From Storage to Retention:
Expanding California's Options for Meeting Its Water Needs

California Roundtable on Water and Food Supply | November 2012

About the California Roundtable on Water and Food Supply

The California Roundtable on Water and Food Supply (CRWFS) is a consensus-based forum to uncover obstacles, identify solutions, and take action to enhance water security for specialty crop agriculture, the public, and the environment. The Roundtable membership represents a broad and balanced cross-section of stakeholders, including, but not limited to, representatives from specialty crop agriculture, water supply management, government, fish and wildlife, natural resources stewardship, environmental justice, rural economic development, and academia. Recognizing that polarized debates on water in California often end at an impasse, the Roundtable first came together in the summer of 2010 with the conviction that a creative and frank "off-the-record" dialogue could help draw out the wisdom and ideas needed to develop strong new pathways forward for water management in California. Roundtable members have found significant common ground even amid ongoing water debates.

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Highlights

- Achieving a more effective and flexible water storage system requires a shift in the way that we, as a society, understand, define, and use storage as an element of integrated water management. Broadening our view of what constitutes a storage reservoir must be accompanied by a shift in our policies and programs to support a "retention" approach to storage—one that holds as much water as possible in the landscape for later use, while maintaining healthy ecosystems.

- To be more resilient and better prepared for future variations in water supply, California must take advantage of all storage opportunities throughout the system that meet the goals of reliable water supply and ecosystem restoration.

- Several valuable aspects of water storage tend to be overlooked in terms of their ability to contribute to the availability and reliability of water supplies for uses that benefit society.

- In particular, California's agricultural lands play an important role in the storage infrastructure. The value of working lands in helping to sequester water for later use while achieving many benefits, such as food security, flood management and habitat restoration, represents a critical missed opportunity for improving water security.

4 KEY PRINCIPLES MUST GUIDE EFFORTS TO ENSURE EFFECTIVE WATER RETENTION IN THE FUTURE:

1. Storage integrates all hydrological components affecting water availability, movement, and retention to improve supply reliability statewide for evolving needs.
2. Comprehensive, timely, accurate, accessible, and transparent data and resulting information about our water resources is an essential foundation for effectively managing water storage in California.
3. An effective storage system requires the coordination of policies and regulations, activities, oversight, and accountability of all government agencies to meet local, regional, and statewide needs simultaneously.
4. Water storage and retention for improved water supply reliability and watershed health is facilitated by the availability of new sources of financial support that allow investment in quantified outcomes.

- Improving the flow of information through coordinated data management and institutional coordination can lead to powerful water retention outcomes.

- Several new and innovative funding mechanisms can complement traditional funding streams for water retention and are particularly well suited to agricultural applications.

Background

California's ability to grow its wealth of specialty crops depends on retaining and storing water from our wet season for use during our long summer dry season. Over time, California has developed elaborate and, by many measures, effective ways to smooth out the peaks and troughs in our natural precipitation patterns. Today, however, with continued population growth and likely changes in where and in what form precipitation falls, serious questions arise about the adequacy of our current storage and conveyance systems and their ability to meet the multiple goals we have for water supply in the state. Accordingly, California is not water-scarce per se, but storage-scarce.

Responding to the importance of this issue, members of the California Roundtable on Water and Food Supply undertook a dialogue on water storage, building on a 2011 report by the Roundtable: ***Agricultural Water Stewardship: Recommendations to Optimize Outcomes for Specialty Crop Growers and the Public in California.*** While this first publication argued the need to optimize water use through urban and agricultural water stewardship, the present work acknowledges that smart use of water must be complemented by more effective stewardship of supplies, extending and renewing them through reuse and added storage, which have potential to substantially increase water security. Focusing on the need for better storage capacity, the Roundtable launched its storage dialogue with three guiding questions:

1. What constitutes a "stewardship" approach to water storage?
2. How can we adapt our existing storage infrastructure to accommodate changing storage needs?
3. How can we add flexibility to meet economic and environmental goals, as well as flood risk management responsibilities, in more reliable ways?

Roundtable members explored ways to build greater supply reliability for specialty crop agriculture, as well as broader human and ecosystem needs, through management strategies that capture and retain water for managed release and use. These strategies would simultaneously deliver additional ecosystem services, including improved water quality, habitat restoration, reconnection of rivers and floodplains, and groundwater recharge. This publication includes a consensus framework for guiding future efforts to improve storage options and a set of high-priority actions that Roundtable members believe are important at this point and have potential to make a significant impact toward improving California's ability to store water for later use.

We define storage as processes that retain water in order to maximize its availability at the times and places it is needed. Storage functions to elongate the availability of precipitation through time and optimize availability over the lengthy dry season; as such, retention of water in the landscape must be a key guiding concept in our approach to storing water.

Tailwater recovery ditch in Northern California
Photo courtesy of USDA NRCS

From Storage to Retention

California's existing storage capacity is being eroded on many fronts, including loss of water storage in the form of snow and ice and diminished groundwater volume. The Sierra Nevada snowpack, a reservoir that provides about one-third[1] of the state's water supply for net urban and agricultural needs, is at risk, posing a serious threat to our ability to store precipitation for release through the dry summer months. Based on historical data and modeling, the California Department of Water Resources has reported that by 2050, the Sierra snowpack could shrink by 25 to 40 percent.[2]

Moreover, the state is already experiencing more extreme weather patterns, including an increased number of peak rainfall and runoff events as well as more dry periods and droughts. Foothill areas of both the Sierra Nevada and Coast ranges are receiving more rainfall and less snow, further limiting storage capacity. Groundwater reserves are shrinking: while estimates vary, in 2003, the Department of Water Resources estimated a loss of 1 million to 2 million acre-feet annually statewide[3], and more recent data from NASA's Gravity Recovery and Climate Experiment (GRACE) estimated an average annual loss of 2.5 million acre-feet in the Central Valley.[4] Land subsidence resulting from groundwater withdrawals decreases the pore space available for future recharge, compromising long-term groundwater storage capacity.

In addition to the loss of storage capacity, new pressures on state water supplies increase the urgency of finding new storage strategies. The state's population is growing rapidly, and we are facing new water management challenges (e.g., ensuring habitat for threatened and endangered species, water quality, and unsustainable groundwater withdrawals) as a consequence of past decisions. Innovative approaches to water storage can help ease the burden.

Our definition of storage matters—it will define the set of strategies that society will apply to address the need. We define storage as processes that retain water in order to maximize its availability at the times and places it is needed. Storage functions to elongate the availability of precipitation through time and optimize availability over the lengthy dry season; as such, retention of water in the landscape must be a key guiding concept in our approach to storing water. Storage is the product of complex physical features, landscape dynamics, and management processes with the potential to retain and release water, along with the evolving suite of regulations that govern them. From a water stewardship perspective, the water storage challenge is not simply one of managing the water cycle or managing the structures to store water, but one that considers how we adapt to a changing water cycle—that is, managing human activities, needs, and risk in a hydrological context that is becoming even more dynamic.

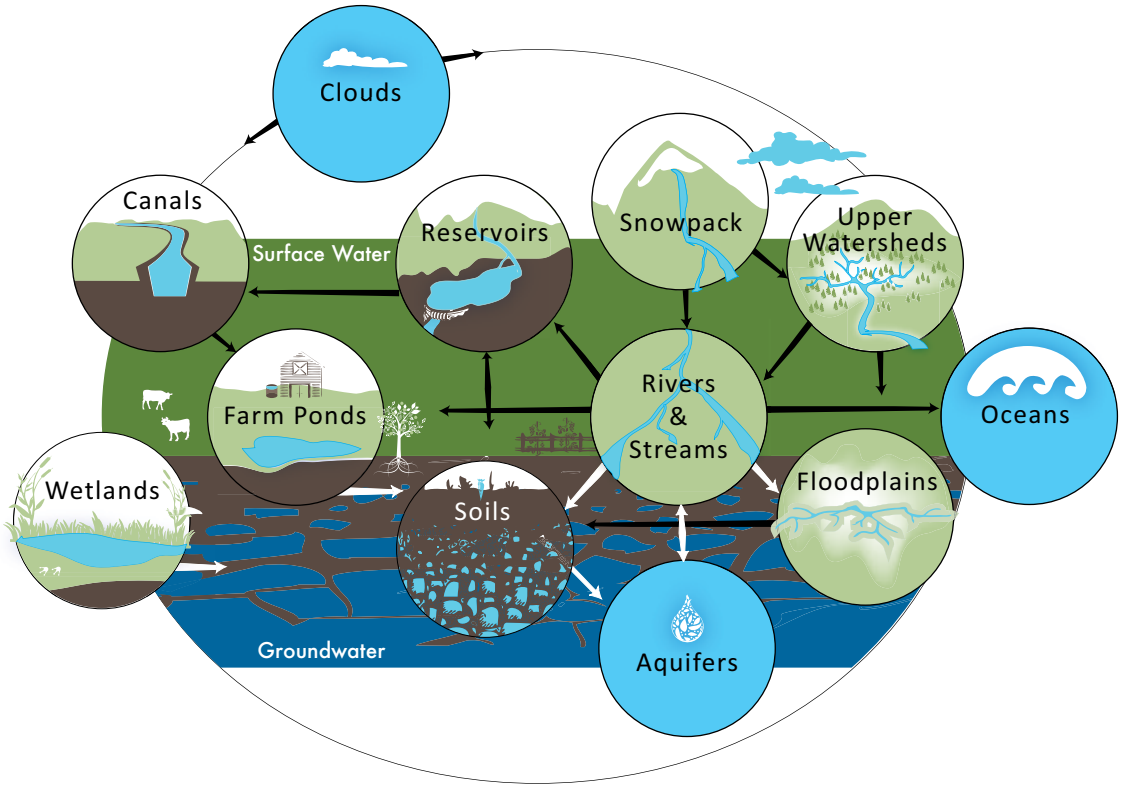
Demographic and land use changes mean that demand is a moving target. Managing for change in the water cycle must be a core principle as we strive to secure a more reliable supply from a volatile resource. Clearly, an effective storage regime that reflects both the changing availability and use of water is central to addressing these challenges. California's public safety, environmental stewardship, and economic stability depend on how well we adapt our storage, cycling, and transit systems to the annual water allowance we receive through precipitation. An integrated storage approach[5] focused on resiliency and flexibility is necessary to meet future water demands.

Our goal is to create a storage system that has optimized its retention capacity and can simultaneously release water to meet as many needs as possible (consistent with the physical limits of California's hydrological cycle) and optimize availability from place to place and across different scales of time (daily, seasonally, and yearly). This approach will include both transitory storage and more permanent storage infrastructure in order to better match water availability with public and environmental needs and benefits.

Public attention on California's water storage system has largely been focused on surface storage—the use of reservoirs to collect water for later release and use.[6] More recently, groundwater storage has increasingly been incorporated into the storage portfolio, and conjunctive (joint) management of surface and groundwater resources has emerged as an important management strategy.[7] Yet several valuable aspects of water storage tend to be overlooked in terms of their ability to contribute to the availability and reliability of water supplies for uses that benefit society. See page 2 for an overview of an expanded set of water storage reservoirs.

Water Storage Reservoirs

An overview of a broad range of storage "reservoirs," all of which are important nodes in the patchwork of reservoirs that is necessary to bridge short- and long-term gaps in the natural availability of water in places of use.



Working Toward a More Effective Retention Model

Achieving a more responsive and flexible storage regime requires a shift in the way that we, as a society, understand, define, and use storage as an element of integrated water management. Broadening our view of what constitutes a storage reservoir must be accompanied by a shift in our policies and programs to support a "retention" approach to storage—one that takes a comprehensive approach to holding back as much water as possible in the landscape for later use while maintaining healthy ecosystems. Water storage as described here can be an important component of a region's Integrated Regional Water Management (IRWM) Plan[8] by integrating a more diverse set of resource management strategies, and consequently increasing regional self-sufficiency. Achieving the vision of storage outlined above will require a shift in our perspectives and policies as depicted on page 3.

From Storage to Retention

FROM	TO	
Uniformity	**Diversity** 	**A diversity of storage** scales, methods, and locations is important for maximizing short- and long-term resiliency in the system. Effective storage will be place-based and flexible, acknowledging varying needs, resources, and solutions available in different regions.
Resistance	**Resilience** 	**Work in concert** with natural watershed dynamics and ecosystem functioning to maintain water supply for food production and healthy ecosystems in the face of environmental change.
Bathtub	**Sponge** 	**Increase retention in the soil** profile in upper watersheds, farms, and throughout the watershed. Annually renewed water in naturally functioning watersheds and meadows is stored in soils, vegetation, and shallow groundwater, and in transit via flowing rivers, creeks, springs, lakes, and other surface water.
Centralized	**Distributed** 	**Capturing water** in many places not only can add meaningful capacity when considered in aggregate but is more likely to reduce costs, increase local control, and benefit local farms and food security. Use every possible option for holding water—cisterns, bladders, engineered underground storage, on-farm ponds, seasonal wetlands, soils, regional ponds, larger reservoirs.
Nodes	**Network** 	**Repattern the flow and distribution** of water in the landscape to integrate water capture, conveyance, and storage connectivity to maximize their discrete and collective opportunities. Increase storage for short- and long-term use by developing distributed storage sites of varying scales and greater connectivity.
Runoff	**Infiltration** 	**Slow down the water cycle** to temper the intensity of big rain events, capture excess water for later use, and filter the water to remove sediment and contaminants. Implement land management approaches that slow runoff and increase infiltration. Integrate water quality objectives into these approaches.
Use	**Reuse** 	Storage systems can enhance tailwater capture, **reuse**, and infiltration, and contribute to new supplies on location or downstream.
Noun	**Verb** 	Thinking of **storage as a process** and not just a series of reservoirs can help us better achieve water storage and distribution goals.

The Yeomans plow enhances water infiltration for a wide range of production types (though not compatible with some irrigation systems such as subsurface drip).

Photo courtesy of Adam Hain and the Ecological Farming Association

Agriculture and the Water Retention Landscape: Priority Actions to Increase Water Supply Reliability

Achieving greater reliability of water supply according to the vision outlined will require changes in many spheres, including storage infrastructure, the data and knowledge needed to develop and fine-tune management approaches, the coordination of institutions at various scales to ensure most effective governance, and financing tools to support implementation of a much broader range of storage solutions. While there is a great deal of work to be done and many challenges to overcome to institute a water storage regime that meets all needs, the California Roundtable on Water and Food Supply has identified a set of priority action recommendations for each of these areas that are important and high-leverage places to start.

1| INTEGRATED STORAGE REGIME

Storage integrates all hydrological components affecting water availability, movement, and retention to improve supply reliability statewide for evolving needs.

To be more resilient and better prepared for future variations in water supply, California must take advantage of all storage opportunities throughout the system that meet the goals of reliable water supply and ecosystem restoration. We need more storage everywhere. In accordance with an integrated resource management[9] approach, our goal should be a flexible, resilient, and integrated storage system that works with natural cycles and is responsive to the unique social and ecological conditions of a given place. In this vision, California's working lands—farms and ranches—play an important role in the storage infrastructure. Such a storage system would not only enhance water management for the benefit of agricultural viability and food security, but also improve ecosystem health, minimize flood risk, and provide other beneficial outcomes. The value of working lands in helping to sequester water for later use while achieving many benefits, such as flood management and habitat restoration, must be recognized and promoted—this represents a critical missed chance to improve water security. Californians have a ripe opportunity to support working landscapes—areas that support both agriculture and delivery of public benefits—to increase their capacity to store or retain water for a variety of uses and ecosystem services.

Creating additional large-scale environmentally appropriate surface storage, as well as updating operation and management of existing reservoirs to increase benefits (known as "system reoperation"), will continue to be important management strategies as we strive to meet California's water demands.

However, several additional storage strategies warrant increased attention as we strive to leverage all opportunities for new storage. These include: (A) restoration and enhancement of upper watersheds and soils, (B) distributed off-stream surface storage, and (C) groundwater management and storage.

Water Retention in the Working Landscape

- Healthy soils store water in the soil profile.
- Land surfaces are left natural to the extent possible without disrupting production and managed to slow runoff and increase infiltration.
- Surface reservoirs and ponds capture peak flows to reduce flooding downstream and offset withdrawals in dry summer months.
- Working lands participate in seasonal floodplain restoration where appropriate to local conditions and land uses.

Healthy soils store more water
Photo courtesy of Adam Hain and the Ecological Farming Association

A. Restoration and enhancement of upper watersheds and soils

DESIRED OUTCOMES	PRIORITIES FOR ACTION
Landscapes in upper watersheds and source water areas (upper reaches, including mountain meadows and forests) that support water and snowpack retention have been restored and reconnected to aquifers and streams. Healthy agricultural soils throughout the watershed foster water infiltration and retention.	❑ Raise awareness among water end users (the public) and policymakers regarding the important role of upper watershed enhancements in broader water supply goals. ❑ Apply the expanding body of research and science on upper watershed hydrology and soil health to support decision-making and planning processes. ❑ Ensure that funding and technical support efforts aimed at improving water supply include upper watershed restoration and agricultural soil health throughout the watershed. ❑ Foster partnerships between water managers and public and private land managers to support a watershed- or catchment-scale strategy for water retention and watershed health.
RATIONALE	
The upper reaches of watersheds, in particular mountain meadows and forests, are critical and under-acknowledged for their role in water storage. Rehabilitated mountain meadows can provide crucial groundwater storage and improved timing of runoff, reducing flood risk during high flow periods and improving downstream flows during critical low flow periods. Beavers, through their damming and ponding activity, can play an important role in the restoration of mountain meadow and range systems by removing encroaching conifers, slowing and spreading surface flow, reconnecting channels and floodplains, and raising groundwater levels. Healthy forest ecosystems and soils can support higher degrees of infiltration, slower surface flows, and increased water retention. In concert with stewardship-based land management practices (e.g., fuel reduction, grazing management, invasive species removal), healthy forests promote biodiversity and encourage native species communities. In addition, farms and ranches throughout the watershed can further improve water security and contribute to watershed health by enhancing soil health and tilth, where soil type permits.	

B. Distributed off-stream surface storage

DESIRED OUTCOMES	PRIORITIES FOR ACTION
An extensive mosaic of scale-diverse water capture and off-stream storage reservoirs of varying capacities have been developed, including, but not limited to, on-farm ponds, floodplains, flood bypasses, seasonal wetlands, cisterns, bladders, underground storage, regional reservoirs, and mid- to large-scale off-stream storage reservoirs, as appropriate. (This may include several watersheds, depending on the distribution system[s] in the project area.) Storage is both strategically and opportunistically located to best connect to areas of use and to maximize ecological benefits. There is coordinated transitory storage on floodplains and in bypasses that protects productive agricultural land for food production where possible, while minimizing flood risk and maximizing ecosystem health. In cases where agricultural land is taken out of production, transitory flood projects are carried out in a way that producers are supportive of and that do not harm agricultural operations.	❑ Define and clearly communicate a state-sanctioned vision and framework for a water retention landscape, and empower local decision-making for the implementation of projects to meet the goals established in the state-level framework. Coordinate funding to help regional stakeholders collaborate on project design and implementation within that framework. ❑ Enable environmentally sound on-farm and regional small- to mid-scale off-stream storage ponds and reservoirs by reducing regulatory barriers (without compromising environmental standards) and bolstering technical and financial support. Addressing regulatory and water rights permitting barriers to distributed surface storage must be a top priority. ❑ Coordinate approaches to storage at a range of scales. Integrated Regional Water Management planning approaches must ensure the incorporation of new site-specific off-stream storage facilities within the larger river-bypass-floodplain scale in a corridor management approach.
RATIONALE	
Increasing surface storage will continue to be an important strategy for meeting water supply needs in California. There is a real opportunity to increase the overall amount of surface storage available by complementing large-scale surface storage with a broad patchwork of smaller reservoirs, ponds, and holding areas that are closer to where users need the water and connect to the naturally available water supplies in the area. These smaller reservoirs can more easily be designed and operated to simultaneously improve water supply reliability and enhance ecosystem health. Off-stream surface storage reservoirs, such as on-farm ponds, can also provide habitat for a variety of species on agricultural land. At the same time, more transitory storage on floodplains and in flood bypasses, as well as storage closer to where the water is needed, minimizes the costs and limitations associated with moving water great distances.	

C. Groundwater management and storage

DESIRED OUTCOMES	PRIORITIES FOR ACTION
Groundwater and surface water are widely understood as interconnected and are managed as an integrated whole. Groundwater recharge areas are protected, and infiltration of good-quality water in these areas has been enhanced. Overdraft of groundwater is mitigated by strong coordination between users and water providers. Groundwater recharge initiatives will enhance water quality, and safe drinking water is provided to rural communities. Implementation is carried out with strong collaboration among local actors in alignment with state planning processes and priorities, including Integrated Regional Water Management planning and groundwater management planning mandates. Management processes effectively manage multiuser needs and minimize conflict around regulation of usage and environmental considerations.	❑ Outreach to county planning staff and other leaders, such as those in flood control districts, to raise awareness of the importance of protecting groundwater recharge areas, and the role that new recharge area maps required under AB 359 can play in planning. ❑ Increase technical support and funding to private lands to increase recharge and flood mitigation activities, particularly those that are improving groundwater quality and helping manage stormwater flows. ❑ Ensure widespread implementation of the SB 1938 standard that requires setting basin management objectives for groundwater elevations, quality, subsidence, and surface/groundwater relationships. SB 1938 passed in 2002. It establishes certain parameters for the preparation, communication, and funding of groundwater management plans in California.
RATIONALE	
California's aquifers hold some of the greatest potential to enhance water storage. Working lands will play a critical role in ensuring that aquifers are recharged. Large-scale adoption of groundwater storage on private lands is possible but requires a framework that addresses the physical reality of interconnected aquifers existing under multiple properties, as well as a greater attention to water quality monitoring and data sharing. This requires a new dialogue in groundwater basins about how to manage this precious resource such that all users (including future users) of the resource have their interests protected to the maximum extent possible.	

Native ground cover in Yolo County
Photo courtesy of USDA NRCS

Wetlands in Butte County, CA
Photo courtesy of USDA NRCS

2| INFORMATION AND DATA

Comprehensive, timely, accurate, accessible, and transparent data and resulting information about our water resources is an essential foundation for effectively managing water storage in California.

DESIRED OUTCOMES	PRIORITIES FOR ACTION
The collection of data is used to answer key questions and assist in effectively managing water. The data are universally available and easily accessible. Data are based on watershed or basin, rather than political, boundaries and come from appropriate responsible sources at both local and state levels. Data and information are shared and integrated among management agencies across all scales and available to all interested parties through easy-to-understand formats and electronic storage and transmission. Data collection and management systems are objective, scientifically and ethically sound, and protected from political interference.	**Leveraging Data** ❑ Create tools and processes that allow all management agencies to understand and quantify watershed performance in terms of sustainability. ❑ Encourage state government to prioritize completing the standardized data collection requirement, pursuant to SBx7-7 or Water Code Section 10608.52. ❑ Collect data digitally and make available online. ❑ Provide more clear and objective criteria to define watershed and basin performance. The 2013 California Water Plan Update would be one appropriate venue for dissemination. **Leveraging Information** ❑ Improve and expand outreach and technical support to working lands stewards to accelerate implementation of soil and land management practices that enhance on-site water storage.
RATIONALE	
Water retention requires actively managing the water system, and information is required in order to make sound decisions. Accurate, accessible, and timely statewide data on water sources, uses, and quality provides a better picture of water flows[10] from the watershed to the basin scale. Currently, data about the sources, uses, and quality of water required to make effective management decisions are incomplete. Data that do exist are managed by a wide variety of entities and not necessarily shared or compiled in a way that allows an understanding of entire watersheds and basins. With better access to data, it would be possible to streamline management and oversight, make better management decisions, and develop outcome-based regulatory approaches that would alleviate the burden for water users.[11] If data were better organized, accessible, and easily disseminated, duplicative monitoring could be minimized.	

Wetlands in California
Photo courtesy of USDA NRCS

Data and Data Management for Water Retention

As in many scientific endeavors, good data are the underpinning of sound water resources management. Too often, data gathering is left off the table or dropped at the first sign of economic or budgetary constraints. As water becomes more scarce, that lack of good data will only exacerbate the acrimony and debate about needs and priorities. Therefore, data gathering needs an inviolate prescription and mandate so that all parties have sufficient information for their deliberations. The mandate is not for any data but rather for a prescription that is constrained by both economy and consensus. The following table demonstrates a general process and prescription for data and data management. While basic, these are the kinds of considerations that should guide data management efforts but are often overlooked.

General Steps in Data Collection and Management	Key Considerations
1. Identify the area and issues of concern	Ask the questions: • What needs to be measured? • Is someone doing it already? • Are existing data available, accessible, reliable, and comparable?
2. Identify what additional data you need, and design the program to answer the question	• Design to answer the question. • Identify data needs. • Establish protocol for sampling design and implementation.
3. Collect the data	• Establish data quality, field method, and handling controls.
4. Manage the data	• Require metadata. • Document quality control of the data. • Establish data analysis protocol.
5. Disseminate the data	• Post to a universal location appropriate for the type of data.

3| INSTITUTIONAL COORDINATION

An effective storage system requires the coordination of policies and regulations, activities, oversight, and accountability of all government agencies to meet local, regional, and statewide needs simultaneously.

DESIRED OUTCOMES	PRIORITIES FOR ACTION
State, federal, and local agencies and private organizations integrate their planning, policies, regulations, and investments. Good communication and broad collaboration helps identify, align, and implement strategic priorities. A set of clear authorities and accountability among all levels of governance and planning exists. Interested parties can easily understand where each entity fits into the system. Interagency communication at the state level and among all levels of water governance is clear and consistent. Directives or recommendations focus on results or intended outcomes and metrics of success, giving local decision-makers the flexibility to drive implementation as appropriate to local conditions and resources. Implementation is under the authority of local bodies to the greatest extent possible, and these entities inform and coordinate with counterparts at state and federal levels. Integration of state and federal policies and regulations enables and empowers regional decision-makers to develop their integrated plans and begin implementation more quickly and cost-effectively.	❑ Develop a cross-agency vision and coordinated plan for storage solutions with a strong focus on working landscapes, including large-scale hydrologic and geomorphic stewardship that integrates flood risk management with ecosystem function, process-based landscape restoration, water supply reliability, and agricultural production at the regional, watershed, and basin scales encompassing both surface and groundwater. ❑ Identify opportunities to better utilize existing laws to improve both groundwater and surface water storage to more effectively address the demands for water. ❑ Move toward inclusive, outcome-based policy and regulatory frameworks. State and federal directives should focus on intended outcomes, as well as the metrics of success, while regional and local entities should be encouraged to adaptively manage implementation as appropriate to their local conditions and resources. ❑ Build local capacity and expertise to achieve greater local water storage capacity by providing technical tools and skills at all scales (landowners, counties, state) and integrating regional planning initiatives such as flood, transportation, and housing plans, among others.
RATIONALE	
Integrated Resource Management (IRM)—of which Integrated Water Management is a part—is an approach that recognizes that no one agency (state or federal) has sufficient responsibility, authority, expertise, or resources to ensure natural resource stewardship throughout California. Current government practices and processes are fragmented and misaligned, resulting in inefficient, unsatisfactory, costly, and at times conflicting results. There are substantial and well-recognized impediments to highly functioning water governance in the state. These include legal obstacles that prevent optimization of water storage and use, compartmentalized institutional authorities, piecemeal regulatory structures that hinder holistic management, a lack of long-term political will, and limited social capital and financial resources that are insufficient to address the full set of water storage needs. Incentives have not been well established to encourage people to help the larger whole. Agency coordination is critical to a successful storage system. Multi-agency collaboratives, whether formally established or ad hoc task forces, have structural and functional characteristics that make them more effective in furthering the mandates and missions of each participating agency and employing IRM to achieve more effective natural resource stewardship. Change happens from both the ground up and the top down. The benefits of IRM include the following: • Increased coordination and engagement with all levels of governments and agencies (federal, tribal, state, local), stakeholder groups, private landowners, and others. • Increased effectiveness through leveraging of existing networks, relationships, and multi-agency venues. • Improved sharing of data, information, tools, and science among governments and agencies. • Coordinated and streamlined permitting to increase regulatory certainty.	

4| FINANCING

Water storage and retention for improved water supply reliability and watershed health is facilitated by the availability of new sources of financial support that allow investment in quantified outcomes.

DESIRED OUTCOMES	PRIORITIES FOR ACTION
Resources are available to effectively and strategically implement the full range of storage options identified in this and other reports; this includes developing expanded financing strategies to supplement general obligation bonds and overcome the sporadic nature upon which they are available.	❑ Build a collaborative effort with broad consensus to define and identify funding opportunities for top-priority projects to advance working lands water capture and storage. This effort could also inform a research agenda and efforts to minimize legal and regulatory barriers. ❑ Develop mechanisms to compensate landowners for providing ecosystem services, such as mitigating flood risk and groundwater storage. ❑ Expand existing tools to quantify outcomes and report deliverables necessary to facilitate investment. ❑ Encourage the use of all state, federal, and private grant and loan programs, in addition to bonds, to address water infrastructure needs. Three such programs are as follows: 1. California Infrastructure and Economic Development Bank financing of local infrastructure projects (CIEDB has issued over $30 billion in conduit revenue bonds since 2000) 2. California Pollution Control Financing Authority, which has $2.68 billion in revenue bond authority 3. USDA Rural Utility Service, which deployed $176 million in 2010 4. PERS and STRS Infrastructure investment programs of pension funds such as the California Public Employees' Retirement System (CalPERS) and the California State Teachers' Retirement System (CalSTRS). ❑ Develop new funding streams to expand water storage at multiple scales, such as those listed on page 12.
RATIONALE	
In an environment of limited local, state, and federal resources, funding for a water retention landscape will hinge on the ability to leverage existing capital resources and to articulate precisely the extent to which those resources are achieving their intended goals. California has relied on numerous public sources to finance its infrastructure — primarily general obligation and/or revenue bonds.[12] Because relying solely on traditional public finance mechanisms is insufficient to meet the growing need for infrastructure investment, new financing mechanisms are needed to provide more consistent levels of funding at multiple scales.[13] To increase the capacity of California's water retention landscape, a diversity of funding mechanisms and scales of funding, including local and regional financing, are required. An added focus on regional financing infrastructure could allow investment in improved watershed health, water retention, and other beneficial outcomes. But for these financing mechanisms to work, there must be better quantification of beneficial outcomes and elimination of legal barriers.	


Photo courtesy of USDA NRCS

Potential New Funding Streams for Water Retention[14]

- New funding mechanisms through water deliveries and regional management structures such as IRWMs.
- Leverage Mello-Roos bonds to support infrastructure-related projects benefiting lower-income areas.
- Support the California Public Utilities Commission's efforts to recognize the energy-water nexus, and direct a portion of the public goods charge for energy back to local water agencies for water management and storage solutions that deliver energy savings.
- Create efficient intermediaries through collaboration among foundations, government, and conventional capital markets to (a) diversify pools of loans geographically and by asset class, (b) work with ratings agencies, and (c) help service loans for those lenders who need it. Intermediaries could include: contract assessment districts, cooperatives, community capital collaboratives, public benefit corporations, and improvement districts.
- Insurance companies, working through the California Organized Investment Network (COIN), can be more innovative in funding investments that support the environmental and community development needs of California.[15]
- Promote federal and state Revolving Loan Funds[16] capitalized with grants, government programs, and individual donations.
- Incentive mechanisms through AB 32 cap-and-trade revenue where storage or retention projects deliver climate benefits, such as through reductions in energy use.
- California counties, cities, special districts, or joint powers authorities can establish a Contract Assessment District (CAD), subject to certain legal requirements and LAFCO authorization, which allows for tax increment financing of public improvements and services. CADs are best known as a mechanism for financing residential solar projects; however, they have recently expanded into water conservation and have the potential to facilitate financing a wide array of improvements such as rainwater harvesting and small water storage projects.
- Crowdfunding[17] represents an opportunity for the public to finance smaller-scale storage projects promoting products or missions they believe in—with investments as small as $10 up to thousands of dollars. Internet crowdfunding platforms serve to minimize the transaction costs of such investments (for example, Kickstarter, Symbid, IndieGoGo, and Seedups).
- Corporate investment in "shared value" allows firms to benefit society and boost their bottom line at the same time. Firms depend on healthy and well-functioning societies to thrive; this strategy allows them to leverage their expertise, value chains, and influence to incorporate social issues into their core business strategies—benefitting both society and their own long-term competitiveness.[18]
- Facilitate opportunities for large entities to engage with regional economic development strategies.
- Social Impact Bonds (SIBs) are an innovative financing vehicle for social programs: instead of paying upfront for a prescribed set of services, SIBs allow government to fund approaches that work—without paying a dime if agreed-upon outcomes are not achieved.

Collaboration among leaders around the state to implement the priority actions associated with infrastructure development, information management, institutional coordination, and financing will constitute a meaningful shift toward a model of water retention that is a necessary foundation for sustainable water management in California.

Seasonal wetland in Northern California
Photo courtesy of USDA NRCS

Endnotes

[1]California Department of Water Resources. (2012). "First snow survey of 2012 shows dry conditions" [news release]. *www.water.ca.gov/news/newsreleases/2012/010312snowsurvey.pdf.*

[2]California Department of Water Resources. (2009). *California Water Plan Update 2009* (Volume 1, Chapter 4, pp. 4–37). Sacramento, CA: Department of Water Resources.

[3]California Department of Water Resources. (2003). *California's Groundwater.* Bulletin 118—Update 2003. *www.water.ca.gov/groundwater/bulletin118/bulletin118update2003.cfm.*

[4]Famiglietti, J. S., M. Lo, S. L. Ho, J. Bethune, K. J. Anderson, T. H. Syed, S. C. Swenson, C. R. de Linage, and M. Rodell. (2011). "Satellites measure recent rates of groundwater depletion in California's Central Valley." Geophys. Res. Lett., 38, L03403, doi:10.1029/2010GL046442.

[5]An integrated storage approach is the process of managing the storage of water for use that combines and coordinates multiple infrastructural elements and user needs so as to provide a functioning, interrelated system.

[6]California Department of Water Resources. (2009). *California Water Plan Update 2009* (Volume 2, Chapter 13, pp. 4–37). Sacramento, CA: California Department of Water Resources.

[7]According to the California Water Plan, conjunctive management (use) of surface and groundwater storage is the "coordinated and planned management of both surface and groundwater resources in order to maximize the efficient use of the resource; that is, the planned and managed operation of a groundwater basin and a surface water storage system combined through a coordinated conveyance infrastructure. Water is stored in the groundwater basin for later and planned use by intentionally recharging the basin during years of above-average surface water supply. *California Water Plan Update 2009* (Volume 4, Glossary). Sacramento, CA: California Department of Water Resources.

[8]According to the California Department of Water Resources, Integrated Regional Water Management (IRWM) is a collaborative effort to manage all aspects of water resources in a region,
involving multiple agencies, stakeholders, individuals, and groups, that attempts to address the issues and differing perspectives of all the entities involved through mutually beneficial solutions.

[9]According to the Nova Scotia Department of Natural Resources, Integrated Resource Management (IRM) is "[a] planning and decision making process that coordinates resource use so that the long-term sustainable benefits are optimized and conflicts among users are minimized. IRM brings together all resource groups rather than each working in isolation to balance economic, environmental, and social requirements of society." As acknowledged in the California Department of Fish and Game's 2012 Strategic Vision, Integrated Resource Management—of air, energy, land, and water—recognizes that no one agency (state or federal) "has sufficient responsibility, authority, expertise, or resources to ensure natural resource stewardship throughout California."

[10] This is sometimes called "flow path analysis."

[11]This is already beginning to happen through SBx7-7, IRIS, the Water Data Library, and the California Water Quality Monitoring Council [W.C. Section 13181].

[12]"General obligation bonds are sold by governments primarily to raise funds for public works projects. General obligation bonds must be approved by voters, and their repayment, with interest, is guaranteed by a government's general taxing powers. When California voters pass a general obligation bond, they commit to paying back the amount of the bond, plus interest, out of the state's General Fund. The General Fund is the pool of public money that the state uses to cover the majority of state services and projects. Each year, California uses part of the General Fund to pay "debt service"—the annual expenses of interest and principal of bonds that the state has sold. This is similar to the way someone who has borrowed money to buy a car or house must make regular payments to repay the loan. The General Fund is also used to pay for public schools and universities, the state prison system, the Medi-Cal health insurance program, unemployment benefits, state parks, and other health and social services. Between 1970 and 1999, small water-related bonds were passed every few years, ranging from $188 million to $1.8 billion (in 2010 dollars), and totaling $9.1 billion over the 29-year time period. However, since 2000, the frequency and size of water-related bonds have increased markedly. Between 2000 and 2006, six water-related general obligation bonds were passed, ranging from $2.5 billion to $5.8 billion, and totaling $22.5 billion. The state Legislature recently passed an additional $11.1 billion water bond, which is yet to be placed on the ballot for voter approval." (See Juliet Christian-Smith, Lucy Allen, Eli Moore, and Peter Gleick. [August 2010]. *The 2010 California Water Bond: What Does It Say and Do? An Independent Analysis of the "Safe, Clean, and Reliable Drinking Water Supply Act of 2010.* Oakland, CA: Pacific Institute.)

[13]The California Financial Opportunities Roundtable (CalFOR), a group of over 90 experts and activists representing the financial sector, community activists, economic development organizations and government agencies, recently explored options to improve innovation, collaboration, financial tools, and business-critical infrastructure for California. Their report highlights 34 different ways to access capital as well as a comprehensive overview of available resources and policy recommendations. It is available at: *http://www.rurdev.usda.gov/Reports/CA-CalFOR.pdf.*

[14]More information on these mechanisms: *http://www.rurdev.usda.gov/Reports/CA-CalFOR.pdf*

[15]Established in 1996, COIN leverages insurance company capital to fund investments that benefit California's environment and its low-to-moderate-income (LMI) and rural communities—similar to the federal Community Reinvestment Act (CRA) that applies to the banking industry. Insurers that write premiums of $100 million or more in California annually are required to
file a statement detailing annual goals for community development investments and community infrastructure investments. California Insurance Code §926.3 (b)

[16]A revolving loan fund (RLF) is a gap financing measure primarily used for development and expansion of small businesses. It is a self-replenishing pool of money, utilizing interest and principal payments on old loans to issue new ones. While the majority of RLFs support local businesses, some target specific areas such as health care, minority business development, and environmental cleanup.

[17]Crowdfunding (also called crowd financing or hyper funding) describes the collective cooperation of people who network and pool their money and/or other resources together, usually via the Internet, to support efforts initiated by other people or organizations. Crowdfunding has been used to accumulate resources for disaster relief, facilitate citizen journalism, connect artists with fans, support political campaigns, and finance startup companies, movies, small businesses, and free software.

[18]For a more detailed discussion of shared value creation, see M.E. Porter and M.R. Kramer, "Creating Shared Value," *Harvard Business Review*, January–February 2011.