise. Given all these factors, the crop a farmer selects is not always the crop that uses water most efficiently. Producers are often slow to change their crops to a more water efficient type due a lack of processing facilities in their region for alternative crops, misaligned economic incentives (i.e. subsidies), a lack of information or training in farm practices, cultural resistance, and a lack of access to capital needed to fund the conversion of crops, purchase of infrastructure, and other adaptations needed for new crops (Encourage Capital & Squire Patton Boggs, 2015). The factors that limit producers' ability to switch to more water and economically efficient crops provide an opportunity for the WSIP. While a WSIP may have a role in establishing processing facilities or providing training, this report focuses on the opportunity for the WSIP to provide capital needed to switch crops. This section provides an overview of the crops grown in the Sacramento Valley, an analysis of potential switching scenarios, a discussion of two crop-switching project structures and the risks, uncertainties, and constraints of the crop switching mechanism in the region.

[18] A carry water allotment of 20% maybe reflected in DWR's seasonal ETAW values for short-term transfer (Appendix IX).

Crops Grown in Sacramento Valley

Like much of California agriculture, the farmland in the Sacramento Valley region is recognized for its diversity, productivity and high value. The valley produces a wide array of crops including: rice, nuts, citrus, row crops, and a variety of vegetables. In addition to nursery and crops grown for seed, Table III lists the 26 different crop categories grown in the nine-county area that comprise the project scope, along with their water use and 2015 acreage.

Dryland pasture, rice, irrigated pasture and orchard crops, like almonds and walnuts, are the area's largest crops in terms of overall acreage. The 26 crop types vary greatly in the amount of water they consume.[19] In general, irrigated pasture, alfalfa, and orchard crops result in the most consumptive use; while tomatoes, beans, grapes, wheat, and oats have some of the lowest consumptive water use. Except for dryland pasture, the crops with the most acreage are also the crops with higher ETAW values in this region. Because water intensive crops are prevalent in this region, the volume of water that could be acquired via crop switching is not likely to be limited by acreage of crops to switch from. While they are useful for understanding general trends for crops, actual ETAW values are farm-specific and will vary with climate, soil type, and other variables.

[19] ETAW values were calculated by aggregating county-level data from DWR from the nine counties in the project scope from 1998-2010.

Crop	ETAW (AF per acre)	2015 Bearing Acres
Alfalfa	3.02	35,521
Almonds	2.52	157,133
Apples	2.49	40
Beans	1.44	13,798
Citrus	2.06	670
Corn	1.86	24,306
Cotton	2.14	1,414
Grapes	1.32	3,619
Hay – other	0.64	20,234
Melons	1.02	640
Oats	0.64	9,157
Olives	2.06	20,812
Pasture dryland	0	2,057,363
Pasture Irrigated	3.09	118,196
Peaches	2.49	11,541
Pears	2.49	0
Persimmons	2.49	172
Pistachios	2.52	1,882
Plums and prunes	2.49	41,187
Rice	2.14	393,888
Safflower	0.7	5,370
Strawberries	1.63	23
Tomatoes – processing	1.81	30,209
Vegetables – misc.	1.63	3,070
Walnuts	2.49	159,332
Wheat	0.64	38,635

Table III: Full list of 26 crops, with water use and acreage, that are grown in the counties within the project scope. Data from 2015 county-level crop reports and DWR county-level Agricultural Land and Water Use Estimates.

Defining Priority Crop Types and Switching Combinations

The overall diversity in crops grown and the variation in consumed water, costs of growing, costs of establishment, and market demand among the crops provides an opportunity to be strategic when deciding which crops to switch. Not every crop type grown in the Sacramento Valley may be a viable and cost effective crop to consider switching to or from. Therefore, the list of 26 crop types was narrowed to four priority crops to switch away from: alfalfa, irrigated pasture, peaches, and plums, and five crops to switch to on a farm: beans, melons, oats, safflower and wheat.

The prioritized list of crop types was established to help analyze whether crop switching is a viable option for acquiring water and identify the best crop switching opportunities for the WSIP to pursue. For instance, identifying the top four water intensive crops to switch away from can help crop switch implementers target farmers. Once the priority crops were identified, the assessment also investigated specific information for the priority crops' abundance, net profits, costs for switching, and market trends. This information helps one to better understand the potential of various crop switching scenarios, as well as provides information for the crop switching financial model discussed later in the report.

The priority crop list was determined by selecting the ten crop switching combinations that unlock the most water. The amount of water unlocked was calculated by comparing the ETAW values of the crops that would be switched from and to. The following restrictions were applied prior to ranking and selecting the top ten switching combinations:

1. Switching combinations must result in positive amounts of water unlocked
2. Crop types with less than 100 bearing acres in the region were excluded
3. Crop types without net profit data were excluded
4. Switching combinations must result in a positive change in net profit per acre
5. Cannot switch to permanent crops (trees and grapes)[20]
6. Crop data must come from the Sacramento Valley region

Given these constraints, the top 10 priority switching scenarios were irrigated pasture or alfalfa to melons or beans (four switches); peaches to oats, wheat, melons, or safflower (four switches); plums & prunes to melons, and almonds to melons (Table IV).

[20] Multi-year perennial crops, like citrus, nuts, apples, grapes, etc., were excluded as potential crops to switch to because they harden demand for water over the long term and reduce the flexibility to fallow or idle, to reduce consumptive use in times of drought.

Switch Scenario	Water Unlocked (AF/acre/yr)	"From" ETAW/ acre/yr	"To" ETAW/ acre/yr	Profit/ acre/yr Change	"From" Profit/ acre/yr	"To" Profit/ acre/yr	"To" Switching Cost/Acre	"From" 2015 Bearing Acres	"To" 2015 Bearing Acres
Irrigated Pasture to Melons	2.07	3.09	1.02	$39,909	$63	$39,972	$14,071	118,196	640
Alfalfa to Melons	2.00	3.02	1.02	$39,788	$183	$39,972	$14,071	35,521	640
Peaches to Oats	1.85	2.49	0.64	$1,150	-$1,170	-$20	$181	11,541	9,157
Peaches to Wheat	1.85	2.49	0.64	$802	-$1,170	-$368	$621	11,541	38,635
Peaches to Safflower	1.79	2.49	0.70	$1,185	-$1,170	$15	$226	11,541	5,370
Irrigated Pasture to Beans	1.65	3.09	1.44	$226	$63	$289	$738	118,196	13,798
Alfalfa to Beans	1.58	3.02	1.44	$106	$183	$289	$738	35,521	13,798
Almonds to Melons	1.50	2.52	1.02	$39,123	$849	$39,971	$14,071	157,133	640
Peaches to Melons	1.47	2.49	1.02	$41,142	-$1,170	$39,972	$14,071	11,541	640
Plums & Prunes to Melons	1.47	2.49	1.02	$39,163	$809	$39,972	$14,071	41,187	640

Table IV: Top ten crop switching scenarios, with ETAW, profit, cost, and acreage comparisons.

In addition to unlocking water, the most useful crop switch combinations for the WSIP are combinations that result in a positive increase in the net profit per acre for the producer. Increasing profits provide an economic incentive for producers to participate in the crop switch project and can result in long-term financial "compensation" for the portion of water rights the producer transfers to the WSIP. The change in net profit for each priority crop switching combination was calculated using the net profit per acre estimates determined in region specific crop costs studies. All ten combinations result in a positive change in net profit with melons resulting in the highest increases in profit regardless of the crop you are switching from (Table IV). While this indicates that these switches are potentially economically beneficial, net profit data should be viewed with some scrutiny.

Net profit estimates are determined using revenue and costs estimates for specific crops. While agriculture revenue data for crops is widely available, the corresponding costs associated with growing crops is not tracked with the same regularity and detail. Cost studies for crops present the best option found to date for estimating agricultural costs and more importantly, using that information to calculate net returns by combining cost estimates with returns. Studies are conducted on infrequent intervals for a host of crop types in the Sacramento Valley as well as other locations in the state. Authors of the cost studies use a series of assumptions to describe a representative farm for that crop type and calculate the costs and net profits per acre based on those assumptions. Cost studies are helpful for gaining insights into the components and relative scale of costs and profits for each crop type, but the infrequency and irregularity of their calculation and dependence on detailed assumptions that may or may not be representative of farms growing those crops region-wide, make it difficult to analyze how the net profits vary at a regional level and over time.

Concerns about the net profit data apply to costs studies for all priority crops, and there are a few crops that highlight these concerns about the cost study data and reinforce the need to be cautious with the findings they support. For example, according to the top crop switching combinations analysis, melons are the most profitable crops, with profit increases ranging between $39,000-$42,000, a whole magnitude larger than other combinations. The large profit increase for the priority crop switching combinations involving switching to melons is primarily due to the high net profit of $39,927/acre/year (Table IV) for melons which is driven by the costs study's revenue estimation of $65,045/acre/year.

Based on the available raw data one would assume melons are highly lucrative and there should be enough financial incentive for producers to convert their land to growing melons even in the absence of the WSIP. However, a closer look into the estimation of melon revenue per acre in the cost study sheds light on why that conclusion may not be definitive. The $65,045/acre/year revenue value from the melon cost study is based on an estimated price (dollar/ton/year) and yield per acre of melons (tons/acre/year). The price per ton value estimated in the study bases the value on assumption that only 20 percent of the melons will be sold wholesale, while 80 percent of the melons will be sold at farmers' markets for higher prices (Fake et al., 2009). This is problematic because it is not clear whether this assumption will hold true for all melons produced in the Sacramento Valley. Furthermore, the estimated average price per ton is almost five times the average price from the crop reports average in the region of study, leading to inflated revenue estimates. Also, the melon cost study estimates a yield of 25.5 tons/acre/year (Fake et al., 2009), while recent country crop report data suggests an average yield of 10.8 tons/acre/year between 2010 and 2015 in the Sacramento Valley. This means that the cost study estimates for melon revenue are based on yields that are nearly two and a half times larger than the current yield rates in the Sacramento Valley, leading to a possible significant overestimation.

Additionally, when comparing net profit data of priority crop switching combinations there are several combinations that result in positive changes in profit but still result in a negative net profit per acre value. This occurs when switching from a crop, such as peaches, with a net profit per acre value that is negative, to a crop, such as Oats, which has a less negative net profit value (Table IV). In some cases, the costs studies can calculate a negative net profit because the assumptions made in the studies result in costs exceeding the revenue per acre. While this may be an accurate portrayal of the conditions at play when the cost study was conducted and does occur in the real world, assuming an indefinite negative profit for both crops to switch to and from does not make sense. If farmers are rational economic actors, they cannot continue to plant crops that lose money continually.

Profits for crops are volatile and fluctuate with market demand, yields, and input costs, therefore selecting a single net profit number (positive or negative) is not the best representation of the profits when thinking about the long term economic impact of crop switch projects (Encourage Capital, 2015). However, in the absence of dependable and regular costs data to compare with the available revenue data, costs study values offer the best insight into net profit for crops in the region. For the purposes of this report it was assumed that a positive change in net profit based on data from costs studies was indicative of a financially beneficial crop switch, but additional research into the net profits of the priority crops would be beneficial prior to implementing a crop switch project.

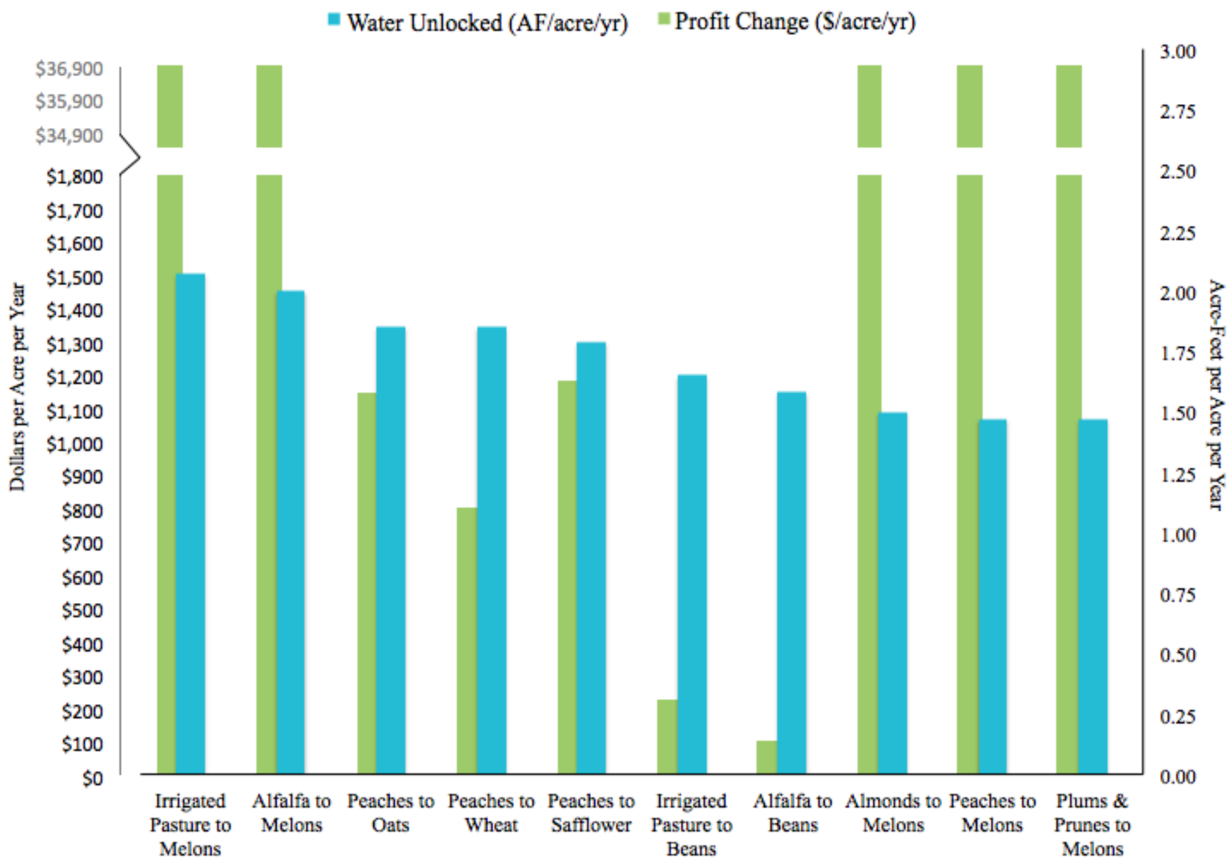

Figure V: Water savings (blue) and profit increases (green) for the top 10 crop switching scenarios. Data from 2010-2015 annual county crop reports and UC Agricultural Issues Center Crop Cost Studies (2016).

Crop Market Trends

As previously discussed, commodity prices are driven by the supply from producers and demands of buyers. Understanding recent changes in supply and demand of different crops can give insights into future expected prices, which helps improve the understanding of a crop switch project's profitability and potential economic impacts.

Bearing acres of crops is one measure of the supply of various crops in the in the Sacramento Valley. Most recently, water intensive crops – alfalfa, almonds, irrigated pasture, peaches and plums/prunes –

make up the majority of bearing acres (86 percent) of the priority switching crops. The remaining 14 percent is made up of water efficient crops – beans, melons, oats, safflower and wheat (Figure VI). A large majority of water intensive crop acreage means that crop switching will not be limited by the availability of acres to switch from.

Analysis has determined that switching a small percentage of current water intensive crops acreage to water efficient crops can unlock enough water to meet needs of the WSIP. Estimates suggest that between 2,400-3,400 acres of water intensive crops would need to be switched to water efficient crops to free up 5,000 acre feet of conserved water. In context, that is less than one percent of the 428,656 total priority crop acreage that would need to be converted based on 2015 acreage numbers.

Relative Footprints of Priority Switching Crops

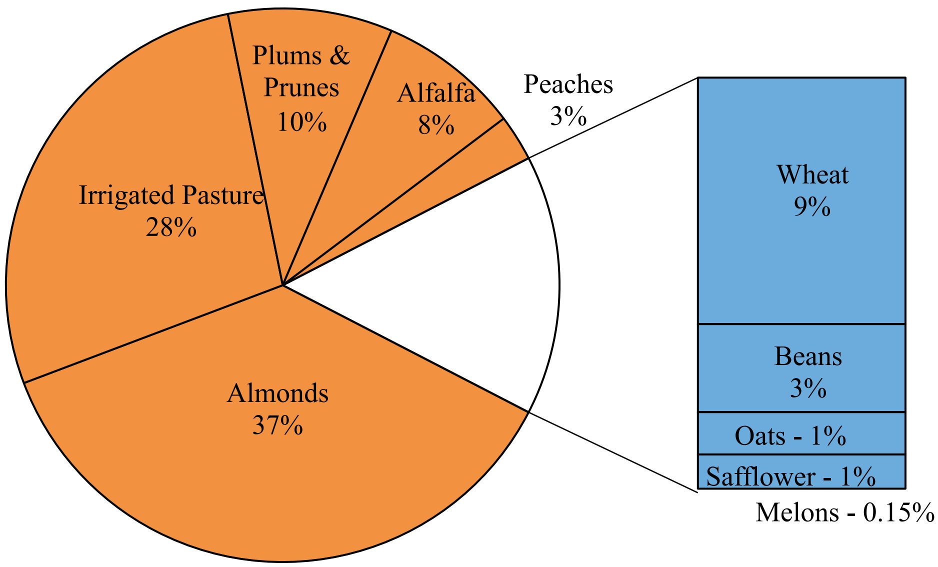

Figure VI: Priority crop footprints based on 2015 bearing acreage. Data from 2010-2015 annual county crop reports.

Acreage values of each priority crop type vary year to year as farmers rotate their crops and respond to commodity demands. Between 2010 and 2015, acreage for oats, safflower, and almonds has increased in the Sacramento Valley, while beans, irrigated pasture, peaches, alfalfa, melons, and wheat have all experienced declines in crop acreage (Figure VII). While most acreage reductions range from thousands to tens of thousands of acres, wheat acreage was reduced by nearly 125,000 acres, an amount that was a whole magnitude higher than any other reductions.

As previously mentioned, the decision of what to grow on a farm is the result of many complex factors and it is difficult to pinpoint exactly why wheat acreage has decreased so significantly or what the acreage trends indicate in general. It is possible that increases in acreage for water efficient crops like oats and safflower support the claim that those crops are economically viable crops to switch to, but it is not certain. Additional data or anecdotal information on what crops producers have recently switched between would help to clarify acreage trends.

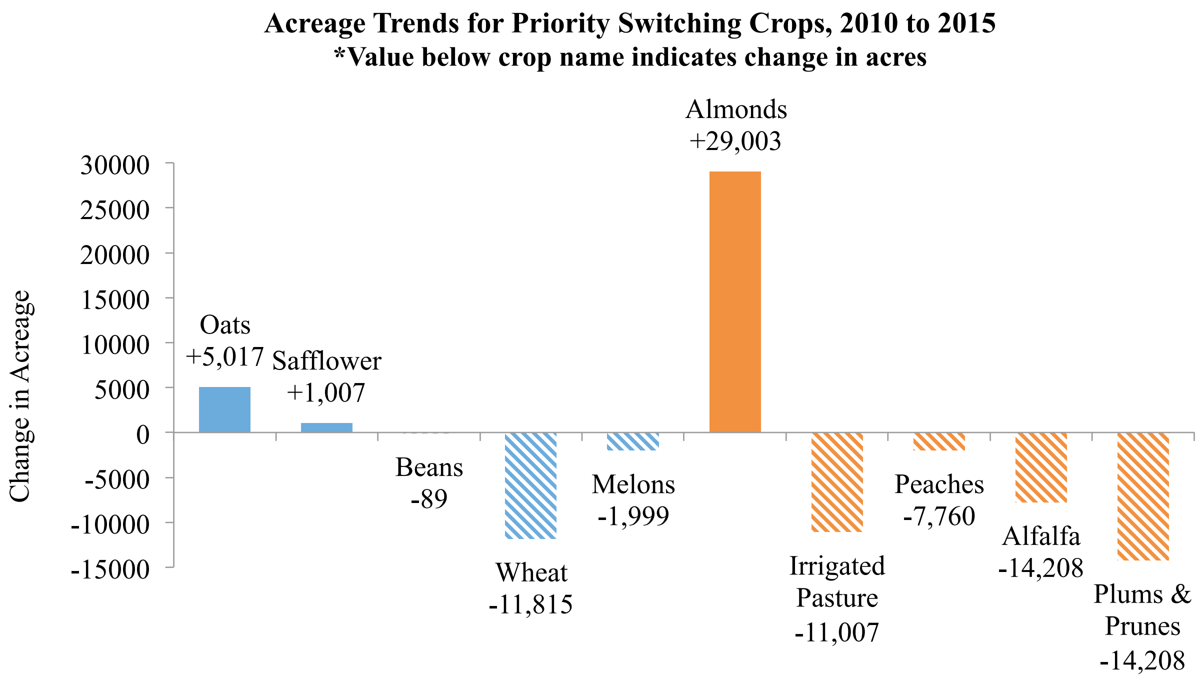

Figure VII: Change in bearing acres for priority crops between 2010 and 2015. Data from 2010-2015 annual county crop reports.

Estimating prior demand for different crop types from the Sacramento Valley is also challenging and complex; however, changes in revenue for crop types in the Sacramento Valley can provide some insight into recent changes in market demand. Annual revenue/ton values for each crop type in the region were obtained by averaging revenue/ton data from annual crop reports conducted by the nine counties of interest. Figure VII summarizes the percent change in revenue/ton between 2010 and 2015 for the ten priority crop types. Three of the five priority crops switch-to-crops have experienced a positive percent change in revenue/ton, with wheat and melons being the exceptions.

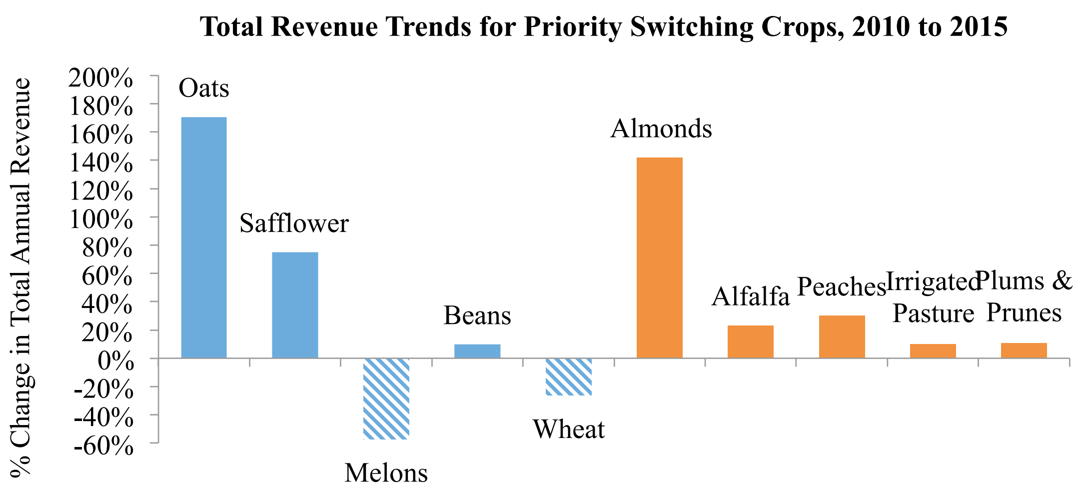

Figure VIII: Changes in priority crop revenues (annual for regional scope) between 2010 and 2015. Data from USDA.

Oats and safflower have particularly large increases in revenue/ton, indicating a possible increase in demand for those commodities. It should be noted that all five priority crops to switch away from, almonds, alfalfa, irrigated pasture, peaches and plums/prunes have also seen positive increases in revenue/ton. If this is indicative of an increase in demand, it may be harder to convince producers growing those crops to switch to something different.

Switching Costs

The upfront costs of switching from one crop to another are also important when considering the economic feasibility of a crop switch project. The initial establishment of a new crop may require different equipment, infrastructure, land preparation, fertilizer inputs, processing or storage facilities, etc. These upfront costs to switch crops can be a barrier for producers to switch to more water efficient crops even if the water efficient crop is more profitable in the long-term. While the upfront costs to switch are highly dependent on farm-specific characteristics, such as existing infrastructure, land condition, and equipment, cost study data can be utilized to provide a general understanding of the upfront investments for different crops.

For perennial crops such as tree crops, grapes, and cotton, the costs per acre to establish are usually well-understood and specifically calculated in cost studies. However, due to the high water consumption of most tree crops and the hardening of demand, these are not viable crops to switch to. Although it is more challenging to determine switching costs for annual plants because they must be replanted every year, there are initial investments that must be made to ready the farm for the long-term conversion to the new annual crop. For the purposes of this analysis, the switching costs for annual crops were calculated using one year of field prep (pre-plant or planting costs), cultural costs, and non-cash overhead from crop cost study reports.[21]

Table V includes the estimated crop switching costs per acre for the priority crops that would be switched to (beans, melons, oats, safflower and wheat). Notably, melons have the highest estimated switching cost per acre, while oats have the lowest cost to switch. The high variability in switching costs per acre between the five priority crops types is primarily the result of differences in irrigation, labor (mechanized versus by hand) and the costs to use the land.

Cost studies for beans include cultural costs for pre-irrigating the fields five times prior to planting. This cost includes both the cost of water and labor and makes up between \$200-\$300/acre of the \$738/acre estimated switching costs (UC Agricultural Issues Center, 2016). Crops with lower switching costs, oats, safflower and wheat, do not require pre-irrigation and are relatively cheaper. While the other priority crops assumed flood irrigation or irrigation via siphon pipes, the switching costs of Melons were estimated assuming the use of drip tape irrigation. This increases the switching cost relative to other crops

[21] In some cases, such as perennial orchard crops, there are costs associated in the removal of the prior crop. In the absence of data, the costs of removal of prior crops were not included in the calculation of switching costs. Furthermore, to minimize the impacts cost of the removal, it is recommended that the WSIP consider switching from perennial crops for those farms that are reaching the end of their productive lifespan. At that point farmers will already have to pay for the removal of their perennial crop and there will not be foregone profits that are not realized by removing crops early.

because it requires the initial purchase of drip tape and adds to labor costs. Drip tape must be installed at the beginning of each year, a labor costs not included for other crops.

The labor methods for preparing and maintaining fields required by different crops can also highly influence the switching costs per acre. The main difference in costs exists between manual and mechanized labor. Field preparation (plowing) and planting of row crops – oats, safflower, and wheat – lends itself to highly mechanized methods, which keep labor costs down (UC Agricultural Issues Center, 2016). Conversely, melon costs include hand plantings and hand hoeing which are relatively expensive. For example, oat-planting costs were estimated to be roughly $67/acre, while hand planting of melons is $592/acre.

Additionally, some cost studies include land costs, such as a mortgage payment, in the non-cash overhead costs. This was the case for both wheat and melons switching cost, which were estimated at $263/acre and $5,646/acre[22] respectively (UC Agricultural Issues Center, 2016). Ideally, the WSIP would not be covering the costs related to the land as they are specifically a cost for switching crops. However, for this report they were included in order to be consistent with calculations of switching costs across all crop types by including all line items identified in the non-cash overhead.

Other more minor drivers of crop switch cost variability include differences in the amount and type of fertilizer, pest control strategies (deer fencing, herbicide, traps, etc.), use of cover crops, complexities of field geometry (rows, beds, leveling, etc.) and upfront supply costs for harvest. The latter being specific to melons which required the purchase of boxes for fruit transportations.

Switching cost values on their own cannot indicate whether a crop switching option is economically viable. Instead, this information must be combined with profit and farm-specific information in a financial model to understand which, if any, crop-switching scenarios make sense for the WSIP.

Crop	**Switching Cost**
Melons	$14,071
Oats	$181
Wheat	$621
Safflower	$226
Beans	$738

Table V: Switching costs of priority “to” crops.

[22] The land cost was extremely high in this case because the cost study assumed a land value of $100,000 per acre due to the land also being a homestead.

If a crop-switching project is specifically designed to free up water that will be assigned a new owner and/or a different use or point of diversion, the upfront transaction cost estimate should also include the costs and fees associated with changing a portion of the water right. While the transaction costs for changing the water rights are likely to be different than the cost associated with the direct purchase of a water right, there are no indications that the cost difference would be significant. Therefore, in the absence of transaction costs of changing water rights specific to crop switching projects, the upfront transaction costs and fees associated with the purchase of an appropriative right can be used as an estimate.

The California Water Code makes conservation[23] efforts beneficial, so any changes in diversions due to efficiency and conservation projects do not change the user's appropriative right and allow them to sell or transfer the difference. However, non-consumptive changes are harder to transfer or sell as this water is usually used downstream and thus can cause injury. Irrigation efficiency projects that decrease consumptive evaporative losses do create "new water," which can be transferred. These projects include changing irrigation systems that reduce the ETAW from soil moisture (drip irrigation instead of flood), lining, closing, or implementing direct delivery irrigation systems, more efficient scheduling of water applications (data to inform irrigation scheduling), better managing irrigation delivery systems. A recent report from Richter et al. (2016) lays out estimates for water savings of different irrigation efficiency methods. While the actual water saved will vary depending on many factors such as climate, soil type, geographic region, and hydrologic conditions, the report provided a short list of estimates for irrigation efficiency projects in California.

Water-Saving Measure	**Saved Volume (AF/acre/year)**	**Water Savings %**
No-till farming	0.33	13%
Switch from flood (furrow) to sub-surface drip – LOW estimate	0.35	32%
Switch from flood (furrow) to sub-surface drip – HIGH estimate	0.49	57%
Temporary fallowing of farm land	3.31	100%
Temporary fallowing of farm land	5.50	100%
Regulated deficit irrigation (pistachios)	0.40	33%
Regulated deficit irrigation (almonds)	0.42	14%
Regulated deficit irrigation (almonds) – LOW estimate	0.60	17%
Regulated deficit irrigation (almonds) – HIGH estimate	1.02	29%

Table VI: Irrigation efficiency measures with water savings estimates for California. Data from Richter et al., 2016.

[23] "...the term water conservation shall mean the use of less water to accomplish the same purpose or purposes of use allowed under the existing appropriative right." (Water Code § 1011).

The legal process of moving the water to another use with this approach will be challenging as it requires extensive documentation of efficiency measures and resulting change in water use, and this approach carries the risk of not being accepted by the SWRCB. To mitigate this risk, TNC can work with the SWRCB on developing guidelines and rules in order to make irrigation efficiency a viable method for water conservation transactions. Despite this challenge, irrigation efficiency is still a potential water acquisition mechanism for the WSIP.

Federal Water Contracts (Central Valley Project)

The section above discussed acquisition of appropriative water rights, outlining the direct purchase approach and details concerning opportunities for on-farm efficiency as a mechanism to unlock water. The second water acquisition strategy is to work with USBR to receive a contract for water from the Central Valley Project (CVP). The CVP is a massive system of dams, pipes, and canals that carry water to agricultural, municipal, and industrial users throughout the Central Valley (see Appendix X for map). The system starts at Shasta Reservoir and extends as far south as Bakersfield. USBR owns and operates the CVP and much of the water that flows through it (USBR, 2017a).

In addition to appropriative water rights, contract entitlements for CVP water may also be a viable asset that could be acquired for the a WSIP portfolio. This is water that is owned by USBR and leased to other users via long-term contracts throughout the system.

CVP Contract Entitlements in the Sacramento River Region		
Number of Contracts	142	
Total Volume Contracted	2,100,834	acre-feet
Average Contract Size	14,795	acre-feet
Smallest Contract	10	acre-feet
Largest Contract	825,000	acre-feet

Table VII: Analysis of CVP contract entitlements and contracted volumes of water in the Sacramento River region.

Acquisition Costs

Users enter into long-term (usually 40-year) contracts with USBR for delivery of CVP water. There are no up-front costs to enter a contract, but there are fluctuating annual rates for water each year. Presently, USBR is not writing any new contracts so the only way to obtain a CVP contract is to receive a contract that has expired or been abandoned. USBR has tentatively offered TNC a CVP contract that has been abandoned. This specific contract is the basis for CVP contract cost assumptions. The annual cost of CVP water has varied nonlinearly over the past 10 years, fluctuating between a low of $15 and a high of $26 per AF (USBR, 2016b). Due to this variability and resulting uncertainty about future prices, an average of costs since 2007 (as far back as data are available) was used. Thus, the estimated value for annual cost per AF of CVP contract water is $18.06. The average rate for irrigators in Sacramento Valley for 2017 is $72.97 and was used as our high estimate (USBR, 2017b).

Depending on the previous use (if any) of the CVP contract acquired, the on-farm water conservation strategies discussed in the previous section may also be used to “unlock” CVP water for transfer to another purpose. The transfer process for acquired water assets, be it appropriative water rights or CVP contracts, requires its own legal process and related transaction costs. Part II below discusses these transfer mechanisms, walks through the necessary steps, and discusses revenue potential.

Part II: Water Transactions

Once water has been acquired by the WSIP, it will be strategically deployed to create migratory bird habitat and/or leased to other users to generate financial returns for investors. These two steps may happen simultaneously; transfer to a new point of diversion may be included in the initial acquisition transaction. For the purpose of analysis, this report considers the transaction component independently of acquisition.

Background: Transferring Water in California

The timeline of a transfer depends on the type of water right and whether it is a short- or long-term transfer.[24] Generally, water transactions in California tend to be "lengthy, cumbersome, and lacking in transparency" (Hanak & Jezdimirovic, 2016). Details on transfer requirements for the eight main types of transfers in California can be found in Table VIII below.

In general, state, regional, and local public agencies that own conveyance facilities are required to make available 70 percent of their unused capacity for water transfers provided they are fairly compensated and (1) no injury occurs to a legal water user; (2) there is no unreasonable impact on fish, wildlife or instream beneficial uses; and (3) there is no unreasonable impact on the overall economy or environment from which water is transferred (Water Code § 1810-1814; Bartkiewicz et al., 2006).

Water Transfer Type	Details
Pre-1914 Appropriate Water Right	Subject to Water Code §1706. Does not require state approval, but has no legal protection from downstream diversion. Requirement of no third-party harm; burden of proof is on other users. Public notice not required. Environmental review required if buyer or seller is a public agency.
Post-1914 Permitted Appropriative Water Right	Subject to Water Code §1725 (short-term) or §1735 (long-term). Requires approval by SWRCB, and has regulatory protection from downstream diversion. Requirement of no third-party harm; burden of proof is on seller. Public notice and comment period required. Short-term transfers are exempt from environmental review; long-term transfers are not.

[24] A short-term transfer is defined as one year or less; California Water Code § 1725.

CVP or SWP Contract Entitlement	Transfers between entitlement holders are subject to unique guidelines of each system. CVP contractors can use CVPIA accelerated transfer process for in-watershed transfers and transfers within the system. SWP contractors can sell unused water back to the system if there are other SWP contractors who will buy it. Requires approval by USBR (CVP) or DWR (SWP), and SWRCB if water is being transferred out of the system. Environmental review required but pre-prepared programmatic EIR/EIAs are often used to streamline the process.
Groundwater	Movement of groundwater (via extraction and pipeline) is generally not considered a transfer. Extraction of groundwater for release into a natural body of water, for diversion by a downstream user, is considered a transfer. Such transfers may be occurring in California but are not documented, and have no regulatory oversight or protection. This will likely change with the implementation of SGMA over the next several years.
Forbearance Agreement	Informal agreement in which a user forgoes their right to divert water, with the intent of leaving it for instream flow or a downstream user. Only type of transfer that is applicable to riparian water rights. Does not require state approval, but also has no legal protection from diversion by unintended downstream users.
Adjudicated Water Right	Subject to specific language of the adjudication. Some adjudications specify that out-of-basin transfers be prohibited. Others defer to SWRCB jurisdiction, in which case transfers are subject to the same stipulations as post-1914 permitted appropriative water rights. Generally, adjudication facilitates water transfers because all water rights are well defined and there is regulatory clarity.
Instream Flow Transfer	Subject to Water Code §1707. Applicable to any of the above rights, though primarily post-1914 permitted appropriative.

Table VIII: List of types of water transfers in California. Denotes what kind of regulatory provisions are associated with each transfer type. All the transfer processes vary in the time and money it takes to complete them, and in their level of regulation. Further exploration is needed to get a more accurate understanding of transaction costs. Information from Tully & Young, 2016.

Based on the regulatory requirements and protections for each transfer type, two transfers have been identified as the best approaches for balancing cost and security: short-term transfers of post-1914 appropriative water rights under California Water Code § 1725 ("shorter-term water rights transfer"), and CVP contract transfers using the Central Valley Project Improvement Act Accelerated Water Transfer Program (CVPIA AWTP).

Transferring Water to Nature

As discussed in the "Ecological Goals" section, there are two ways to provide habitat: send water to rice fields enrolled in BirdReturns, or send water to a wildlife refuge in the SNWR system.

BirdReturns

Water rights can be sent to any participating BirdReturns fields using short-term water rights transfers.[25] Because BirdReturns is an existing program for which TNC already has working relationships with farmers and local institutions, the details of sending water to BirdReturns are not a focus of this report.

Federal Wildlife Refuges

Both water asset types, water rights and CVP contracts, can be sent to wildlife refuges. USBR operates both the SNWR system and the CVP, therefore it may be easier to deliver CVP contract water to refuges than appropriative water, because the formal water rights transfer process and the associated transaction costs can be avoided. Also, wheeling fees normally levied by USBR may be waived for this purpose.

Transferring Water for Revenue

The primary strategy for generating revenue in the WSIP model is leasing acquired water on a short-term basis to other users at market price. This concept is akin to buying a house and then renting it out; it only works if the rent is higher than the mortgage. Underpinning the entire WSIP concept is the assumption that the costs of water acquisition and habitat creation can be recouped by renting out the water to other users when the water is not needed for birds. Due to the variability in spot market prices, ability to generate returns for investors through leasing will change year-to-year.

In this section, two primary transaction types are explored in detail. These are short-term leases of appropriative (post-1914) water rights and accelerated short-term transfers of CVP water contracts. Legal, financial, and logistical factors are considered for each transaction type. Estimates are made for lease prices (expected revenues) and transaction costs.

A critical component in the viability of the WSIP model is the ability to lease acquired water assets to generate financial returns for investors. If (as is likely) water cannot be easily leased to other users, or if the costs of doing so outweigh the revenue gained, the WSIP model cannot function.

Short-Term Transfers of Appropriative Post-1914 Water Rights

Short-term transfers of post-1914 appropriative water rights are expensive, but they are the most secure type of transaction and there is no limit on how much water may be transferred. Most important, these transfers depend on an asset (i.e. a water right) that appreciates over time and that can be sold at the end of a water fund. This transfer mechanism can be used to lease water to other users and to BirdReturns.

Legal Process

Short-term transfer of post-1914 water rights falls under § 1725 of the California Water Code. The provisions are almost identical to the steps listed for permanent acquisition, apart from environmental review. Per California Water Code § 1729, transfers less than one year in duration are exempt from CEQA review. This reduces transaction costs by up to $40,000. As such, short-term transfers present a particularly good opportunity for revenue generation.

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[25] The legal process and transaction costs association with this transfer type are discussed in the Transferring Water for Revenue section below.

Market Analysis

There are two key questions to answer when considered the feasibility of using water rights to generate revenue through short-term leasing:

1) Is there a sufficient market for leased water?
2) What prices can be expected?

The highest number and volume of transfers (respectively 60% and 53%) within California occur from and/or within the Sacramento Valley (Table IX). This indicates that there is sufficient market activity in the region for TNC to regularly lease water out to other users. Note that these types of transactions are relatively infrequent, but large volumes of water are transferred at a time (Table IX). This makes sense given that transaction costs are estimated around $35,000. These transactions tend to be between large irrigation districts and/or municipal water suppliers. This approach would probably be most beneficial to the WSIP for making large leases to other users to generate profit.

State-Approved Short Term Water Transfers, 2012-2015

Total Volume Transferred	1,436,125	acre-feet
Volume Transferred from Sacramento Valley	757,483	acre-feet
Percent of Volume Transferred from Sacramento Valley	53%	
Total Number of Transfers	43	
Number of Transfers from Sacramento Valley	26	
Percent of Transfers from Sacramento Valley	60%	
Average Approval Time	62	days

Table IX. Short-term appropriative water rights transfers approved by SWRCB under California Water Code § 1725, between 2012 and 2015.

There are risks and constraints associated with this transfer type as well. They must be a year or less, which means that new transactions must be made every year that the WSIP is operating. Hopefully, some agreements can be set up for longer leases and/ or a simplified way to renew a lease each year to reduce the time and cost associated with finding buyers. There is also the risk that a transaction falls through, usually due to curtailment of the transferor's water right but also due to bottlenecks in the Delta. For example, 6 of the 43 transfers approved in the last three years were not completed, and all of them were destined for south-of-Delta buyers. This represents 36,000 AF of undelivered water (Appendix XIV).

Table X shows a range of prices that can be expected for short-term leases in California. More recent data, including transactions during the 2014-2015 drought, show significantly higher lease rates than the historical data presented here. Given that the Sacramento Valley is predominantly an agricultural region, transfers to agricultural users are most likely. In some cases, these ag-to-ag lease rates can be very high, as permanent crops must be irrigated even in very dry years and the market responds accordingly. However, higher revenues may be earned if leases to urban users are made. Because they occur in short time frames, lease prices are highly dependent on hydrologic conditions. Prices are generally higher in dry years when water is scarcer, and lower in wet years when water is abundant.

Mean Sale Prices (per acre-foot) for Water Transactions in California, 1989-2009

Hydrologic Condition	Dry Year	Normal Year	Wet Year
Short-Term Transfers between Agricultural Users	$ 76.33	$ 62.40	$ 59.52
Short-Term Transfers from Agricultural to Urban Users	$ 197.90	$ 156.15	$ 81.09
Permanent Sale	$ 1,206.36	$ 860.38	$ 531.19

Table X: Average per-AF prices for leasing and selling water in California from 1989 to 2009. Data from Libecap & Donohew, 2010.

Short-Term Transfers of Water Rights Attached to Acquired Farmland

Dry or drought years in California limit supply and create a higher demand for water from urban and agricultural users leading to an increased market price for water. These years present an opportunity to generate higher returns on investment from the water rights owned by the WSIP. The more water that can be made available to lease during those years, the better returns will be. Taking water from the environmental use for leasing during drier years is challenging because those years are also when migratory birds are most impacted by wetland loss. However, transferring water rights that correspond to farmland owned by the WSIP during dry years may be a feasible way to take advantage of higher lease prices without reducing temporary habitat acreage. To enable the transfer of water from farmland operations owned by the WSIP to a buyer, the partnership may consider implementing deficit irrigation or crop idling strategies. Both strategies are approved by DWR and have a history of being effective for short-term water transfers (DWR & USBR, 2015b).[26]

Deficit Irrigation

Deficit irrigation implies watering crops below their full transpiration potential, at a deficit, thus putting them under stress. Yields may decrease, but depending on the crop and market circumstances, the water conservation payments can offset the loss in profit from decreased yields. Deficit irrigation seeks to increase crop water productivity (CWP) by maximizing yield per unit of water. Techniques usually involve technical management of irrigation[27], reductions in crop cuttings, or seasonal applications (Squillace & Mcleod, 2016). These techniques are usually applied during drought tolerant stages in a crop's development, usually later in the growth cycle. Regulated deficit irrigation (RDI) is the technical management of irrigation with careful monitoring. RDI involves well-timed water application that maximizes efficiency and reduces crop need.[28]

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[26] While these strategies are helpful for generating revenue after the water right has been acquired, short-term deficit irrigation or fallowing are not viable mechanisms for permanently acquiring water to use in the WSIP. In order to generate a transferable water right to the WSIP, fallowing or deficit irrigating would need to be permanent strategies on that farm, which is basically equivalent to a landowner directly selling the WSIP a portion of their water right.

[27] Technical management of irrigation involves precise and timed application of water using data on soil moisture, weather, and crop needs to deliver a precise amount of water per user defined specifications.

[28] Benefits of RDI include: Reduced water consumption while either maintaining or marginally reducing crop productivity; Reduced humidity can make crops less prone to fungal outbreaks; Limits leaching of nutrients from

The amount of water savings by deficit irrigation as demonstrated by literature and various studies is somewhat limited and DWR, SWRCB, and USBR still do not have formal guidelines. The possibilities for water savings depend on crop water use, climate, and soil. Estimates aggregating various studies from California indicated that substantial water savings can be achieved with little loss to yield (Table XI). Other studies indicate that alfalfa, rapeseed, and maize are also good candidates for RDI (Squillace & Mcleod, 2016).

Crop	Change in Applied Water	Change in Yield	Quality
Almonds	-20%	-4%	Better quality
Pistachios	-28%	NA	NA
Citrus	-25%	-5%	Better quality
Vine	-39%	0%	Better quality

Table XI: Potential RDI Water Savings in California's Central Valley.[29]

Overall, deficit irrigation allows for reduced beneficial consumption and reduced water application. In theory, deficit irrigation could be used in situations where WSIP own and operate farms as a means of unlocking water. However, this is not a viable transfer mechanism in California at this time, as any transfer of conserved water from deficit irrigation would require additional scientific evidence and demonstration of proof. This is likely to be a costly and time-consuming process. Investigation into the costs of deficit irrigation techniques is outside the scope of this report, and are not included in the financial model. Deficit irrigation may be a useful technique for the WSIP to capitalize on high market prices for water, but due to these constraints its use will likely be limited.

Crop Idling

Crop idling unlocks water temporarily, by taking crops out of production for short periods of time (usually a growing season) on a rotational basis. Similar to deficit irrigation, crop idling may be a useful tool in the WSIP model; however, idling does not have the same complex burden of proof of water savings. This makes idling more expedient, potentially less costly and more useful for taking advantage of high market prices for acquired farmland.

Risks, Uncertainties, and Constraints

As idling takes crops out of production, it can have economic impacts on parties not directly involved in the transfer (e.g. agricultural workers). To minimize socioeconomic impacts, crop idling is normally limited to 20 percent of irrigated acreage within a county for each eligible crop, unless a public hearing is conducted (Water Code § 1745.05(b)). For transfers south of the Delta there may be caps on idling and

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soils, thus reducing polluted runoff and groundwater quality issues; For some crops the quality of the crop can improve.

[29] Average values from various studies pulled from Richter et al., 2016 and Cooley, Christian-Smith, & Gleick, 2008.

transfers due to limits on CVP and SWP facilities from Biological Opinions (BOs). For example, rice idling in the Sacramento region was limited to 49,924 acres while the maximum CVP transfer quota was limited to 565,614 AF in 2016 (USFWS, 2016a).

CVP Accelerated Water Transfers

The lowest-cost and most expedient option to transfer contract water in the Sacramento Valley region is to use the CVPIA AWTP to transfer water. This is the second transfer mechanism explored in this report.

Background

Prior to the passage of the CVPIA in 1991, trading of CVP contracts among water users was prohibited. This changed with the passage of the CVPIA authorizing transfers of contract water § 3405(a), which allows the transfer to any user if the purpose is recognized as beneficial under state law. Like appropriative water rights, transfers are limited to contract water that would have been consumptively used or irretrievably lost to beneficial use (§ 3405(a)(1)(L)). The size of the transfer is limited to the average annual quantity delivered during the three years of normal water delivery prior to the CVPIA. However, a key provision is that transferors within the basin (counties, watershed, or other areas of origin) can transfer their whole contract right as they are exempted from historic/consumptive use criteria and size limits (§ 3405(a)(1)(M)). Additionally, any transfer greater than 20 percent of a long-term contract is subject to review and approval by the local district or agency and public notice (§ 3405(a)(1)). Water transfers are reviewed and either approved or rejected within 90 days. The agency that reviews transfers is dependent on length of transfer. Short-term transfers, less than 10 years, are administered by area managers. For the Sacramento Valley, this is performed by the Northern California area office. Long-term transfers (10 or more years) are subject to approval by the regional director at the Mid-Pacific Regional Office (USBR, 2013).

Central Valley Project Accelerated Water Transfer Program (AWTP)

The AWTP has associated prepared programmatic environmental impact statements that assist in streamlining in-basin transfers or reallocations of contract supply. The AWTP for CVP contractors within the Sacramento Valley limits transfers and/or exchanges to 150,000 AF annually per environmental documentation that has been approved for 2016-2020 (USBR, 2016c).[30] In 2014, 43,780 AF of in-basin transfers or reallocations of contract supply occurred, indicating space for additional capacity within the existing AWTP in the Sacramento Valley (USBR, 2015a). AWTP transfers, like other CVP transfers, require public notice if more than 20 percent of a contract's water is transferred, potentially leading to disputes and incurring additional costs. Another limitation is that you are not allowed to transfer and then switch to an alternate source of surface or groundwater source that could adversely impact CVP operations or third parties (USBR, 2016c). The last important limitation is that transfers are constrained to only occur between CVP contractors; it is not applicable to transfers outside of the system. Thus while this approach is extremely attractive, its efficacy may be limited.

[30] Allowed among Corning Canal and Tehama-Colusa Canal (TCC) Contractors, Sacramento River Settlement (Settlement) Contractors, the Colusa Drain Mutual Water Company and the Sacramento, Delevan and Colusa National Wildlife Refuges (Refuges).

Transfers using CVPIA AWTP are by far the least expensive; the only transaction cost is a $3,000 deposit to USBR to cover administrative expenses, and if any of that is unused the transferor gets reimbursed for the remaining amount (USBR, 2013). This low barrier to entry is reflected in the data in Table XII; hundreds of transactions have occurred in the past 3 years. The high number of transfers and the relatively low volume of water transferred suggests that this is a dynamic and nimble system as far as water markets in California go. Considering how many irrigators in the Sacramento Valley hold CVP contracts (over 100,)[31] this could be a viable mechanism for the WSIP.

CVPIA Accelerated Transfer Water Deliveries, 2012-2015		
Total Volume Transferred	428,761	acre-feet
Volume Transferred from Sacramento Valley	125,874	acre-feet
Percent of Volume Transferred from Sacramento Valley	29%	
Total Number of Transfers	500	
Number of Transfers from Sacramento Valley	129	
Percent of Transfers from Sacramento Valley	26%	
Average Approval Time	90	days

Table XII: Transfers between CVP contractors in the Sacramento Valley region using the CVPIA Accelerated Water Transfer Program (AWTP), from 2012 to 2015. Data from Sheri Looper, Water Resource Program Specialist, United States Bureau of Reclamation. (Average Approval Time source: CVPIA Section 3405a(2)(D)).

Conveyance Costs

Conveying water, also known as "water wheeling," has a cost associated with it any time that water is transferred using built systems (rather than just flowing downstream). Conveyance costs are relatively inexpensive and simple in the Sacramento Valley compared to other regions in California (e.g. south of the Sacramento Bay-Delta). The main conveyance mechanism is the Sacramento River. Despite this relative simplicity, obtaining the complete information on conveyance costs from point A to point B is challenging as facilities from the CVP, irrigation districts, and private irrigators may be used. Due to limitations in obtaining reliable estimates for the costs of using conveyance infrastructure owned by irrigation districts and private irrigators, we assume that our transfer will only use federal facilities.

All water moved through the CVP system incurs a restoration charge per AF. USBR collects a restoration fund charge on water deliveries in addition to the annual water rates as required by the CVPIA to mitigate the environmental impact of the CVP (USBR, 2016e). For the fiscal year 2017 (10/01/16 – 9/30/17) the fee is $20.45 per AF for municipal and industry (M&I) and $10.23 for irrigation (IRR) (USBR, 2016e). Other conveyance costs for CVP contract water are built into the annual rates discussed previously. Moving all other water using federal facilities is covered under the Warren Act, which applies to non-contract water conveyance and storage (USBR, 2015b). The charge for the conveyance of irrigation water depends on origin, destination, and if storage is involved. A base charge for conveyance is $15 and is included in our analysis for permanent water rights and conserved water (USBR, 2016f). We use this as a

[31] CVP Full Cost Water Rates for Contractors 2016 spreadsheet (USBR 2016d).

conservative low estimate, in fact there may be transfers where these costs are near zero if the Sacramento River is used and no pumping is needed. Warren Act transfers also incur the same restoration charges as water deliveries, listed above. Lastly, wheeling non-project water using the Warren Act requires NEPA review incurring additional costs and time.

Part III: Financial Model Tool

How the Model Works

As part of this probject, a Microsoft Excel-based financial tool was built to help TNC evaluate the financial feasibility of potential WSIP projects, based on the strategies for acquiring and transferring water previously identified in this report. This tool allows TNC to predict the range of expected financial returns of WSIP strategies under various scenarios and to assess proposed water acquisition opportunities, based on manual inputs of market conditions.

Among other factors, the tool considers various acquisition methods and their differential costs, inflation and discounting, costs associated with leasing water, the number of months in which water is leased, who the water is leased to (i.e. agriculture or urban users), the number of months in which the water is used to create habitat, where the water for habitat is going (i.e. refuges or BirdReturns), and crop switching scenarios. While estimates are provided where available, the tool also offers manual input options for many values. This way TNC will be able to alter parameters as more information is obtained.

To evaluate a transaction, the user enters information on the input sheet of the model. The model requires the user to specify how the water right(s) were acquired, how many AF of water were acquired, the one-time cost of acquiring that water (if applicable), which crop switching scenario was used (if applicable), which months the water will be used for habitat creation and which months the water will be leased, how much TNC is expecting to receive for the leased water, discount rate, and appreciation rate. The model then calculates the total volume and cost of water acquisitions from all the listed transactions, taking into account both annual and one-time transaction costs. Based on the months the model user chooses to lease or deliver water to nature (e.g. BirdReturns), the model calculates the expected costs and revenue of leasing water or permanently selling a water right. NPV and IRR are generated on the summary dashboard sheet of the model.

The inputs sheet is split into two parts: Acquiring Water and Transferring Water. In the Acquiring Water section, the user can enter up to four water transactions (or acquisitions), so the tool can still be useful in even complex portfolio transactions. After the user has filled out the input form, the dashboard presents the IRR and NPV in both graphical and numerical form for four different scenarios under two different transaction cost frameworks: low costs and medium costs.

Additional Considerations

Key Partnerships

TNC will need much support – political, social, financial, and operational – in order to successfully implement a WSIP in the Sacramento Valley. This is not a venture that can be undertaken by one organization alone. As the name suggests, developing key relationships will be crucial to the success of a Water-Sharing Investment Partnership. “Partnership” refers not only to investors, but to all of the entities that would be involved in this project. Partners can be broken down into three general categories: government, local stakeholders, and private sector.

Government

TNC will need to form partnerships with government agencies on the federal and state level in order to gain necessary political, legislative, and possibly financial support for the project.

Bureau of Reclamation

On the federal level, the most crucial partner is USBR. First and foremost, USBR owns and operates the Central Valley Project. Additionally, per the CVPIA, USBR has made an explicit commitment to provide water for wildlife, including migratory birds. USBR acknowledges, “acquisitions of water for environmental purposes are an important tool for the Department of Interior in meeting fish and wildlife management responsibilities” (USBR, 2016g). In addition, USBR could provide funding through the WaterSMART grant program, which allocates $3 million in federal funds “specifically for projects related to water marketing” in fiscal year 2017 (USBR, 2017c).

United States Fish and Wildlife Service (USFWS)

As the operators of the national wildlife refuges in the Sacramento Valley, USFWS are key partners for delivering water deliveries for migratory birds. In addition to using water to create temporary wetland habitat on privately owned rice fields, WSIP water can also be used to augment water flowing into permanently managed wildlife refuges, depending on the highest conservation benefit. Close coordination and communication with USFWS refuge staff will help WSIP program staff optimize the environmental use of the water.

Like NRCS, the USFWS also administers conservation grant programs that may offer supplementary or alternative funding should TNC continue the current version of the program and pay rice farmers to create habitat with the landowner’s existing water right.

The North American Wetlands Conservation Act (NAWCA) established a competitive matching grants program that is administered by the USFWS and supports public-private partnerships that carry out projects in Canada, the United States and Mexico. The projects funded under NAWCA grant program must involve the long-term protection, restoration, and/or enhancement of wetlands for the benefit of wetland-associated migratory birds (USFWS, 2016b). There is precedent for non-profit partners using NAWCA grant funding to pay producers for creating temporary wetland habitat. In 2013 and 2015, Ducks Unlimited received nearly $1 million (~$2 million total) to enhance wetland habitat on private lands by providing cost-share funding to facilitate the delivery of water to habitat projects. Funding in both grants was used to complete wetland enhancement by funding seasonal flooding or emergent wetlands, moist farmland acreage, and rice fields on private lands to provide migratory and breeding habitat to waterfowl, shorebirds, and wading birds on the Texas Gulf Coast (USFWS, 2015).

Natural Resource Conservation Service (NRCS)

A second important federal partner for both BirdReturns and a WSIP is the NRCS. The NRCS oversees several large funding programs that are focused on providing incentives for agriculture producers to carry out conservation projects that improve soil, air, water quality, and enhance wildlife habitat. While it is currently uncommon for sustainable farmland investment firms to utilize NRCS and other farm bill programs (Murray & McGrath, 2016), incentive programs may be a viable option for reducing the investment required from the WSIP to acquire water, or in some cases, could be an alternative source of funding for BirdReturns.

The conservation portion of the 2014 Farm Bill established NRCS funding programs to provide cost-sharing for improved farming practices, conserving environmentally sensitive lands, securing easements to protect agricultural lands and wetlands, and encouraging conservation partnerships. The benefits these programs to the WSIP and BirdReturns include:

- Reduced capital costs of upgrading irrigation infrastructure and crop switching in joint venture or landowner/operator scenarios.
- Reduced costs or annual payments for implementing good conservation and sustainable management practices in the owner/operator scenarios.
- Reduced the capital costs of land acquisition via easements.
- Funding for landowner payments to create temporary migratory bird habitat.[32]

The conservation programs are divided into four buckets: Working Lands, Conservation Reserve Program, Easements, and Partnerships. Realizing the benefits of this program will require in-depth discussions with NRCS staff at the state and local level to understand the priority activities in the Sacramento Valley region and specific eligibility requirements. Discussions with NRCS should touch on the barriers a WSIP would face in utilizing these programs, including the following obstacles:

- **Enrolment eligibility and uncertainty:** Knowing which programs and the potential amount of funding that is available is highly dependent on the specific characteristics of the farm. Eligibility requirements and priorities of programs vary by state/region and several programs are competitive, leading to process and funding uncertainty. Lastly, the process can take additional time and effort (usually includes planning and implementation requirements and limited enrollment periods).
- **Restriction on recipients:** For most programs, there are restrictions on the annual income of the potential recipient established by the Adjusted Gross Income Provision.
- **Long-term uncertainty:** The current Farm Bill will expire in 2018 leading to some uncertainty in the long-term reliability of this funding.

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[32] The Environmental Quality Incentives Program (EQIP) in California can provide partial funding ($171.96/acre) for temporary habitat ponds (NRCS, 2017). Additionally, there is a precedent for using these programs to pay rice farmers for creating temporary wetland habitat. A portion of the funding designated by a 2015 Regional Conservation Partnership Program project (Rice Stewardship Partnership Project) sponsored by Ducks Unlimited and USA Rice was used to pay farmers for temporary habitat in Texas and Louisiana (NRCS, 2016).

Natural Resource Investment Center (NRIC)
The new Natural Resource Investment Center (NRIC), within Department of Interior (DOI), is a group focused on market solutions to water management and species protection. TNC has had initial conversations with Jeff Klein, Executive Director of NRIC, and Martin Doyle, Senior Finance Fellow, regarding the Sacramento Valley WSIP. If NRIC is still operating under the new Administration, TNC should continue to work with NRIC staff to explore how the center can support WSIP implementation in the Sacramento Valley. Specifically, their assistance in working with DOI's USBR and USFWS would be helpful.

At the state level, TNC will need regulatory approval from SWRCB on almost any transaction done through the WSIP. Including SWRCB in early conversations and soliciting their input on the WSIP concept will make transfer approvals more likely once the WSIP is in operation. The situation is similar with DWR; including them in early conversations will increase the likelihood that market-friendly water policy gets put into motion in the coming years. Andy Sawyer, an attorney for SWRCB, was interviewed for this report. He will be a valuable contact, source of information, and possible advocate going forward.

Local Stakeholders

Local water rights holders, irrigation districts, and farmers are perhaps the most important partners to have support from, because these are the people with whom TNC will be transacting with, and working with on the ground to provide habitat. TNC is in a fortunate position to already have relationships with some farmers and irrigation districts in the region, through BirdReturns or other conservation projects. For example, TNC has a great partnership with the California Rice Commission, which is the organization that connects rice farmers to BirdReturns. Collaborating with groups like this, farming associations and irrigation districts, helps TNC reach a large number of farmers without having to establish relationships one at a time. Going through the association or district also helps TNC gain trust and legitimacy in local communities more easily. TNC should continue to foster these on-the-ground relationships and strategically solicit opinions from trusted partners about the WSIP idea to gauge whether it would be something that the agricultural community would support.

Private Sector

Should TNC decide to move forward with the WSIP concept, private and/or institutional investors will be critical to the success of the fund. Large-scale agricultural corporations operating in the region may also be important partners.

Constraints and Uncertainties

Hydrological forecasts are inherently uncertain, as are all multi-year projections. Records derived from tree ring analyses in the US Southwest and flows at Lee's Ferry on the Colorado River, for example, indicate that climate is constantly in flux. Key summary statistics, such as annual rainfall and runoff, naturally vary over time, and even longer-term hydrological statistics are non-constant. Climate change further complicates future predictions of rainfall and runoff by disrupting the established cycles of natural climate variability contingent upon astronomical/orbital cycles: eccentricity, obliquity, and precession.

This uncertainty complicates the planning process that underlies a WSIP for several reasons. First, available water transfers and sales data indicate that sales and transfer prices in California vary over time, possibly due to variations in statewide water supply (though current data are insufficient to establish the exact marginal contribution of scarcity to price variation). This affects the potential revenue available from short-term leases by a WSIP. Second, variations in water supply – climatological predictions for California suggest increased runoff in wet months and decreased runoff during dry months, due to earlier snowpack melt (Kahn, 2016) – affect the availability of water leased for revenue or else provided for bird habitat, as well as the water needs of each. During wet years, there is less need for supplemental water to send to BirdReturns or SNWR but there is also less market demand for water. The predictable result of this is undesirable tradeoffs between generating fund revenue and satisfying environmental needs in dry years, while sitting on water that has little value during wet years.

Additional Methods of Revenue Generation

There are other ways to generate revenue for the WSIP, using farmland acquired by TNC, such as solar production on lands in the WSIP portfolio or entering into a dry-year lease agreement. Solar production on lands acquired for their water rights is a concept that has been tentatively explored in the Texas WSIP project.

Photovoltaic Solar Development

If TNC were to acquire land with attached water rights, and remove those water rights for other use, the land may also be used as an asset to generate revenue for the WSIP in ways other than agriculture. For example, solar panels could be installed on the land to produce energy that could be sold to regional energy utilities. This potential opportunity is explored below.

Feasibility of TNC's Role in PV Development

The California market for renewables sales seems to be driven by investor-owned utilities' semi-annual solicitations for energy from independent renewables energy producers (e.g. TNC or a party contracted to develop TNC properties). These solicitations are in turn driven by state-level regulatory mandates for IOUs to meet progressively higher fractions of retail electricity sales to consumers through renewable energy sources. PG&E is the only IOU serving the area in which TNC is sourcing water rights. PG&E lists all currently available solicitation opportunities for renewables development on its Wholesale Electric Power Procurement webpage (Pacific Gas & Electric (PG&E), 2017a).

The feasibility of a project of 20-50 MW was initially explored (sometimes referred to as "utility-scale") for solar projects sited on agricultural land acquired as part of a WSIP in Texas. An examination of PG&E's programs suggests it is theoretically possible for independent energy to sell PV energy at this scale. In practice, however, there were no readily available instances of utility-scale solar projects in the Sacramento Valley that had participated in any of PG&E's available programs. Moreover, PG&E indicated in 2014 that it was temporarily halting the only program that solicited utility-scale solar generation, the Renewable Portfolio Standard Request for Offers. California IOUs are ahead of the legislative schedule for renewables acquisition, and much of the utility's renewables portfolio has been composed of relatively small-scale, distributed generation. PG&E indicated it would reevaluate the need for new solicitations under this program in 2020 contingent on the fulfillment of prior contracts.

Several programs for smaller scale solar are currently offered by PG&E. For example, consider the Regional Renewable Choice or Enhanced Community Renewables program. RRC requires that "community members/subscribers [be] located within the same municipality or county or within ten miles of the [solar] project's address" (PG&E Wholesale, 2017b). PG&E's Solar Choice program provides a map of its projects. To date, there are 3 projects in the Sacramento Valley: are all located between Yuba City and Oroville, smaller than 2 MW, and operating on an "interim" basis (Solar Choice Energy Source); that is, existing solar plants were repurposed to temporarily serve demand from customers participating in Solar Choice.

These and similar programs collectively provide for acquisition of renewables projects up to 20 MWs. This document does not address these programs in detail, due to the detailed and time-sensitive nature of each program. For example, in the course of writing an initial and final draft of this section, the authors discovered that PG&E launched a number of new programs, including the 2016 PV RFO for procurement of energy from installations between 3 and 20 MW. The potential for solar development should likely be evaluated based on available programs and past projects in PG&E's service area at the time of land acquisition.

Regulatory Constraints

Solar projects on private land in California must go through a county-based planning process, as well as environmental review. Counties often have planning provisions limiting agricultural conversion. In some cases, solar projects have been legally challenged on the basis that they are inconsistent with these provisions (Owsowitz, 2012).

There are two state laws relevant to agricultural land conversion. First, CEQA mandates mitigation of certain types of farmland loss, which has resulted in the preservation of "several thousand acres of land under conservation easement" (CDFA, n.d.).[33] Conversion of farms to solar may require the additional purchase of easement land. Second, land designated under the California Land Conservation Act of 1965, or Williamson Act, is abundant throughout the Sacramento Valley (CDC, 2015). This land is set aside for agricultural purposes for a minimum of 20 years in exchange for tax breaks. Williamson Act contracts can be cancelled by city- or county-level government if the proposed land conversion is "not likely" to lead to the conversion of "adjacent" agricultural land, or if "'other public concerns substantially outweigh the objectives' of the Williamson Act." Alternatively, the Department of Conservation can cancel contracts in the case of a "solar-use easement" of at least 20 years (Owsowitz, 2012).

A final note on siting reveals an unexpected advantage of pairing land with associated water rights and solar. All solar power plants, whether photovoltaic or concentrated, require water. The Solar Energy Industries Association (SEIA) cites a requirement of 20 gal/MWh for uses such as cleaning solar panels, whereas the National Renewable Energy Laboratory (NREL) cites a median and max of respectively 26

[33] More information on the legal aspects of land-conversion mitigation are available in Meserve, 2011.

and 33 gal/MWh (SEIA, 2010a; NREL, 2011). To put this in perspective, a 20 MW-installation requires at most 660 gal/hr, and annual water consumption would be at most 5,781,600 gallons or 17.7 AF.[34]

Financial Constraints

The federal Solar Investment Tax Credit (SITC) authorizes an annual income tax credit for certain solar-related projects, such as electricity generation. The credit was extended by Congress in 2015, with a timeline for phasing out access to the credit based on the date of a project's initiation and completion (SEIA, n.d.). 26 U.S. Code § 48(a)(2)(A)(i)(II) and (a)(6)(A) jointly provide for a credit of 26% for commercial-scale projects constructed in 2020 and 22% for projects constructed in 2021. Per 48 (a)(6)(B), projects which begin construction prior to 2022 must begin service prior to 2024 to qualify for the above credits. Projects constructed prior to 2022 that begin service after 2024 qualify for a 10% credit. To qualify for the credit, TNC must be "the business that installs, develops, and/or finances the project" (SEIA, 2010b). If TNC leases acquired land to solar developers, TNC cannot claim the credit directly.

Currently, SITC is the main federal incentive for large-scale renewables production, though it is set to "expire" relatively soon (Other such incentives have already expired, such as the renewable energy production tax credit.) Whether TNC can take advantage of SITC depends on how soon TNC can begin and finish construction of a project and whether it has the tax appetite to utilize the tax credit.

Dry-Year Lease Agreements

Another way to create financial returns is to enter a portion of acquired farmland into a dry-year lease agreement with a municipal water user (like a city or wholesale agency). This can be defined as "a long-term lease agreement that maintains water in its original use in most years, but provides an intermittent water supply to other uses under preset conditions" (EDF, 2016). The terms of the agreement would specify in which years (could be based on a set schedule or on hydrologic conditions) TNC would reduce water use on the farmland (likely through temporary fallowing) and transfer that water to the municipal user in exchange for a payment defined by the agreement. This option contract may be set for just a few years, or for the entire duration of the WSIP. This approach has proven to be mutually beneficial by existing deals in California, such as the water supply agreement between Palo Verde Irrigation District (PVID) and the Metropolitan Water District of Southern California (MWDSC). Per this agreement, MWDSC pays PVID $3,170 for each acre enrolled in the agreement at the outset, and then $733 each year for each acre that is fallowed to provide water (MWDSC, 2013).

Conclusion

The purpose of this report is to answer the overarching question: is the WSIP a viable strategy for TNC to provide water for migratory bird habitat in the Sacramento Valley? At the conceptual level, there are two necessary conditions that precede successful implementation of the WSIP concept (Richter, 2016):

[34] This assumes the plant operates 24 hours/day for an entire year. Since solar plants don't operate continuously, even during the day, this metric should be taken as an upper bound.

1) The region suffers from chronic water scarcity issues.
2) The region has a water rights system in which water markets do, or could, function.

The Sacramento Valley may meets both of these requirements, though a key unanswered question about the functionality of the water rights system is if water transactions can be done cost-effectively. In a recent interview, SWRCB Chair Felicia Marcus said, "The question is how do we all pitch in to provide a vibrant ecosystem, vibrant urban areas and vibrant agriculture? We need all three" (Saving the West, 2017). Given these two enabling conditions, the WSIP concept – if carried out correctly – could help meet these overlapping water needs.

On a practical level, the feasibility of a WSIP depends on whether or not it can be financially sustainable, given the significant legal and logistical requirements and associated costs of marketing water in the region. The research questions this report addresses specifically are:

1) What are potential sources of water in the Sacramento Valley, and what is the financial, legal, and logistical feasibility of acquiring them?
2) How can acquired water be used to both create habitat and generate financial returns?

This report finds that the acquisition and transfer strategies discussed may be viable mechanisms for providing water for migratory birds in the Sacramento Valley. The estimates of the costs of these mechanisms, especially when inserted into the financial model, the preliminary outputs show that it may be very challenging to make the WSIP financially self-sustaining. It is unlikely that the revenue generated will be large enough to fully offset the high transaction and conveyance costs of acquiring and leasing water. Based on the research communicated in this report, it is recommended that TNC carefully consider next steps in implementing a Sacramento Valley Water-Sharing Investment Partnership.

The recommended water acquisition strategies are 1) the purchase of post-1914 senior appropriative water rights from agricultural water rights holders in the region and 2) obtainment of CVP water contracts from USBR. Water rights can be acquired directly through outright purchase, or indirectly through on-farm water conservation. On-farm conservation consists of crop switching or other efficiency measures that can be permanently sustained. TNC can do this through a joint venture with a water rights holder, or by buying farmland and implementing conservation themselves. CVP contracts can be acquired by entering into negotiations with USBR, a process that TNC has already begun.

The recommended approaches for sending water to nature or leasing it for revenue could be accomplished via short-term water rights transfers under § 1725 of the California Water Code or use of the Accelerated Water Transfer Program for transferring CVP contracts. Based on market activity for both transfer types in recent years, there appears to be sufficient demand for leased water for TNC to be able to generate revenue using this approach.

Despite the broad feasibility of the individual mechanisms explored for the WSIP in this report, there is still significant uncertainty about whether a WSIP can be a financially viable solution in California given the difficulty and expenses of the approval processes for transferring water under current state regulations, fines, and environmental review costs. The transaction costs of acquiring and leasing water rights are relatively high, and may be cost-prohibitive for the WSIP. This cannot be determined conclusively, partially due to a lack of data on historical transactions costs in California and due to uncertainty in future prices, rates, supply and demand, and technologies. These uncertainties, costs, and lack of data are all factors that TNC must consider in deciding whether to go forward with the WSIP. This uncertainty may be reduced by locating more data, specifically pricing data on water rights purchases and leases. However, the costs associated with these transactions are hard to quantify. Despite difficulties in determining financial sustainability for the WSIP at a large scale, it is the characteristics specific to individual projects and opportunities that are likely to determine if a project can provide meaningful and productive benefits while also possibly generating financial returns. As opportunities arise, TNC can use the information presented in this report, as well as the use of the financial model to estimate the possibility of financial returns on a project-by-project basis.

Next Steps / Areas of Future Research

In order for a WSIP to function optimally in the Sacramento Valley, and in California more broadly, additions and clarifications need to be made to the California Water Code to make it more explicitly amenable to water markets (N. Washburn, personal communications, August 9, 2016). The SWRCB must be able to process transfer requests more expediently and cost-effectively so that transaction costs are not prohibitive. Built into this is the need for more accurate and transparent data on water use and transfers.

EDF recommends four legislative actions to advance water markets in California, which also aptly summarize the necessary policy conditions for the success of a WSIP (Sellers et. al., 2016). Those are:

1. Standardize and publicly disclose supporting data for all transfers.
2. More effectively coordinate the transfer approval process.
3. Structure the transfer approval process to ensure benefit to the environment and to disadvantaged communities.
4. Promote water sharing based on investments and changes in practice to achieve water savings.

Some policy solutions are already in place. Legislation passed in 2009 requires all water rights holder to report how much water they are using to the SWRCB every three years, but this set no measurement requirement so the reports could just be estimations (Escriva-Bou et al., 2016). Senate Bill 88, which was passed in 2016, lays out more stringent water use monitoring and reporting rules. It requires that specific technology be used to measure water diversions on a monthly basis (at minimum),[35] and that water rights holders report this information annually to SWRCB (California Legislative Information, 2016). Once implemented, this legislation will make action towards establishing a WSIP substantially more feasible.

[35] See the infographic in Appendix XI for more detail on SB 88.

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Appendices

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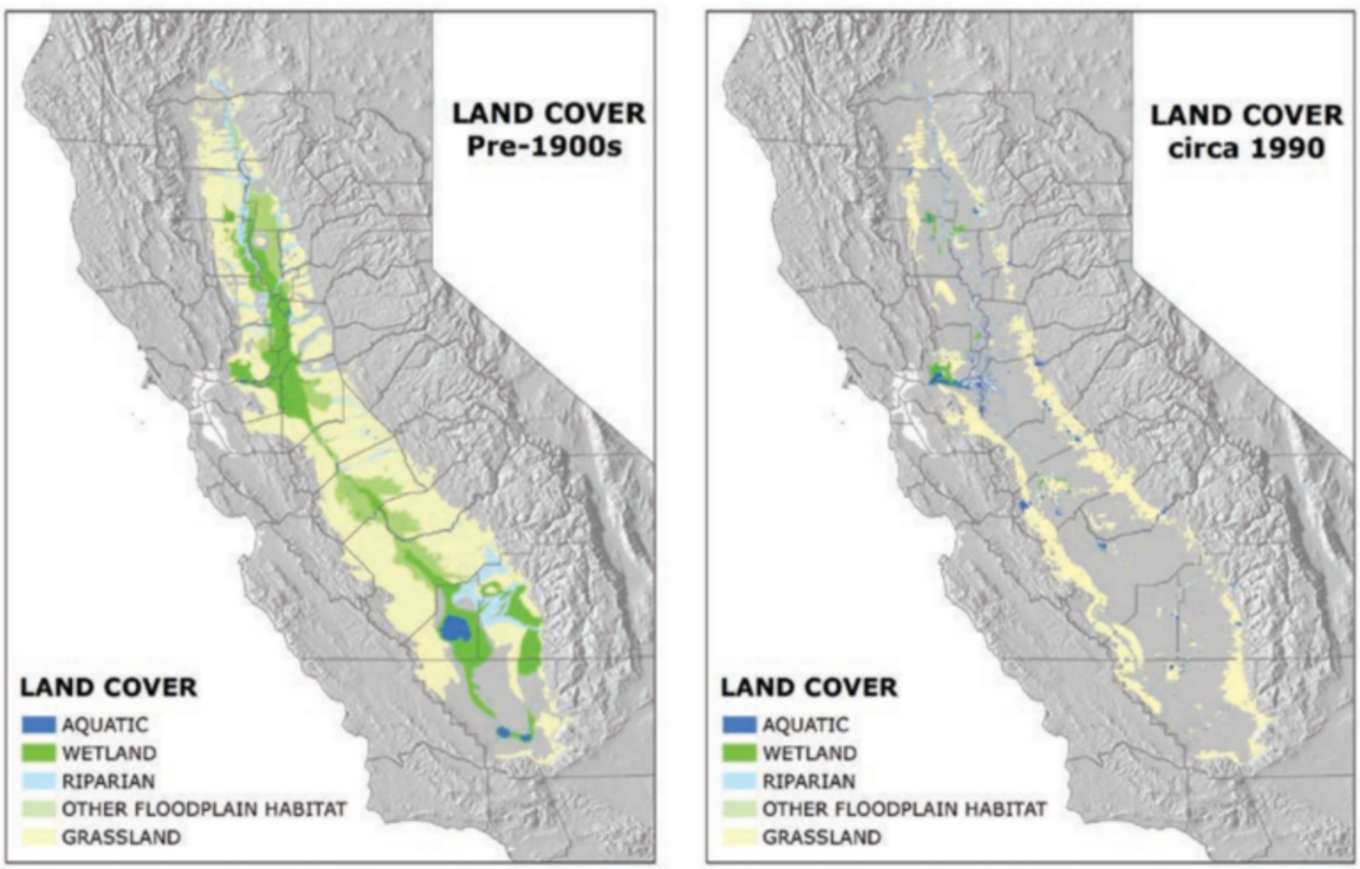
Appendix I: Historical loss of wetlands in California's Central Valley



Disappearance of Central Valley wetlands © Central Valley Historic Mapping Project, California State University, Chico, Geographic Information Center, 2003

Retrieved from Blankenbuehler, 2016

Appendix II: BirdReturns Fall 2016 Data

BirdReturns Fall 2016

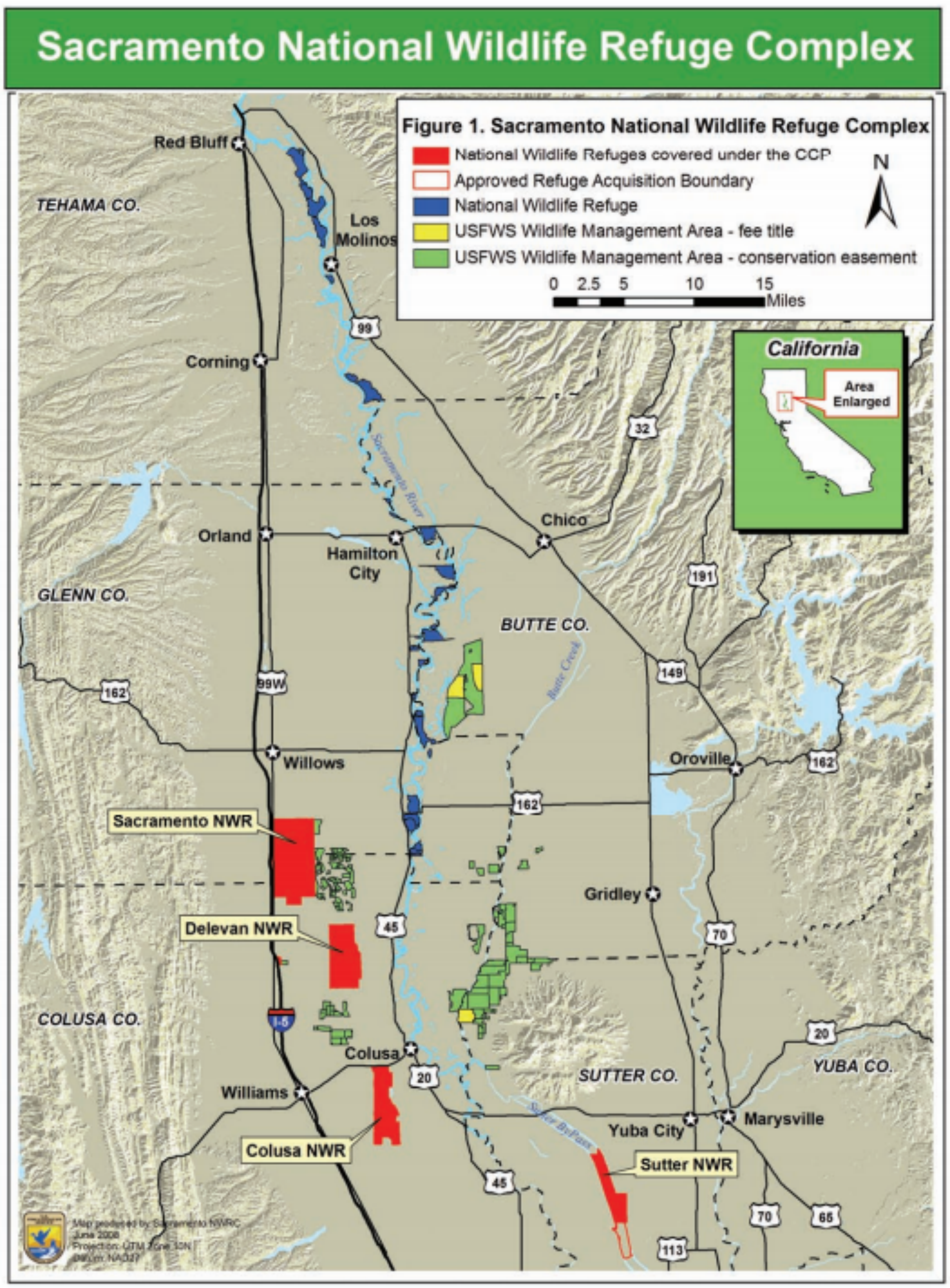
ACCEPTED	Bids	Acres
Aug B	9	1,288
Sep A	8	972
Sep B	8	997
Oct A	5	1,158
Oct B	5	1,175
	35	5,590

Bids Submitted	97
Acres Submitted	21481
Percent of Bids Accepted	36%
Percent of Acres Accepted	26%
Acres not Accepted	15,891

COUNTY	Bids	Acres
Butte	9	1576.5
Colusa	5	488
Glenn	1	108
Placer	0	0
Sac	1	350
Sutter	13	1609.4
Yolo	5	1367.6
Yuba	1	90.1

Retrieved from Julia Barfield at The Nature Conservancy, California Chapter.

Appendix III: Map of Sacramento National Wildlife Refuge



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www.usbr.gov/mp/cvpia/docs_reports/docs/Annual_Report/2013_cvpia_annual_report.pdf

Appendix IV: Wildlife Refuge Water Deliveries, 2001-2013

REFUGES

Table 17: Incremental Level 4 Acquisitions by Fiscal Year, 2002-2013

Fiscal Year*	Incremental Level 4 Water Acquired (AF)	Percent of Incremental Level 4 Target (133,264 AF)
2002	85,390	64
2003	70,000	53
2004	67,710	51
2005	70,962	53
2006	83,822	63
2007	41,111	31
2008	30,308	23
2009	31,726	24
2010	62,238	47
2011**	104,322	78
2012	54,013	41
2013	52, 396	39
Average	**63,833**	**47**

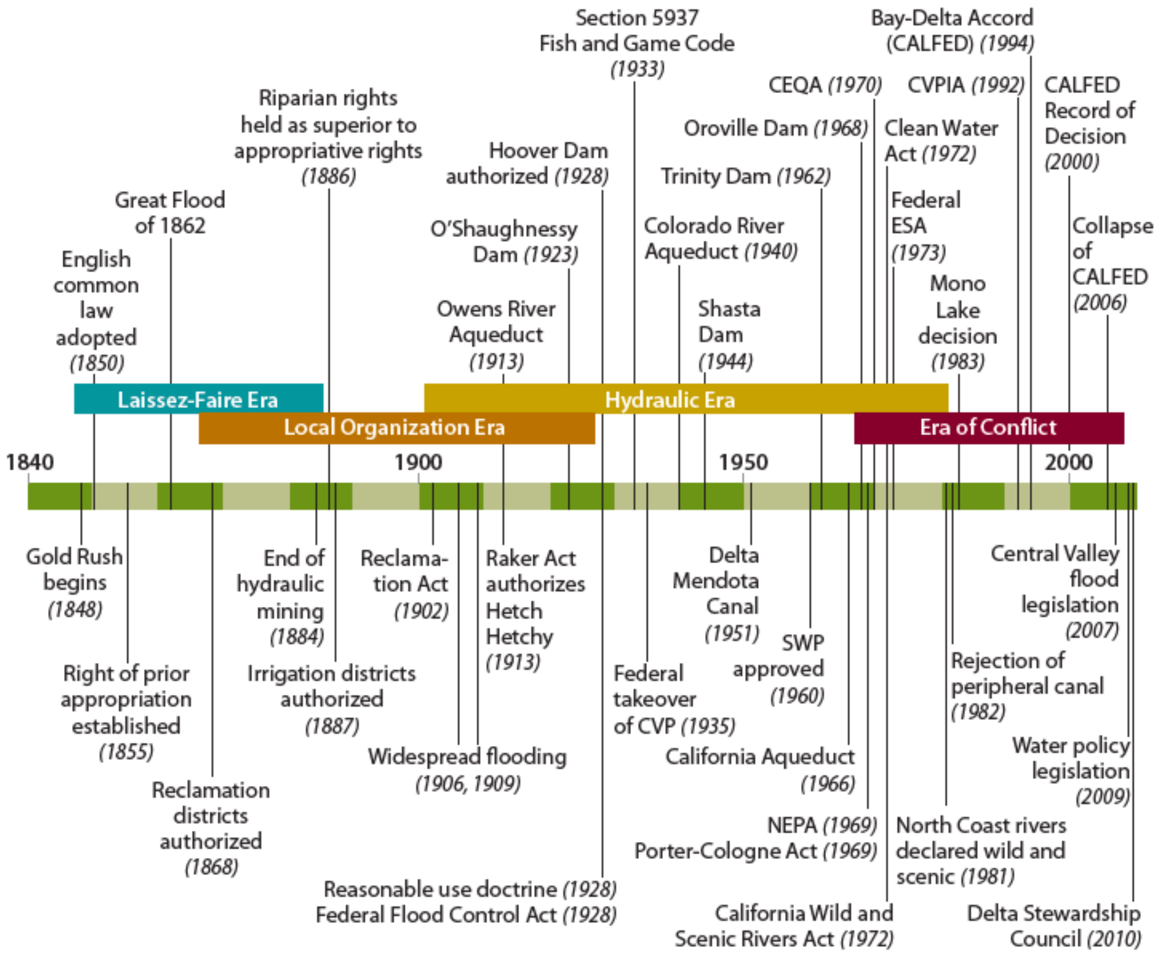
* This table reflects acquisitions starting with Fiscal Year 2002, the first year that CVPIA mandated Full Level 4 deliveries for all refuges [Section 3046 (d)(2)].

** 2011 is the first year the Program is reporting purchased and non-purchased water acquired toward the Incremental Level 4 target.

Retrieved from Central Valley Improvement Act Annual Report, FY 2013 (most recent available): https://www.usbr.gov/mp/cvpia/docs_reports/docs/Annual_Report/2013_cvpia_annual_report.pdf

Appendix V: Map of Project Scope

Appendix VI: California Water Policy Timeline

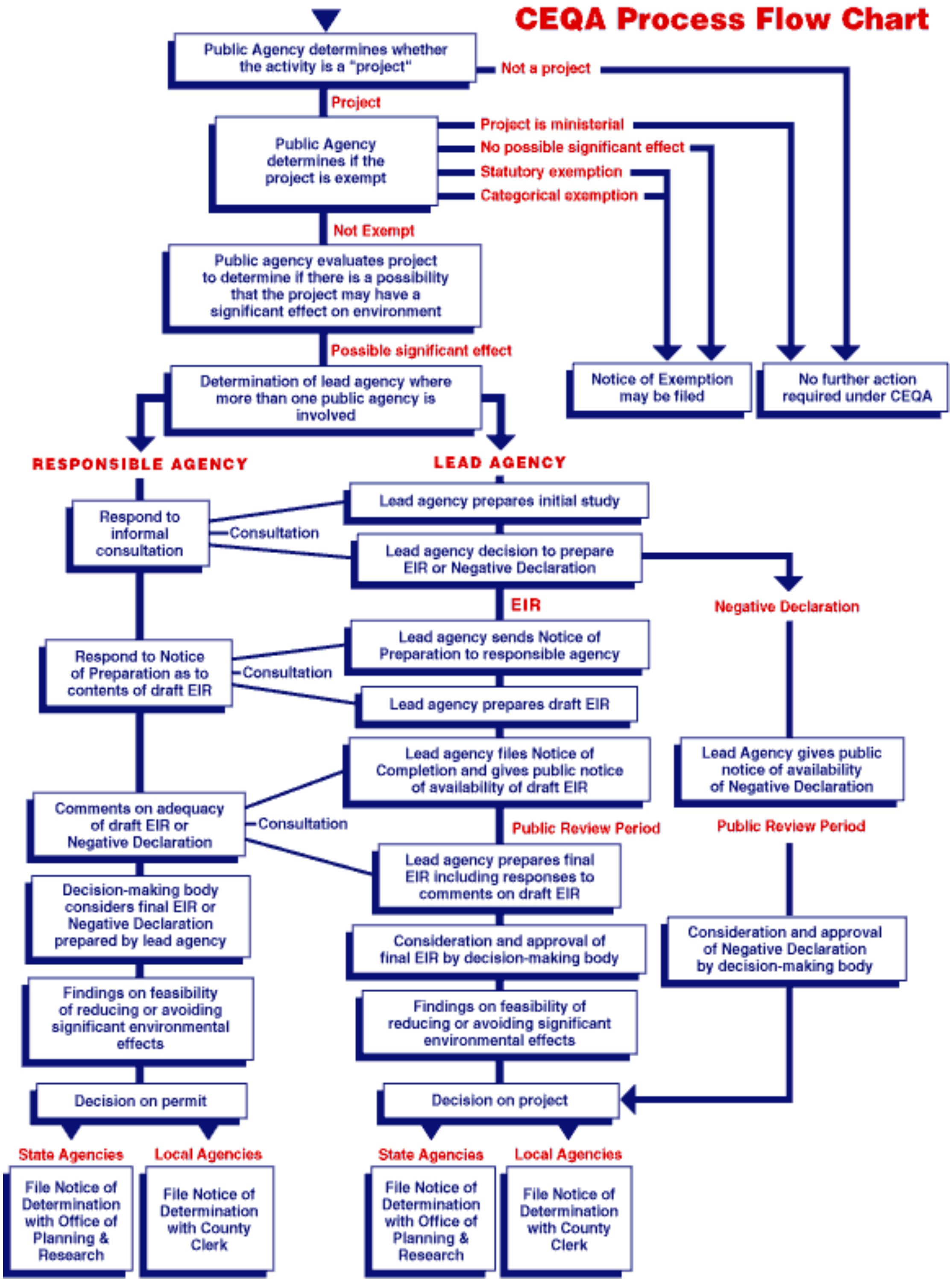


Timeline from PPIC Water Policy Center, retrieved from
http://www.ppic.org/content/pubs/report/R_211EHR.pdf

Appendix VII: Permanent Water Right Price Estimation

Annuity of short term lease price for 10 years		
Year	Lease Price	PV
0	250	$250.00
1	250	$242.72
2	250	$235.65
3	250	$228.79
4	250	$222.12
5	250	$215.65
6	250	$209.37
7	250	$203.27
8	250	$197.35
9	250	$191.60
10	250	$186.02
Est. Price per Permanent AF		**$2,382.55**

Appendix VIII: CEQA Flow Chart



Retrieved from http://resources.ca.gov/ceqa/images/CEQA_process_chart.gif

Appendix IX: DWR Crop Classifications and ETAW Values[36]

CROP CATEGORY	CROP ACRONYM	DEFINITION
1	Grain	Wheat, barley, oats, miscellaneous grain and hay, and mixed grain and hay
2	Rice	Rice and wild rice
3	Cotton	Cotton
4	Sugar Beet	Sugar beets
5	Corn	Corn (field and sweet)
6	Dry Bean	Beans (dry)
7	Safflower	Safflower
8	Other Field Crops	Flax, hops, grain sorghum, sudan, castor beans, miscellaneous fields, sunflowers, hybrid sorghum / sudan, millet and sugar cane
9	Alfalfa	Alfalfa and alfalfa mixtures
10	Pasture	Clover, mixed pasture, native pastures, induced high water table native pasture, miscellaneous grasses, turf farms, bermuda grass, rye grass and klein grass
11	Processing Tomato	Tomatoes for processing
12	Fresh Tomato	Tomatoes for market
13	Cucurbit	Melons, squash and cucumbers
14	Onion/Garlic	Onions and garlic
15	Potato	Potatoes
16	Other Truck Crops	Artichokes, asparagus, beans (green), carrots, celery, lettuce, peas, spinach, flowers nursery and tree farms, bush berries, strawberries, peppers, broccoli, cabbage, cauliflower and brussel sprouts
17	Almond/Pistachio	Almonds and pistachios
18	Other Deciduous Trees	Apples, apricots, cherries, peaches, nectarines, pears, plums, prunes, figs, walnuts and miscellaneous deciduous
19	Subtropical Trees	Grapefruit, lemons, oranges, dates, avocados, olives, kiwis, jojoba, eucalyptus and miscellaneous subtropical fruit
20	Vine	Table grapes, wine grapes and raisin grapes

[36] ETAW values averaged from 1998 to 2010 for project scope counties.

CROP CATEGORY	CROP ACRONYM	ETAW/AF (PROJECT SCOPE COUNTY AVERAGE)
1	Grain	0.64
2	Rice	3
3	Cotton	2.14
4	SgrBeet	2.26
5	Corn	1.86
6	DryBean	1.44
7	Safflwr	0.7
8	Oth Fld	1.56
9	Alfalfa	3.02
10	Pasture	3.09
11	Pro Tom	1.81
12	Fr Tom	-
13	Cucurb	1.02
14	On Gar	2.38
15	Potato	-
16	Oth Trk	1.63
17	Al Pist	2.52
18	Oth Dec	2.49
19	Subtrop	2.06
20	Vine	1.32

Retrieved and compiled from DWR website http://www.water.ca.gov/landwateruse/anlwuest.cfm

Crop	ETAW (in af/acre)[a]
Alfalfa[b]	1.7 (July-Sept.)
Bean	1.5
Corn	1.8
Cotton	2.3
Melon	1.1
Milo	1.6
Onion	1.1
Pumpkin	1.1
Rice	3.3
Safflower (only eligible for idling)	0.7
Sudan grass	3.0
Sugar beets	2.5
Sunflower	1.4
Tomato	1.8
Vine seed/cucurbits	1.1
Wild rice	2.0

[a] Only that portion of the estimated savings that can be directly exported or stored is eligible for transfer. For example, the ETAW for rice shown above represents the ETAW for May through September. If transfer water cannot be stored in May and June, the allowable ETAW would be 2.1 af/acre based on a monthly distribution of the ETAW of rice May through September of 15%, 22%, 24%, 24%, and 15%, respectively.

[b] Only alfalfa grown in the Sacramento Valley floor north of the American River will be allowed for transfer. Fields must be disced on, or prior to, the start of the transfer period. A higher ETAW may apply if the transfer water is exported through a facility not limited to the transfer export window of July – September or if the transfer water can be stored prior to the start of the transfer window. Alfalfa acreage in the foothills or mountain areas is not eligible for transfers.

Retrieved from USBR website
http://www.water.ca.gov/watertransfers/docs/2016_Water_Transfer_White_Paper.pdf

Appendix X: Map of Central Valley Project (CVP)

Retrieved from USBR website, https://www.usbr.gov/mp/2012_accomp_rpt/mpr_highlights.html

Appendix XI: Approved Section 1725 Water Transfers, 2012-2015

State-Approved Short Term Water Transfers (Water Code Section 1725), 2012-2015							
Seller	Buyer	Volume (AF)	Date Received	Date Approved	Approval Time (days)	Sac Valley?	Curtailed?
Sutter Extension WD	SWP Contractors	1,500	4/10/15	5/18/15	38	Y	
Foresthill PUD	SCVWD	2,000	12/19/14	5/18/15	150	Y	
Garden Highway MWC	SWP Contractors	1,520	4/28/15	6/8/15	41	Y	Y
Plumas MWC	SWP Contractors	1,740	6/12/15	6/23/15	11	Y	Y
South Sutter WD	SWP Contractors	5,580	6/3/15	7/7/15	34	Y	
South Feather WPA	SWP Contractors	10,000	9/17/15	10/5/15	18	Y	
DWR	Alameda County WD	5,000	11/26/14	1/20/15	55	N	
DWR and USBR	Multiple Agencies	335,560	3/25/15	4/27/15	33	Y	
Contra Costa WD and USBR	Byron Bethany ID	500	5/22/15	6/22/15	31	Y	
Placer County Water Agency	EBMUD	12,000	6/25/15	7/24/15	29	Y	
El Dorado ID	Westlands WD	700	6/29/15	8/18/15	50	N	
USBR	Alameda County WD	5,000	8/28/15	9/28/15	31	N	
DWR	SWP Contractors	277,863	2/12/14	3/28/14	44	N	
Placer County Water Agency	EBMUD	20,000	2/14/14	4/2/14	47	Y	
RD 756	Semitropic Water Storage District, Kern County WA, Alameda County WD, Zone 7 WA, SCVWD	11,603	2/21/14	5/12/14	80	N	Y
Delta Farms RD 2026	Semitropic Water Storage District, Kern County WA, Alameda County WD, Zone 7 WA, SCVWD	9,131	2/21/14	5/12/14	80	N	Y
Merced Irrigation District	San Luis and/or Santa Clara Valley	5,000	3/20/14	4/22/14	33	N	
Garden Highway MWC	San Luis and Delta-Mendota WA	7,500	5/2/14	Not approved	N/A	Y	Y
Plumas MWC	SWP Contractors	5,000	5/2/14	Not approved	N/A	Y	Y
DWR	Westlands WD	15,225	5/8/14	6/9/14	32	N	
South Sutter WD	SWP Contractors	10,000	5/23/14	6/9/14	17	Y	
Placer County Water Agency	Westlands WD	35,000	5/23/14	7/8/14	46	Y	
USBR / Contra Costa WD	Alameda County WD	5,000	5/27/14	7/11/14	45	N	
DWR	San Luis and Delta-Mendota WA	6,600	5/27/14	7/11/14	45	N	
USBR / Contra Costa WD	Byron Bethany ID	4,000	7/17/14	8/27/14	41	N	
Placer County Water Agency	Westlands WD	20,000	4/23/13	6/27/13	65	Y	
Pelger MWC	San Luis and Delta-Mendota WA	1,730	4/30/13	7/1/13	62	Y	
DWR and USBR	Multiple Agencies	196,000	5/1/13	7/1/13	61	Y	
Tulare Basin Farms	Multiple Agencies	3,520	5/1/13	7/1/13	61	N	
Garden Highway MWC	Multiple Agencies	5,000	5/1/13	7/1/13	61	Y	
Eastside MWC	San Luis and Delta-Mendota WA	1,100	5/3/13	7/1/13	59	Y	
RD 1004	San Luis and Delta-Mendota WA	7,175	5/3/13	7/1/13	59	Y	
Pleasant Grove-Verona MWC	San Luis and Delta-Mendota WA	8,100	5/6/13	7/1/13	56	Y	
Conaway Preservation Group	San Luis and Delta-Mendota WA	8,000	5/6/13	7/1/13	56	Y	
David and Alice te Velde Revocable Family Trust	San Luis and Delta-Mendota WA	4,000	5/8/13	7/12/13	65	Y	
City of Sacramento, Sac Suburban WD	Multiple Agencies	3,658	5/10/13	7/15/13	66	Y	
Thermalito Water and Sewer District	Westlands WD	2,500	6/7/13	8/14/13	68	Y	
Merced Irrigation District	San Luis WD and Westlands WD	15,000	7/12/13	9/13/13	63	N	
Walker River Irrigation District	Instream flow to Walker Lake	25,000	2/28/13	2/21/14	358	N	
Merced Irrigation District	Westlands WD	10,000	7/2/12	10/24/12	114	N	
DWR and USBR	Multiple Agencies	52,320	5/18/12	7/6/12	49	Y	
Merced Irrigation District	USBR	180,000	12/16/11	4/1/12	107	N	
USBR on behalf of Arvin-Edison Water Storage District	MWDSC	100,000	1/5/12	4/2/12	88	N	

Retrieved from
www.waterboards.ca.gov/waterrights/water_issues/programs/drought/water_transfers.shtml

Appendix XII: Infographic on Senate Bill 88

New State Water Measurement Requirements for All Surface Water Users (10+ acre-feet)

This document provides a summary of new state water measurement requirements and deadlines for California surface water users.
If you have questions about the information contained in this document, or otherwise wish to discuss the maintenance and protection of your water rights, please contact Brownstein Hyatt Farber Schreck, LLP.

Who

The California State Water Resources Control Board's (SWRCB) regulations under SB 88 apply to all water right holders diverting 10 acre-feet (af) or more of surface water annually (applies to ~12,000 right holders).

What

New requirements for measuring, monitoring and reporting water diversions require purchase and installation of measurement devices appropriate for the quantity of water and diversion type; the cost of installing the devices ranges from ~$300 to $800 for small diverters and up to ~$19,000 for large diverters.

When

The implementation timeline is phased depending upon the quantity of water diverted. The largest water diverters must start reporting Jan. 1, 2017; **the filing deadline for Measurement Method, Alternative Compliance Plan and Request for Additional Time was extended from Jan. 1 to Jan. 30, 2017, for diversions of 1000+ acre-feet.**

Where

Across California; this applies to all water rights holders including those claiming a riparian, pre- or post-1914 appropriative water right.

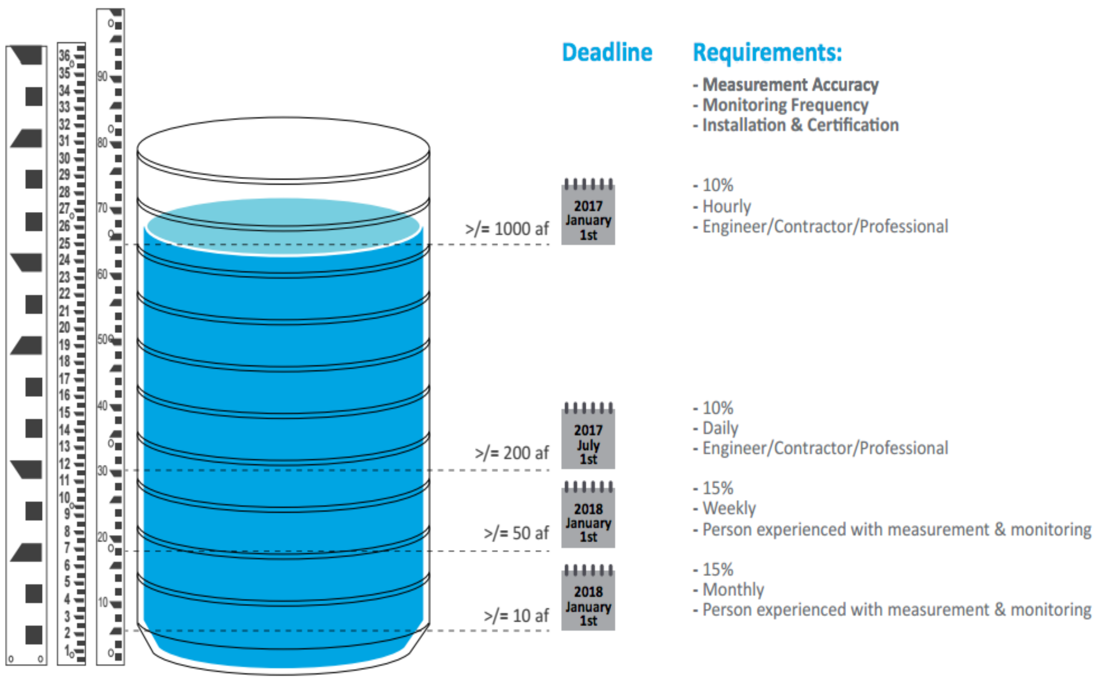
Why

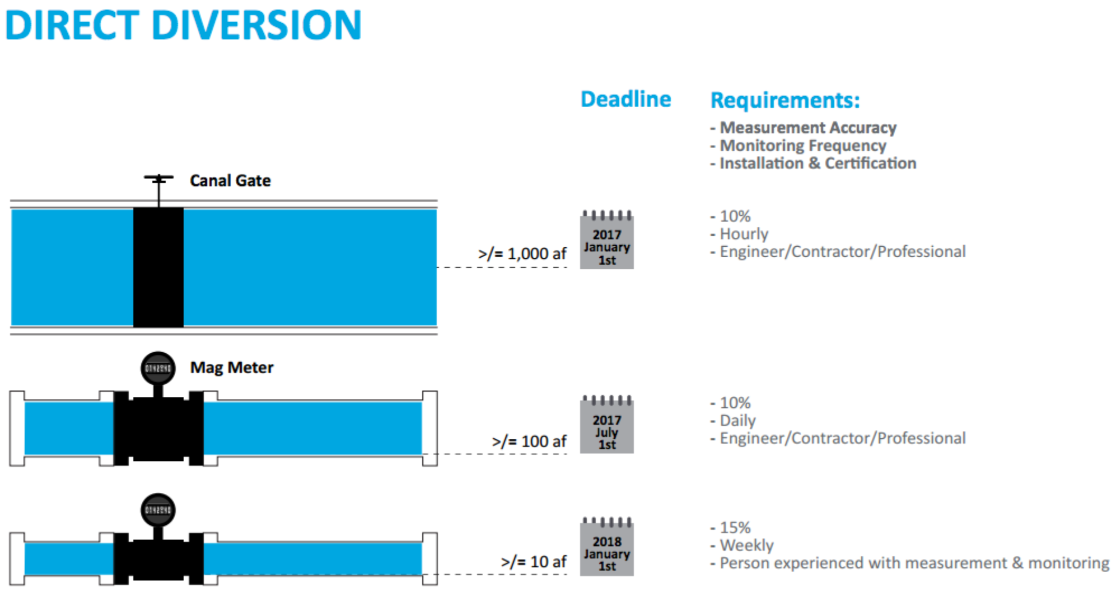
The state cannot regulate what it cannot measure and the drought exasperated the need for real-time, transparent data.

How

See below for examples of water measurement devices and links to SWCRB documented consultants and measurement vendors.

STORAGE





Infographic created by Brownstein Hyatt Farber Schreck, retrieved from www.bhfs.com/Templates/media/files/SB%2088%20Measurement%20Infographic_123016.pdf