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INCREASING WATER SECURITY AND DROUGHT PREPAREDNESS THROUGH INFRASTRUCTURE, MANAGEMENT AND INNOVATION

HEARING

BEFORE THE

SUBCOMMITTEE ON
WATER AND POWER

OF THE

COMMITTEE ON
ENERGY AND NATURAL RESOURCES
UNITED STATES SENATE

ONE HUNDRED FIFTEENTH CONGRESS

FIRST SESSION

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INCREASING WATER SECURITY AND DROUGHT PREPAREDNESS THROUGH INFRASTRUCTURE, MANAGEMENT AND INNOVATION

WEDNESDAY, AUGUST 2, 2017

U.S. SENATE,
SUBCOMMITTEE ON WATER AND POWER,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, DC.

The Subcommittee met, pursuant to notice, at 10:06 a.m. in Room SD–366, Dirksen Senate Office Building, Hon. Jeff Flake, Chairman of the Subcommittee, presiding.

OPENING STATEMENT OF HON. JEFF FLAKE, U.S. SENATOR FROM ARIZONA

SENATOR FLAKE [presiding]. This hearing of the Senate Energy and Natural Resources Subcommittee on Water and Power will come to order.

The purpose of today's hearing is to receive testimony on water supply and drought issues. We will hear testimony on a range of water-related topics including, infrastructure and supply, certainty in planning and innovative management practices that are critical to maintaining secure water supplies. This includes items that are crucial to Arizona such as the Colorado River.

Drought planning, watershed restoration, better use of existing reservoirs, a reliable water supply and drought protection cannot be achieved without storage infrastructure and forward-thinking management and planning. Oftentimes discussions on water policy at the federal level are dictated by cost; however, it is important that Congress also consider the barriers local communities face as they plan and pursue new water projects.

I look forward to today's hearing to hear how state and local policies encourage judicious water use and how permit streamlining and regulatory predictability can ensure all solutions are on the table.

We will also hear about innovations in water treatment technology and project financing that can help with water infrastructure and supply challenges.

Now we live in an age, as we know, that you expect when you turn on the tap that there is water there, that the water will always be there, which means that supply certainty is critical for managers.

Protecting the sanctity of state water rights, resolving conflicts and collaborative planning, as we will see today, help ensure water certainty. As we have seen in Arizona, providing this certainty can also unleash private investment and innovative partnerships that improve water management.

Finally, changes to operation and management of existing infrastructure can be a cost-effective water strategy as well.

I am glad that the Committee will hear from several witnesses today who can speak to the importance of using the most up-to-date hydrology and forecast in operating existing reservoirs. I think that we can learn from this testimony and build on last year's drought legislation to try to address critical water needs for Arizona and the nation.

Water managers on the ground have great ideas about how to increase water supply and drought resistance. I look forward to working with them on these efforts.

In addition to the experts we will hear from today, we have received a number of written statements for the hearing record and I will be considering that input as we move forward as well.

As Senator Franken and I were talking just a bit ago, this is an important issue for Arizona and I noted that through all of my life, whenever it rains, no matter where I was living, when I would see rain I would have the instinct to call my dad because as an old rancher that was when he was in a good mood.

[Laughter.]

And our favorite time as a family was to hop in the truck after a good rain and to see which draws were running to see which stock tanks would fill. That was our version of excitement in Snowflake, Arizona.

[Laughter.]

Anyway, I am glad we are having this hearing. I am glad to have Ranking Member Angus King from Maine and turn to him for his opening statement.

STATEMENT OF HON. ANGUS S. KING, JR., U.S. SENATOR FROM MAINE

Senator KING. Thank you, Mr. Chairman. Thank you to our expert witnesses who are joining us this morning, especially my constituent from Maine. Welcome to Washington at this time of year—like me you would probably rather be in Maine on a day in August.

As the Chairman mentioned, we will hear from a range of points of view this morning on different approaches to maintaining the crucial, healthy water supply. Even in Maine we are not immune to the impacts of a fragile water supply due to drought conditions.

We recently had our first drought in 14 years which impacted 70 percent of our state, and a very significant percentage of our state's residents—I think it is almost half—depend upon wells for their water. That drought finally ended this past April, but it was a very serious matter for us.

I understand my colleagues in the West probably are not very sympathetic to hearing about droughts in New England, but they do occur and all regions of the country have these serious issues. So I am looking forward to hearing about the different approaches that have been developed in other parts of the country.

The critical nature of water management across the country has stimulated a variety of approaches to planning and financing. For example, we will hear from Martha Sheils, from the New England Environmental Finance Center, in regard to the importance of green infrastructure improvements on the water supply. I am also looking forward to hearing how we can promote public-private partnerships in water infrastructure projects and use the lessons in other areas where infrastructure improvements are, in fact, desperately needed. We will also hear about the value of planning and flexibility that we can provide in water management and how innovations in water use technology can make water management more effective.

While we have different specific water concerns around the country and needs depending upon where we are, we can certainly take lessons from these folks who have joined us this morning to think differently and use more creative approaches to water management, public-private partnerships, innovative infrastructure and technology solutions.

So, Mr. Chairman, thank you for calling this hearing. I look forward to hearing from our witnesses with their testimony.

Senator FLAKE. Well, thank you.

We will turn to the witnesses. Thank you for joining us today.

We will begin the panel with Mr. Tom Buschatzke, Director of the Arizona Department of Water Resources. Tom, I greatly appreciate the close working relationship that we have had over the years and all that you have done for the State of Arizona on critical water issues. You have been an important water leader for the state, and we always look forward to having you testify here before the Senate.

Next, we will have Shirlee Zane, Chairman of the Board of the Sonoma County Water Agency.

Then, Martha Sheils, as mentioned, the Project Director for the New England Environmental Finance Center. I must say that these hearings are typically Western-focused so it is nice to have a witness here who will talk about things going on in Maine.

Then we will hear from Heiner Markhoff, President and CEO of GE Water and Process Technology.

Finally, we will hear from Mr. Carlos Riva, CEO of Poseidon Water.

Thank you all for the testimony you will provide. We would like you to limit your remarks, if you can, to five minutes to have time for questions. Your full statements will be submitted for the record.

With that, we will recognize Mr. Buschatzke.

STATEMENT OF THOMAS BUSCHATZKE, DIRECTOR, ARIZONA DEPARTMENT OF WATER RESOURCES

Mr. BUSCHATZKE. Thank you and good morning, Chairman Flake, Ranking Member King and members of the Subcommittee.

I'm Tom Buschatzke, Director of the Arizona Department of Water Resources. Thank you for providing me an opportunity to testify on behalf of the State of Arizona. I have submitted written testimony for the record, and my comments today will highlight key issues in that testimony.

Arizona continuously develops and improves the legal framework, policy prescriptions, institutions and infrastructure needed to secure its water resources, create certainty and prepare for drought. The state prioritizes internal actions but collaborates regionally and with the Federal Government. Aggressive water management actions have resulted in a reduction in Arizona's water use while its population and economic output have increased, all while decreasing mined groundwater usage.

For the past 20 years, drought has been a constant in Arizona. When shortage on the Colorado River is declared, about 84 percent of the total falls to Arizona. This knowledge drives robust drought mitigation programs in the state.

Now I want to share some examples of innovative water management actions in Arizona.

First, the Palo Verde Nuclear Generating Station contracted for reclaimed water for cooling purposes in 1973, long before reuse became a common practice.

In 1986 and again in 1984, the landmarked Groundwater Management Act was amended to incentivize underground storage of surface water and effluent. That program promotes the use of existing infrastructure to help reduce costs and the water can be used for drought management or for growth.

The Arizona Water Banking Authority was created in 1996 to backfill Colorado River shortages. It has stored over four million acre-feet for Arizona, but it has also stored 600,000 acre-feet for Nevada. Our underground storage credits can be marketed to others.

Tribes lease water to others facilitated by federally authorized tribal water right settlements. One we're using, the state's policy is to settle rather than litigate tribal water rights claims. There are 11 tribes in Arizona with pending claims, so much work still needs to be done.

Turning to Arizona's efforts to deal with drought impacts to the Colorado River, major activities are ongoing. Over the past decade, the risk that Lake Mead might fall to unhealthy levels, even with the existing shortage criteria, has risen to unacceptable levels. In response, Arizona, Nevada, California and the Bureau of Reclamation negotiated a draft Drought Contingency Plan, or DCP, as it is commonly referred to. The DCP further incentivizes the conservation and storage of Colorado River water in Lake Mead and creates greater flexibility to recover some of that water. Under the DCP, Arizona and Nevada would take additional reductions at higher Lake Mead elevations and for the first time, California would take reductions to help protect critical Lake Mead elevations.

A draft minute to the water treaty with Mexico, Minute 323, would have Mexico take actions equivalent to the DCP when both agreements are finalized. Arizona believes that Congressional authorization, likely through this Subcommittee, directing the Secretary of the Interior to execute the DCP will be pursued when the DCP is finalized. That authorization will create certainty for all the parties.

As demonstrated by the ground-breaking measures I have outlined, collaboration in an all-hands-on-deck approach is the future of the Colorado River.

Within the state, we will do more with our existing infrastructure.

The Bureau of Reclamation and the operators of the Central Arizona Project (CAP) completed a system use agreement earlier this year, something that Chairman Flake has been prodding the Department of the Interior to complete. It allows for wheeling of non-project water. The agreement creates a clear pathway for the recovery of water stored underground and the transport of that water in the CAP canal to entities that will be shorted by Colorado River reductions. Wheeling also allows for exchanges between water users which lowers their costs and creates flexibility.

Another opportunity is the use of the dedicated flood control space at modified Roosevelt Dam to increase its yield by an average of 70,000 acre-feet per year. To date, environmental compliance considerations and Corps of Engineer process issues forced interested parties to set aside their efforts. Streamlining the process, similar to the amendment Senators Flake and Risch inserted into the Energy bill last year, could help make that a reality.

In conclusion, Arizona's internal efforts to manage its water resources and its collaborative efforts on the Colorado River will be most successful in a setting where federal oversight is minimized, regulations and permitting processes are reduced or streamlined and the primacy of states to manage water resources is honored.

Thank you.

[The prepared statement of Mr. Buschatzke follows:]

Testimony of Thomas Buschatzke
Director
Arizona Department of Water Resources
COMMITTEE ON ENERGY AND NATURAL RESOURCES
SUBCOMMITTEE ON WATER AND POWER
United States Senate
August 2, 2017

Chairman Flake, Ranking Member King and members of the Subcommittee:

I. Introduction

My name is Tom Buschatzke and I am the Director of the Arizona Department of Water Resources. Thank you for providing me an opportunity to present testimony on behalf of the State of Arizona as the subcommittee examines the issues of increasing water supplies for drought preparedness through infrastructure, management, and innovation.

Arizona has a long-standing philosophy regarding drought preparedness and water management: continuously develop and improve the legal framework, policy prescriptions, institutions and infrastructure needed to create certainty so that reliable and secure water resources are the pillar upon which the State builds its economy, grows its population, and maintains a superior quality of life for its citizens. While Arizona has a history of partnering with the federal government and its neighboring states, it has always maintained an ethos of first taking actions within the State to better manage its water supplies and to be prepared for drought.

Flexibility to manage water supplies and adaptation to drought conditions are part of Arizona's history and will continue to be a key management strategy now and in the future.

II. Background

The State of Arizona and its water users have a long history of developing water supplies and the necessary infrastructure to deploy those supplies to maximize their benefit to the citizens and businesses in our State. Sound management of those supplies has been a primary focus in our State and the arid nature of Arizona is a constant reminder of the value of every drop of water available to us. Arizona is fortunate to have a diverse portfolio of water supplies. Arizona currently uses about seven million Acre-feet of water per year statewide which comes from the following sources: the Colorado River-41%; groundwater-40%; in state rivers-16%; and reclaimed water reuse-3%.

Arizona has a long history of collaboration and innovation in managing its water supplies. Private development of water resources was the paradigm in Arizona's territorial days. As we moved toward statehood in 1912, the Reclamation Act of 1902 offered new opportunities to increase water supplies and to build infrastructure to create more reliability for our existing supplies. Some of those success stories include the Salt River Project, the Gila Project, the San Carlos Project, the Mojave Valley Irrigation District, the Wellton-Mohawk Irrigation and Drainage District, the Yuma County Water Users' Association, the Yuma Mesa Irrigation District, the North Gila Valley Irrigation and Drainage District, the Yuma Auxiliary Project-Unit B, and the Central Arizona Project.

Arizona took a major step forward regarding its legal and policy framework for managing water supplies in 1980. Arizona adopted the Groundwater Management Act, a groundbreaking set of laws that managed our finite groundwater supplies and incentivized conjunctive use of surface water and groundwater. The Act was a hard-fought compromise between agriculture, industry, mining interest and municipalities. The Act imposes stringent water management regulations in the areas of the state designated as Active Management Areas, or "AMAs." Within AMAs, mandatory water conservation

requirements are established for municipal, industrial, and agricultural water users. Agricultural acreage is capped, with no new agricultural land allowed to be put into production after 1980. Turf acreage is limited on new golf courses and so is the amount of water they can use. New housing developments are required to show that they have a 100-year renewable water supply before they can be built. Outside of AMAs, community water systems, i.e., municipal providers, are required to have conservation and drought management plans in place and agricultural acreage is capped in areas designated as Irrigation Non-Expansion Areas.

The overarching goal of the Act is to preserve finite groundwater supplies for use when drought has reduced surface water supplies. These aggressive water management actions reduced Arizona's water use over time while the State's population and economic output have increased. One result is that Arizona's dependence on groundwater has decreased from 53% in 1980 to 40% today.

III. Arizona's Drought Vulnerability

Arizona has been under an emergency drought declaration since 1999. The Governor of Arizona makes that declaration annually pursuant to a recommendation from the Governor's Drought Interagency Coordinating Group. The declaration relates to conditions "on the ground" in Arizona as well as drought impacts to water supplies.

The west-wide drought presents some unique challenges for all Colorado River users and the State of Arizona. The Colorado River watershed is entering its 17th year of below average runoff due to drought. Arizona stands to lose 320,000 Acre-feet of its 2.8 Million Acre-feet Colorado River allocation when a Tier 1 shortage is triggered by order of the Secretary of the Interior pursuant to the 2007 Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations of Lake Mead. Under the Interim Guidelines a projection of the elevation of Lake Mead is made in mid-August for the first day of the next calendar

year. If that projection shows Lake Mead falling below elevation 1,075 feet then a Tier 1 shortage is put into place starting on January 1 of that year. Today, Lake Mead is at elevation 1,079[1] feet. The probability of a shortage declaration in the Lower Basin of the Colorado River had been steadily increasing over the past few years. While there has been some modest improvement in the shortage probabilities there is still an unacceptable risk of shortage. The probability of a shortage in calendar year 2019 is 31% and that increases to 32%[2] for 2020. It is important to note that a Tier 1 shortage triggers reductions for Arizona, Nevada and the Republic of Mexico but not for California. Arizona shoulders the brunt of the shortage among the three states and Mexico, about 84% of the total. This is one of the driving forces requiring the State to look within its borders to create drought mitigation programs.

Deeper shortages will occur if Lake Mead's elevation continues to decline. Between elevation 1,050 feet and 1,025 feet a Tier 2 shortage results in Arizona suffering a reduction of 400,000 Acre-feet and at elevation 1,025 feet Arizona loses 480,000 Acre-feet, a Tier 3 shortage. The probabilities of Tier 2 and 3 occurring have also been increasing as the drought continues. If Lake Mead's elevation continues to drop and falls below elevation 1,025 feet, the volume of shortage to Arizona is unknown at this time. This uncertainty further galvanizes Arizona's efforts to aggressively take actions to have drought mitigation activities in place.

Low reservoir conditions in the Colorado River system impact not only water users, but directly impact the production of hydroelectric power from major dams on the River. Hoover Dam's generating capacity during the current drought has decreased from a maximum of 2,074 Megawatts to 1,602 Megawatts, a 23% decrease. On average, a one foot drop in the

[1] Based on USBR Lower Colorado River Region's weekly Colorado River water supply report for July 24, 2017.
[2] Based on USBR Lower Colorado River Region's Colorado River April 2017 24 MTOM/CRSS Study and resulting projections of Lake Mead elevations.

elevation of Lake Mead decreases the generation capacity by about 5 Megawatts. Glen Canyon Dam hydropower production is eliminated if Lake Powell falls below elevation 3,490 feet, and United States Bureau of Reclamation has indicated that impacts to power production could occur at elevation 3,525 feet.

The drought also causes other impacts indirectly related to reduced precipitation. The health of the watersheds of the Colorado, Salt, Verde and Gila Rivers is an increasingly important issue in the region. A number of national forests in Arizona were created primarily for watershed protection and are indicative of the fact that forest health and water supply are closely connected. The drought has exacerbated issues associated with poor forest management including fuels and timber management so that the risk to our forests from catastrophic wildfires is increasing.

IV. Innovation and Continuous Improvement

Reuse of Reclaimed Water

Arizona's history also includes a strong commitment to recycling and reuse of reclaimed water. Arizona was reusing substantial volumes of reclaimed water long before reuse became a common practice. The poster child for reuse in Arizona is the Palo Verde Nuclear Generating Station in the Phoenix metropolitan area. The Nuclear Generating Station contracts for 80,000 Acre-feet per year and uses 72,000 Acre-feet per year of treated municipal wastewater from the 91st Ave Wastewater Treatment Plant which serves five cities in the region. The 2010 agreement is for a 40-year term and replaces an earlier agreement from 1973. Palo Verde produces up to 4,200 megawatts of power and serves about 4 million people in four western states. Technological advances and improved management practices have increased efficiency in the use of the water by the cooling towers and has substantially reduced water use since the startup of the plant in 1986.

Improving the Groundwater Code

The 1980 Groundwater Management Act has been improved over time as new programs and tools were identified. In 1986, the Arizona Legislature established the Underground Water Storage and Recovery program to allow persons with surplus supplies of water to store that water underground and recover it at a later time for the storer's use. In 1994, the Legislature enacted the Underground Water Storage, Savings, and Replenishment Act (UWS), which further defined the recharge program. Water quality protections are part of this program.

There are several mechanisms used to accomplish the storage requirements and certify the creation of "long-term storage credits" that can be accessed in the future. One way to earn long-term storage credits is to put Colorado River water or reclaimed water into basins constructed for the purpose of allowing the water to infiltrate into the underlying aquifer. Long-term storage credits can also be earned by supplying a substitute surface or reclaimed water supply to a farmer who is pumping groundwater. The groundwater left in the ground by that farmer creates long-term storage credits. This method for creating long-term storage credits leverages existing infrastructure: the canals, laterals and wells being used by the farmer.

Another commonly used method to create long-term storage credits is to utilize existing dry streambeds. Water is delivered into those streambeds and infiltrates into the groundwater aquifer. Infiltration rates can be enhanced by the construction of basins or berms. A less frequently used fourth mechanism is to put surface water or effluent directly into the aquifer through injection wells.

Protections are in place to ensure that the addition of water to the aquifer through this program does not harm the aquifer's water quality. Protections also ensure that existing structures extending below land surface are not damaged by rising water levels.

The Underground Water Storage and Recovery program serves multiple objectives and integrates sustainable water supply management and drought protection. Water users in Arizona have taken advantage of this program to create volumes of water to protect against reductions in surface water supplies due to drought. Long-term storage credits can be used to meet the 100-year requirement for residential growth to demonstrate that it is using renewable water supplies. Long-term storage credits are fungible and can be sold from one water user to another, thus creating a market mechanism to help manage water supplies in Arizona.

The State recognized the value of the Underground Water Storage and Recovery Program and in 1996 created the Arizona Water Banking Authority. This state agency is charged with storing water underground to backfill shortages of Colorado River water for municipal, industrial and tribal entities that have their water delivered to them through the Central Arizona Project and for certain municipal and industrial Colorado River water users who have contracts directly with the Secretary of the Interior. To date the Water Banking Authority has stored about 4.1 Million Acre-feet for these purposes. The Water Banking Authority's powers also include the ability to engage in interstate banking of Colorado River water with California or Nevada. To date the AWBA has stored 601,000 Acre-feet for Nevada. Water was stored in Arizona for California but that has all been recovered by California.

Proactive Measures to Protect Lake Mead and the Colorado River System

Arizona recognizes that the risks to its Colorado River supplies associated with the on-going drought and the over-allocation of water supplies for the Lower Basin States of Arizona, California and Nevada are great. It has conscientiously pursued a strategy to create resiliency to respond to drought impacts through its internal activities, policies, and legal framework. But we recognize that more needs to be done.

Collaboration is another key strategy that Arizona is pursuing to deal with the Colorado River. Actions taken in concert with the federal government through the Department of the Interior and the Bureau of Reclamation, California, Nevada, Utah, Wyoming, Colorado and New Mexico are critical to a successful outcome. Likewise, including the Republic of Mexico as a valuable partner in managing the Colorado River system is a key tactic.

The 2007 Interim Guidelines set the stage for conjunctively operating Lake Powell and Lake Mead and set the shortage triggers and volumes for Arizona and Nevada in the Lower Basin. Signed on November 20, 2012, Minute 319 of the 1944 Mexican Water Treaty brought Mexico into the fold so that they would take shortage reductions at the same elevations in Lake Mead and in the same proportions as Nevada and Arizona through the term of Minute 319, which expires at the end of 2017. The total shortage volumes were intended to reduce the risks of Lake Mead falling to levels where draconian shortage levels could be imposed. It has become evident that the total existing shortage volumes attendant to the 2007 Guidelines and Minute 319 do not sufficiently reduce the probabilities that Lake Mead could fall to draconian levels. That revelation lead to a realization by Arizona and the Basin States that additional actions to achieve the original goal of the 2007 Guidelines, reducing the probabilities of Lake Mead falling to unhealthy levels, were needed.

The Drought Contingency Plan - A Work in Progress

Arizona, Nevada and California along with the Bureau of Reclamation are negotiating a "Drought Contingency Plan" ("DCP") to add to the protections created in the 2007 Guidelines. While that Plan has not yet been finalized, it is nearing completion. Under the DCP, California would for the first time agree to take reductions to help protect critical Lake Mead elevations. The DCP incentivizes the conservation and storage of Colorado River water in Lake Mead by improving existing management

tools. Those tools are system conservation and Intentionally Created Surplus, methods to bolster the contents of Lake Mead through conservation. Those conservation volumes increase the water surface elevation at Lake Mead and work to delay or avoid shortage reductions for Arizona, Nevada and Mexico. The Plan creates greater flexibility to store water in Lake Mead and to take it out when needed to incentivize more storage in the Lake. That increased flexibility creates benefits for California Colorado River water users and is a key factor in their ability to agree to take reductions at lower levels in Lake Mead, because they could offset those reductions by tolling their conserved water account in Lake Mead. Arizona and Nevada could also take advantage of that flexibility for their additional DCP reductions as well.

Arizona believes that the best way to cement the commitments of the parties to the DCP and to create the certainty that the DCP will deliver its intended benefits, including increasing the flexibility to store and recover conserved water from Lake Mead, while protecting the interests of all water users throughout the Colorado River Basin including the States, is to obtain Congressional authorization directing the Secretary of the Interior to execute the agreement and operate the system pursuant to the terms of the agreement.

The DCP is an example of the evolution of the interaction between the Basin States and their ability to find creative ways to take advantage of existing infrastructure, Lake Mead, and tools to better manage the Colorado River system while honoring the rights to Colorado River water that each state enjoys and the certainty those rights create for each state.

Mexico as a Valued Partner

The benefits to the water users in the United States attendant to Minute 319 to the 1944 Mexican Water Treaty include shortage reductions for Mexico, an ability for Mexico to conserve water in Lake Mead that helps to prop up the elevations of the Lake to avoid shortage triggers, and for a portion of conserved Mexican water to be transferred to US water users that provide funding for those conservation projects. The formal approval of that Minute between Mexico and the United States in November 2012 created certainty that the expected outcomes in the Minute would be achieved, including investments in conservation by US water users.

Negotiations on a successor to Minute 319 have been on-going since May 2015. The essential elements of Minute 319 are being repeated in a proposed successor, Minute 323. The Basin States, including Arizona, have been a part of the negotiations with the Mexican delegation along with the Department of the Interior, the State Department and the International Boundary and Water Commission. Corollary agreements that allow all the elements of the Minute to be implemented need formal approval by the Basin States and some water users in those states. Those corollary agreements create certainty. Direct participation by the States in the binational meetings has been critical to the successful negotiation of Minute 323. Arizona is fully supportive of Minute 323 and legislation authorizing me to sign the corollary agreements was signed into law by Arizona Governor Doug Ducey on March 2, 2017. We hope to see approval of Minute 323 and the corollary domestic agreements in early fall 2017.

Minute 323 also contains provisions in parity to those contained in the draft DCP. When the DCP is finalized and becomes effective those parallel provisions in Minute 323 would kick in. Those provisions are known as the "binational scarcity plan" in Minute 323. Mexico is clearly demonstrating its commitment to forging a strong partnership with the

United States and the Basin States in the protection of the Colorado River system.

Many of the features of Minutes 319 and 323 are tied to operations of Lake Mead and rely on elements of the 2007 Interim Guidelines. Those Guidelines were subject to NEPA and other environmental compliance. Approval of Minute 319 and the anticipated approval of Minute 323 rely on the NEPA compliance in place for the 2007 Guidelines. Knowing that NEPA coverage for Minute 323 already exists was one component of Arizona's willingness to negotiate and support Minute 323.

Minutes 319 and 323 are also indicative of the collaborative nature of Colorado River management, innovative thinking and Arizona's commitment to taking the necessary actions to protect its Colorado River entitlement.

Settlement of Tribal Water Rights Claims

Arizona has 22 federally recognized Indian Tribes and 13 have had their water rights determined, in whole or in part, either by litigation or by settlement. Arizona's policy is to pursue settlement of tribal water rights claims rather than to litigate them. The tenet for these settlements is the certainty achieved for the tribal entities, non-tribal entities and the United States, as trustee for the Tribes. A negotiated settlement allows non-tribal entities to better manage the impacts of water rights awarded to Tribes. In addition to avoiding costly litigation, settlement allows for compromise and trade-offs that benefit the tribal, non-tribal and federal parties to the settlements. Tribes receive certainty for their future needs but also often receive funding for infrastructure so that their water supplies can actually be put to use for the benefit of their communities. Creating a mechanism for turning a "paper water right" into wet water, is in one of the key elements of settlements.

Another major benefit of settlements in Arizona is that Tribes have received a right to market their water supplies while protecting the permanent nature of their water right. Arizona Tribes have leased water to neighboring cities, a key tool for achieving an equitable settlement package. Additionally, Tribes may create long-term storage credits under Arizona's Underground Water Storage and Recovery program for their own benefit but also to market the credits for use off-reservation. Marketing of tribal water rights also leverages existing infrastructure. Existing canals, water delivery systems and wells are being used to transport and deliver tribal water that is being marketed.

Arizona Tribes including the Gila River Indian Community, the Fort McDowell Yavapai Nation, the Tohono O'odham Nation and the Colorado River Indian Tribes have participated in programs to conserve water in Lake Mead thus helping Arizona deal with the drought impacts on the Colorado River.

The flexibilities and opportunities created by settlements of tribal water rights have served Arizona's water management goals well. Arizona will continue to seek settlement for the 11 Tribes in Arizona with outstanding water rights claims.

V. Development and Deployment of Arizona's Water Resources The Central Arizona Project Canal

Arizona is leveraging existing infrastructure to develop and deploy additional water resources. The Central Arizona Project Canal runs from the Colorado River through central Arizona and into southern Arizona in the Tucson area, a total of about 336 miles. The canal is used to deliver approximately 1.5 million acre-feet of water from the Colorado River each year. There is capacity in the canal to move other types of water as well. For example, certain groundwater aquifers outside of central Arizona have been statutorily designated to allow transfer of the groundwater to central Arizona. The CAP canal can be used to transport

that water pursuant to a February 2017 agreement between the operator of the canal, the Central Arizona Water Conservation District, and the Bureau of Reclamation. That agreement is known as the "system use agreement" and it sets out the rules for ensuring that the legal framework governing the use of the canal is honored while taking advantage of the flexibility to move water inherent in the canals design and operation.

The system use agreement also allows the canal to be used for the transportation of long-term storage credits, i.e., water stored underground. That water will be recovered to backfill Colorado River shortage reductions for non-tribal and tribal entities. The canal can also be used to effectuate the marketing of long-term storage credits.

The system use agreement also compliments new water management tools. The Cities of Tucson and Phoenix entered into a landmark exchange agreement in 2014. Phoenix is sending some of its Colorado River water through the CAP canal to Tucson where it is being stored underground. When Phoenix needs the water, Tucson's CAP water will be delivered to Phoenix and Tucson will use its well to recover Phoenix' stored water. That exchange leverages the use of the CAP canal and Tucson's wells creating cost savings, flexibility and drought resiliency for both cities.

Completion of that agreement was a major accomplishment for Arizona.

Roosevelt Dam

An opportunity exits to generate additional water for use in Arizona at Modified Roosevelt Dam, a facility owned by the Bureau of Reclamation and operated by a local entity, the Salt River Project. The dam was originally completed in 1911. Modifications to the dam completed in 1996 added 556,000 Acre-feet of dedicated flood control space, along with new water conservation space and safety of dams space (1,223,000

Acre-feet). A Water Control Manual governs the operation of the flood control space behind the dam. Flood control operations are exceedingly safe and conservative. The safety of dams storage space above the flood control space provides protection for the Probable Maximum Flood.

There is an opportunity to use the flood control space for "temporary storage" when the conservation storage space fills and water remains in the flood control space at the end of the runoff season, typically in April. The water conserved as temporary storage can then be put to beneficial use prior to the next storm season in late fall or early winter. Preliminary modelling by the Salt River Project estimates that an average of about 70,000 Acre-feet per year might be generated under this concept. The model also projects that the yield is highly variable, ranging between zero and 300,000 acre-feet in a year. In fact, water would have been available in 2005, 2008 and 2010 if temporary storage in the flood control space had been an option.

The median yield of the Salt River Project system between 1981-2010 was 680,000 Acre-feet. Adding an average of 70,000 Acre-feet per year, a 10 percent increase, would be a significant addition to the water supplies delivered by the Salt River Project.

In 2008 Salt River Project representatives and local municipal water providers who receive water from the Salt River Project reached out to the Army Corps of Engineers to discuss this concept. Many hurdles were identified and the effort was set aside for future consideration. Streamlining the process for creating temporary storage at Modified Roosevelt Dam can help to make this opportunity come to fruition.

VI. Conclusion

Arizona has created a robust water management structure to maximize its resources and to create and control its own destiny to the maximum extent possible. It has created innovative programs, robust partnerships,

water marketing tools, and leveraged existing infrastructure. It continues to successfully look within the State for solutions to water supply and drought management issues. Collaborative efforts with the United States, other western states and their water users and Mexico have also been key to the success of the State in managing its water supplies and creating resiliency against drought on the Colorado River.

Continuing and building upon those collaborative efforts are an absolute necessity. Minimizing federal oversight, streamlining, and reducing regulations and permitting processes and recognizing that states are the best entities for managing their water resources will allow Arizona to move forward, to innovate and to continuously improve its water management laws, policies and institutions and create a resilient water future for generations to come.

Senator FLAKE. Thank you, Mr. Buschatzke.

Ms. Zane.

STATEMENT OF SHIRLEE ZANE, CHAIRWOMAN, BOARD OF SUPERVISORS, SONOMA COUNTY, CALIFORNIA, AND CHAIRWOMAN, BOARD OF DIRECTORS, SONOMA COUNTY WATER AGENCY

Ms. ZANE. Thank you.

Chairman Flake, Ranking Member King and members of the Subcommittee, thank you for the opportunity to testify today.

My name is Shirlee Zane, and I serve on the Board of Supervisors for Sonoma County, California, and also as the Chairwoman of the Board of Directors for the Sonoma County Water Agency.

I'm very proud to be here today to provide a local perspective on water management. We believe that securing our water future means investing in our water resources.

Water is life. We have the pleasure and awesome responsibility to deliver safe, affordable drinking water, 365 days a year, 24 hours a day. Drought or flood, we must provide a secure water supply.

There are two points that I would like to convey to the Subcommittee this morning. First off, the rule curves used for reservoir operations are woefully outdated and are in dire need of updates. And secondly, Western water managers require improved long-range forecasting of precipitation in order to manage water resources for both extreme wet and dry conditions.

We manage two reservoir projects that provide water supply for the people in Sonoma and Marin Counties. Lake Mendocino and Lake Sonoma are dual-purpose reservoirs. The U.S. Army Corps manages flood protection functions and the Water Agency manages water supply functions. The Lake Mendocino Water Control Manual was created in 1959. Nearly 60 years later, the manual has not been adjusted.

In 2013, the Corps was required to release 25,000 acre-feet of rainfall from Lake Mendocino's reservoir because it had to adhere to the antiquated rule curve, despite weather predictions that no rain was forecasted. The reservoir dropped to 25 percent of capacity later that season and Sonoma County lost water valued at tens of millions of dollars. If we had an updated rule curve, Sonoma County would have been better positioned to adapt to the prolonged drought that followed in the next four years.

The unpredictability in our weather patterns and climate means we are constantly managing its water supply with an underlying goal of becoming more resilient. Not only is resiliency critical for our security, but it also makes sense economically.

We embarked upon an initiative in 2014 with federal and state partners to improve weather forecast modeling in managing reservoir operations. The effort is called Forecast Informed Reservoir Operations, better known as FIRO. It is a partnership with the Corps, the Bureau of Reclamation, NOAA, Scripps Institute of Oceanography and the State of California, as well as our agency. This summer the partnership released a preliminary viability assessment of FIRO for Lake Mendocino and that document is at-

tached to my testimony. Our ultimate goal is to put into place a modern rule for Lake Mendocino.

We, in the West, need better data and long-term forecasting to improve water management. In California, we experience atmospheric rivers. These atmospheric rivers provide about 50 percent of the yearly rainfall in California within just a few storms. The frequency and location of atmospheric rivers are the primary drivers of floods and droughts; however, rainfall forecasting beyond 10 to 14 days remains unreliable. Lead time information about weather is crucial for operating water supply and flood control infrastructure. These sub-seasonal to seasonal rainfall forecasts are critical for improving efficiency of water project operations.

We're working with the Western States Water Council to build a coalition of stakeholders that are committed to working with our partners at NOAA to improve forecasting capabilities. The need for a global system to accurately predict our weather patterns is critical. NOAA is leading the way.

The bottom line is this: better science leads to better data, and better data would greatly benefit reservoir operations.

Mr. Chairman, we're committed to working with this Committee and other members in Congress who support securing our water future by investing in better technology. We know that modern technology can be used more effectively to manage our reservoirs in California and all across the West. Our future generations need us to act now to secure water supply.

Thank you again for this opportunity to testify, and I'm pleased to answer any questions you may have.

[The prepared statement of Ms. Zane follows:]

STATEMENT OF

SHIRLEE ZANE
CHAIRWOMAN, BOARD OF SUPERVISORS, SONOMA COUNTY, CA
CHAIRWOMAN, BOARD OF DIRECTORS, SONOMA COUNTY WATER AGENCY

BEFORE THE
ENERGY AND NATURAL RESOURCES SUBCOMMITTEE ON WATER AND POWER
UNITED STATES SENATE

Increasing Water Security and Drought Preparedness Through Infrastructure, Management and Innovation

August 2, 2017

Chairman Flake, Ranking Member King, and members of the Subcommittee: Thank you for the opportunity to testify today. My name is Shirlee Zane, and I serve on the Board of Supervisors for Sonoma County, California, and as the Chairwoman of the Board of Directors for the Sonoma County Water Agency. I am very proud to be here today to provide a local perspective on the importance of water management to communities throughout the nation, and to highlight our Water Agency's forward thinking and efforts to improve reservoir operations in the face of both prolonged drought and extreme flooding in recent years. The Water Agency is working every day to secure our future by investing in our water resources, environment and community.

There are two points that I would like to convey to the Subcommittee this morning: First, the rule curves used for reservoir operations are woefully outdated, and are in dire need of updates; and second, western water managers require improved long-range forecasting of precipitation to more effectively manage water resources for both extreme wet and dry conditions.

The Water Agency has a diverse portfolio of water management tools we implement to secure its future water supply, including groundwater, surface water storage facilities, and water recycling collection and treatment systems. Water conservation is another important tool the Water Agency actively deploys, as it is our belief there is never enough water to waste. We are also proud to deliver our water in a completely carbon free system. That means our water supply system is powered by 100% renewable energy sources.

Rule Curves and the Need for Better Reservoir Operations

Sonoma County Water Agency manages two major reservoir projects that provide water supply for over 600,000 people living and working in Sonoma and Marin Counties – located just north of the San Francisco Bay and Golden Gate Bridge. Lake Mendocino and Lake Sonoma are dual-purpose reservoirs that provide flood protection, managed by the U.S. Army Corps of Engineers (Corps), and water supply, controlled and coordinated by the Water Agency, which serves as the local sponsor. We make releases to meet the needs of residential water users, as well as other

public water systems. We also manage releases to maintain minimum instream flow requirements for beneficial uses, including recreation and the maintenance and conservation of vital fish habitat.

The Lake Mendocino Water Control Manual was created in 1959 to specify reservoir elevations for flood control. The manual was developed using the best information available at the time. Nearly 60 years later, the manual has not been adjusted to reflect new hydrologic data, scientific information, improved forecasting ability, changing climate conditions and reduced inflows. As an unfortunate result, in 2013, the Corps was required to release 25,000 acre-feet of rainfall from Lake Mendocino's reservoir because it had to adhere to the antiquated rule curve, despite weather predictions that no precipitation was forecasted. The reservoir dropped to 25% of capacity later that season, and Sonoma County lost water valued at tens of millions of dollars from that single incident. California continued to suffer through the worst drought in history for another three years. If we had an updated rule curve or manual in place, Sonoma County would have been better positioned to adapt to the prolonged drought.

We saw quite the opposite over this past year, during which time significant storms and record rainfall have increased Lake Mendocino's target water supply capacity to over 100 percent. Exceeding capacity in Lake Mendocino means that water is now encroaching into the flood control pool. Put simply, while our reservoir operators for years were tasked with making careful decisions about our limited water supply in times of drought, their recent focus has been to keep as much water in the reservoir without compromising flood protection or dam safety. In fact, Sonoma County had a simultaneous flood ***and*** drought declaration last year, highlighting the challenge of managing a water supply in the face of uncertainty and extreme weather conditions.

I would like to share a recent success story resulting from this year's historic storms that exemplifies how greater flexibility in reservoir operations benefits both flood control and water supply objectives at Lake Mendocino. The Water Agency manages reservoir releases when water levels remain in the water supply pool. When water levels rise enough to enter the flood control pool of the reservoir, the Corps takes charge of releasing water for flood protection and dam safety purposes.

In order to maximize that additional water storage, on December 16, 2016, the Water Agency requested that the Corps allow an additional 5,825 acre-feet of water to be stored in the flood control pool. The Corps calls this action a "temporary deviation" from its flood control manual. In January of 2017, the Corps approved this request, noting that it still fully maintained dam safety and flood control goals. This allowed an increase of water in the flood control pool from 68,400 acre-feet to 74, 225 acre-feet. These kinds of deviations are essential to allowing the Water Agency to best manage our reservoirs on a short-term basis; however, we must work toward more comprehensive solutions using technology and knowledge that already exists.

The unpredictability in our weather patterns and climate makes improved resiliency an underlying goal as the Water Agency manages its water supply. As a locally elected official, I understand the importance for our nation's counties to be prepared for and resilient in the face of emergencies. Not only is resiliency critical for our security, but it makes sense economically. To put this point in perspective, the cost of repairing the State of California's crumbling roads,

dams and other critical infrastructure damaged by this year's winter storms is projected to approach $1 billion. Additionally, many communities have expended their emergency funds and are looking to the state and federal government for assistance. Ultimately, local governments are on the front lines of resolving these ongoing challenges through the development and implementation of policies and programs that will help us to prepare for and minimize the impacts of extreme weather events.

A Promising Solution: Forecast Informed Reservoir Operations

Recognizing the critical intersection between reservoir operations and weather forecasting, the Water Agency embarked upon an initiative in 2014 with federal and state partners to investigate the potential use of improved weather and water forecast modeling in managing reservoir operations at Lake Mendocino. The effort, known as the Forecast Informed Reservoir Operations, or FIRO project, includes a collaborative partnership that the Water Agency co-leads with Scripps Institution of Oceanography, and includes active participation by the Corps, the Bureau of Reclamation, the National Oceanic and Atmospheric Administration (NOAA), the U.S. Geological Survey (USGS), and the State of California. We greatly appreciate the funding that Congress has provided to the Corps to help implement the efforts of the FIRO project in recent years.

This summer, FIRO's partners released a preliminary viability assessment of forecast informed reservoir operations for Lake Mendocino, a significant milestone in implementing the concepts supported by the FIRO working group. That document is attached to my testimony. The analysis indicated a 15-35% increase in water supply using FIRO strategies without impairing flood protection. The next step will be to complete a full viability assessment that will include implementation of pilot FIRO operations via temporary deviations to the Water Control Manual at Lake Mendocino and implementation of model improvements using new data to improve existing models and analysis. Our ultimate goal is to put into place a modern rule curve for Lake Mendocino that uses current data, technology and decision support tools.

The FIRO project is an applied research and demonstration initiative with potentially national significance. We are investing in the technology to predict major weather events, and translating that predictive capacity into on-the-ground responses, including water savings, stormwater management, and water availability for users.

Atmospheric Rivers and Sub-seasonal to Seasonal (S2S) Forecasting

As previously stated, we in the West need better tools and long-term precipitation forecasting to improve water management. In California, we experience Atmospheric Rivers, or ARs as they are now commonly referred to in the press. These ARs provide about half the yearly rainfall in California in just a few episodes, and the frequency and location of ARs are the primary drivers of floods and droughts in the State. However, precipitation forecasting beyond 10-14 days remains unreliable. Scientists working in this field agree that we need better observational tools that tell us when and where ARs will hit. This includes knowing if no ARs are forecasted in the foreseeable future, which would assist our partners at the Corps in better managing flood control releases from our reservoirs. The Water Agency has entered into a cooperative agreement with Scripps Institution of Oceanography and the Center for Western Weather and Water Extremes

(CW3E), under the leadership of Dr. Marty Ralph, to advance research in ocean science and meteorology. The research will help define the role of ARs in filling Lake Mendocino and potentially offering predictability to retain water without increasing flood risk.

The notion of lead-time information about weather events is crucial for operating water supply and flood control infrastructure and for making other Western water management decisions. These sub-seasonal to seasonal (S2S) precipitation forecasts are critical for supporting the decisions and improving efficiency of water project operations. The Water Agency is working with the Western States Water Council to build a coalition of stakeholders in the West that are committed to working with our partners at the NOAA's National Weather Service and Office of Atmospheric Research to improve forecasting capabilities. I would like to take a moment to recognize Jeanine Jones with the California Department of Water Resources, who has been leading the charge on this initiative on behalf of the Council. The need for a global system to accurately predict our weather patterns is critical, and NOAA is leading the way on getting us there. The bottom line is that better science leads to better data, and better data would greatly benefit the FIRO initiative and many other Western forecasting needs.

The need for better utilization of existing data and the need for better data overall in managing reservoirs doesn't just exist in California, but across the West. For example, while we experience AR's in California, in the interior West, using snowpack data to manage reservoir levels can achieve the same benefit and result.

Congressional Support

Given the national implications of our work, we are grateful for the Committee's interest in these critical topics. We have supported legislation in the past to encourage the Corps to update their water manuals, including legislation that came before this Committee last year as an amendment offered by you, Mr. Chairman, and Senator Feinstein. We were also pleased to see the provisions in last year's "Water Infrastructure Improvements for the Nation (WIIN) Act" that addressed water supply conservation during a drought emergency. We would like to see similar language enacted that applies to Corps projects regardless of a drought emergency. As I stated earlier, we have gone from a prolonged drought in Sonoma County to dealing with flooding this past winter and spring. We need updated rule curves regardless of the region's annual precipitation.

Additionally, we were pleased that the "Weather Research and Forecasting Innovation Act," which includes provisions to improve sub-seasonal and seasonal forecasts, was enacted earlier this year. It is our hope that lawmakers will appropriate funding for this critical initiative.

Mr. Chairman, we are committed to continuing to work with our delegation, this Committee, and other members of Congress who support the need for better data and technology that can be used to manage reservoirs more effectively in California and across the West. The better we understand the water in the sky, the better equipped we are in managing the water on the ground. Thank you again for the opportunity to testify and I am pleased to answer any questions you may have.

PRELIMINARY VIABILITY ASSESSMENT OF LAKE MENDOCINO FORECAST INFORMED RESERVOIR OPERATIONS

2017

STEERING COMMITTEE CO-CHAIRS

Jay Jasperse, Sonoma County Water Agency
F. Martin Ralph, Center for Western Weather and Water Extremes at Scripps Institute of Oceanography

STEERING COMMITTEE MEMBERS

Michael Anderson, California State Climate Office, Department of Water Resources
Levi Brekke, Bureau of Reclamation
Mike Dillabough, US Army Corps of Engineers
Michael Dettinger, United States Geological Survey
Joe Forbis, US Army Corps of Engineers
Alan Haynes, NOAA California-Nevada River Forecast Center
Patrick Rutten, NOAA Restoration Center
Cary Talbot, US Army Corps of Engineers
Robert Webb, NOAA's Earth System Research Laboratory

SUPPORT STAFF

Arleen O'Donnell, Eastern Research Group
Rob Hartman, Hydrologic Predictions
David Ford, David Ford Consulting Engineers
Ann DuBay, Sonoma County Water Agency

1 Executive summary

This report describes the preliminary viability assessment (PVA) of forecast informed reservoir operations (FIRO) for Lake Mendocino, which is located on the East Fork Russian River three miles east of Ukiah, California. The results described in this report represent the collective activities of the Lake Mendocino FIRO Steering Committee (SC) (SC members are named on the inside cover of the report). The SC consists of water managers and scientists from several federal, state, and local agencies, and universities who have teamed to evaluate whether current technology and scientific understanding can be utilized to improve reliability of meeting water management objectives of Lake Mendocino while not impairing flood protection. While the PVA provides an initial evaluation of the viability of FIRO as a concept, additional steps remain to complete the full viability assessment (FVA). Also, the PVA does not identify how FIRO strategies would be implemented. That effort would be the focus of the FVA, which builds off the analyses developed in the PVA.

This report summarizes current Lake Mendocino operation and a preliminary analysis of FIRO alternatives, including analysis methods, results, and recommendations. A set of accompanying reports describes the analysis in detail. These are referred to herein as the Sonoma County Water Agency (SCWA) report, the Hydrologic Engineering Center (HEC) report, and the Center for Western Weather and Water Extremes (CW3E) report (SCWA 2017, USACE 2017, and CW3E 2017, respectively).

1.1 How is Lake Mendocino operated?

Lake Mendocino has been operated cooperatively by SCWA and the US Army Corps of Engineers (USACE) for flood and water management and environmental protection since construction of the impounding structure—Coyote Valley Dam—in 1958. Operation is governed by rules established at the time of construction with best-available technology and knowledge of system hydrology and hydraulics at that time. The rules are published in the project water control manual (WCM), which was amended in 1986 and 2004 following its initial publication in 1959.

The original WCM rules allocate the 122,400 acre-feet (AF) of storage in Lake Mendocino to storage for flood management and storage for conservation purposes. The seasonally varying flood storage pool varies from a maximum of 54,000 AF in the winter rainy season to 11,400 AF in the drier summer season. Rules require the flood pool to be empty except briefly in periods of greatest inflow. Then flood runoff is stored and released at a rate that avoids or minimizes exceedance of downstream flow targets at Hopland (a key stream gage downstream from the reservoir), Healdsburg, Guerneville, and elsewhere.

The conservation storage, used for water management objectives and meeting minimum in-stream flow requirements (for fisheries and/or environmental purposes, herein referred to as environmental flows), is filled as water is available to do so. However, operation following the WCM rules strictly does not permit storage in the flood pool for conservation purposes. These rules apply even if inflow forecasts do not indicate an immediate need for empty space to manage flood water.

For example, in December 2012, a large storm associated with an atmospheric river (AR) filled space available in the conservation pool and encroached approximately 25,000 AF of the flood pool (i.e., consumed a large fraction of the 54,000 AF normal flood pool capacity). USACE dam operators followed the WCM rules and released this water from the flood pool, ensuring space was available to manage potential future floods, even though no storms or

flooding was forecasted in the near future. Storage in Lake Mendocino began to decline significantly through the late winter and early spring of 2013 because no additional storm events occurred. In order to preserve storage in Lake Mendocino and to prevent the reservoir storage dropping to unsafe levels by the fall of 2013, SCWA filed a Temporary Urgency Change Petition with the State Water Resources Control Board (SWRCB) to reduce environmental flows required by SCWA's water rights permits. Strictly following the WCM rules in this case resulted in the loss of water that SCWA could have used for greater environmental and recreational benefit, had the WCM rules allowed for some flexibility based on short-term (e.g. days) forecast information. (The environmental "storage" would be for the purpose of having adequate water in late summer for the early migration of Chinook salmon.) Furthermore, the winter of 2013 turned out to be the beginning of a severe and extended drought. If stored water could have been retained in Lake Mendocino from the December 2012 storm and AR event, drought impacts to the Upper Russian River could have been postponed and moderated.

1.2 What is FIRO, and how could it enhance operation?

State, federal, and local agencies, in cooperation with SCWA and the University of California San Diego (UCSD), Scripps Institution of Oceanography (SIO), initiated a research and development (R&D) project to enhance Lake Mendocino operation through more efficient use of the available storage. This project was guided by the Lake Mendocino FIRO SC. In 2015, the SC drafted a work plan, which provided a scope for the PVA. The SC shared a vision that operational efficiency would be improved by using forecasts to inform decisions about releasing or storing water. This strategy was identified as forecast informed reservoir operation, or FIRO. Because recent scientific advances had identified ARs as the cause of almost all flooding on the Russian River (Dettinger, et al. 2011), and ARs produce half of the annual precipitation, the SC also recognized the importance of incorporating research to evaluate and improve understanding and prediction of ARs.

FIRO, as viewed by the SC, includes expanding meteorological, watershed, channel condition, and environmental monitoring; advancing science to enhance meteorological, watershed, channel condition, and environmental forecasting; and integrating data collection, management, display, and analysis capabilities into decision support system (DSS) tools for Lake Mendocino operators. To make best use of these enhancements, technological components will be coupled with flexibility in operation rule interpretation (or with changes to the rules) for flood and water management and environmental protection.

With FIRO capabilities, operators could, for example, limit lost opportunities that arise in situations such as occurred in 2012. If improved forecasts had been available and used in 2012, and strong (AR-type) storms were not predicted to occur after the earlier storm, and if operation rules were more flexible, a decision could have been made to store water in the flood space needed to meet future demands, rather than to release that water. This could have made available up to 25,000 AF of additional water to meet beneficial uses right as the region entered into a severe and extended period of drought. Likewise, with FIRO capabilities, operators might mitigate flood risk when a storm is predicted to be intense and cause downstream damage. FIRO could result in a decision to release water from the reservoir's conservation pool to lower reservoir levels, providing additional storage for "controlling" flood waters.

1.3 What is the plan for implementation of FIRO?

The Lake Mendocino FIRO SC devised a multi-step strategy to assess the viability of FIRO and move to implementation of FIRO. This plan, published in late 2015, included first the PVA, to be conducted over two years, and the FVA, which would require substantial additional effort over roughly another three years. The PVA—results of which are reported herein—considered the following questions:

1. If FIRO is implemented, will operation improve reliability in meeting water management objectives and ability to meet environmental flow requirements, and to what extent?
2. If FIRO is implemented, will operation adversely affect flood risk management in the system? If so, where and to what extent can that be mitigated?
3. What meteorological and hydrological forecast skill is required to enable FIRO to be implemented? Is current forecast skill for landfalling ARs (and their associated heavy precipitation and runoff) and other extreme precipitation events adequate to support FIRO, and what improvements would be needed to enable full implementation of FIRO for Lake Mendocino?

The SC's strategy for decision making was this: If the PVA suggested FIRO would be viable, the project team would move forward with the FVA. Due to the preliminary nature of the analysis, the PVA relied on representations of FIRO system components, reasonable simulation of performance of those components, and anticipated flexibility in operation of Lake Mendocino under FIRO. In the subsequent FVA, candidate components of the Lake Mendocino FIRO system would be identified; the forecast parameters and associated forecast skill requirements would be quantified; research to improve forecast skill to meet those requirements would be conducted; alternative components formulated, assessed, and compared; and a plan for implementation developed. If necessary components do not exist, R&D programs would be identified in the FVA, and work initiated to develop the components. Finally, necessary changes to the operation rules and the process for modifying the rules would be identified in the FVA consistent with USACE procedures and protocols to support consideration of policy modifications by the USACE as it contemplates approaches to enhance reservoir operations.

If the PVA found FIRO implementation not viable, the project team would identify scientific and operational enhancements necessary to make FIRO viable. The team then would initiate an R&D effort to provide those enhancements. The enhancements might include state-of-the-art operational and emerging weather forecast systems such as the Rapid Refresh (RAP), High Resolution Rapid Refresh (HRRR), Next Generation Global Prediction System (NGGPS), the National Blend of Models (NBM), and other post-processing innovations. These enhancements may better forecast properties of AR storms. These storms are important drivers of inflow for which flood storage is needed in Lake Mendocino.

1.4 How was the PVA conducted?

The PVA was undertaken in three parts: analysis of the hydrometeorological forecast requirements and assessment of current forecast skill; a study to determine whether forecast informed operation could improve reliability of meeting water management objectives; and a parallel coordinated study to demonstrate whether forecast informed operation could improve reliability of meeting water management objectives while not increasing flood risk.

For the first part of the study, to support anticipated changes in operational decision making, SC members quantified forecast skill requirements. (5-7 days lead time is needed

on forecasts of 2 inches [in] of rain above Lake Mendocino in 24 hours [hr], which requires accurate prediction of AR landfall location, strength, and timing as well as runoff efficiency and timing). They also assessed current skill. (Prediction of AR landfall and streamflow have meaningful skill out several days, but improvements are needed in timing, location, strength and duration, while extended periods of dry weather were found to have greater predictability than the details of AR landfall and runoff).

For the second part of the PVA, SCWA analysts developed and used mathematical models to assess improvements to reliability of meeting water management objectives and ability to meet environmental flow requirements. For a range of meteorological and hydrologic conditions, they simulated Lake Mendocino operation with a variety of FIRO alternatives. The Perfect Forecast Operations alternative represents flexibility in operation rules and assumes perfect forecast skill (using the inflows that actually occurred as the forecasts), which establishes a theoretical maximum benefit. The Ensemble Forecast Operations alternative represents the same flexibility in operation rules but reflects current forecast skill and is thus more realistic. The Hybrid Operations alternative represents an initial or interim implementation of FIRO. The SCWA analysis used a "risk-based" decision process to determine releases, considering probability of future failures to satisfy targets. Performance metrics used for the SCWA analysis include:

- End of water year storage.
- Dry season environmental flows.
- Discharge at Hopland and Healdsburg.
- Uncontrolled spill from Lake Mendocino.

For the third part of the PVA, HEC analysts focused on flood risk impacts. To do so, they simulated Lake Mendocino flood operation for a wide range of meteorological and hydrologic conditions, accounting for flow requirements for water management objectives and environmental purposes. HEC analysts also considered a variety of FIRO alternatives. The Encroach alternative represents a simple FIRO alternative based on perfect precipitation forecasts. The Combined alternative represents a more complex FIRO alternative based on perfect forecasts of several types of data. The EncroachWIF [with imperfect forecast] alternative is the same as the Encroach alternative but is assessed using imperfect precipitation forecasts. Performance metrics used for the flood risk analysis include:

- End of water year storage.
- May 10 storage (when maximum conservation storage becomes available each year).
- Expected annual damage (EAD) and average annual damage (AAD) reduction.
- Discharge and stage frequency at Hopland, Healdsburg, Guerneville, and Lake Mendocino.
- Uncontrolled spill from Lake Mendocino.
-

1.5 What were the results of the PVA?

The analyses completed for the PVA demonstrated forecast informed operation, as simulated in the studies, improved reliability of meeting water management objectives without adversely affecting flood risk management in the basin.

The SCWA analysis with FIRO alternatives showed significant additional storage that resulted in improved reliability of meeting water management objectives. Compared with existing operation, additional water was stored and available for delivery for nearly all years

simulated. Table 1 shows the median end of water year storage for 1985-2010 for existing operation and each FIRO alternative. Increases attributable to FIRO as modeled range from 8,633 AF to 27,780 AF, or up to a 49% increase.

Table 1. Potential improved reliability in meeting water management objectives achieved by FIRO alternatives in terms of increase in median end of water year storage based on simulation results for 1985-2010

Alternative (1)	**Median end of water year storage (AF) (2)**	**Increase from Existing Operations (AF) (3)**	**Percent increase (4)**
Existing Operations	56,220	—	—
Perfect Forecast Operations	84,000	27,780	49%
Ensemble Forecast Operations	76,277	20,057	36%
Hybrid Operations	64,853	8,633	15%

The HEC analysis showed no significant loss of ability of the system to manage flood risk for the Russian River basin. HEC assessed risk in terms of AAD based on 1951-2010. Table 2 shows AAD for the existing condition and FIRO alternatives.

Table 2. Russian River basin flood risk: FIRO alternatives do not measurably change flood risk based on analysis of 1951-2010 and statistical sampling.

	POR compute (60 years, 1951-2010)		**FRA compute (5,000 events)**	
Alternative (1)	**AAD ($ million) (2)**	**Increase in AAD from existing[1] ($ million) (3)**	**EAD ($ million) (4)**	**Increase in EAD from existing[2] ($ million) (5)**
Existing Conditions	6.10	—	10.40	—
Combined (complex, perfect forecast)	6.10	0	10.40	0
Encroach (simple, perfect forecast)	6.10	0	10.50	0.10
EncroachWIF (simple, imperfect forecast)	6.10	0	10.50	0.10

As the PVA proceeded to answer the two operational questions, a question arose regarding the existence of or ability to develop forecasts of sufficient accuracy to support forecast informed operations. This question was addressed by researchers at CW3E. CW3E analyzed the reliability of the Global Ensemble Forecast System (GEFS) used by the California Nevada River Forecast Center (CNRFC) of the National Weather Service (NWS) for Lake Mendocino inflow forecasting (using procedures described in the CW3E report). CW3E computed R^2 (coefficient of determination) and root mean square error (RMSE), comparing GEFS 6-hr ensemble average mean areal precipitation (MAP) time series to observed data for the Lake Mendocino cool season (October to April) for 1985-2010 for forecast lead times of 1 to 16 days. They found RMSE increased with lead time, starting with 0.28 in of precipitation on

forecast day 1, increasing to 0.48 in by forecast day 16. They found R^2 decreased with lead time from 0.64 on forecast day 1 to less than 0.01 at forecast day 16, remaining greater than 0.5 out to forecast day 3. CW3E also tested GEFS skill related to prediction of 1-in precipitation in 24 hr (a key metric for Lake Mendocino release decisions) and compared GEFS skill with CNRFC forecaster skill. Overall, CW3E found forecasts to support FIRO were available or could be produced with enhancements that will be available through additional research. Skill in precipitation forecasting was best during extended dry periods, and appears viable for use in FIRO; however, significant errors remain during stormy periods. Current and ongoing efforts seek to study (1) the predictive skill of transitions from extended dry periods into wet periods and (2) the predictive skill of ensemble-based forecasts of atmospheric water vapor flux during AR-type storm events. Individual cases of past events illustrate meaningful skill in (1) transitions out to 3 days lead time on average and up to 5 to 7 days leads for individual cases and (2) ensemble-based water vapor flux forecasts out to 5–6 days lead time on average and up to 9 days lead for individual cases.

Analysis of the river channel geometry and operating release rates showed that it would likely take roughly 2 days to release up to 10,000 AF without exceeding the established target flow rate and then 2 to 3 days for that release to move downstream past the flood-prone town of Guerneville. Thus, skill is required at 5-days lead time for prediction of landfalling ARs and their associated heavy precipitation and runoff.

The PVA reaffirms that ARs are the key to flooding on the Russian River, and errors in their prediction are the primary source of uncertainty in the prediction of major precipitation and runoff events affecting Lake Mendocino, its watershed, and the Russian River. The PVA demonstrates that errors in precipitation and streamflow forecast result partly from errors in the timing, duration, intensity, and location of landfalling ARs, mesoscale frontal waves (MFW, a disturbance that forms offshore and can change the locations and duration of AR landfall and associated heavy precipitation), and inaccuracies in the representation of clouds and precipitation.

An example of a landfalling AR associated with prediction uncertainty that caused flood stage to be reached at Guerneville occurred in December 2014 (Figure 1). Predictions of the stage at 1- to 3-day lead times varied by up to 10 feet (ft) (from roughly 4 ft below flood stage to 6 ft above), while the actual stage reached roughly 2 ft above flood stage. Analysis showed that this forecast uncertainty resulted from errors in the detailed characteristics of the landfalling AR. These errors originated partly from the relatively poor prediction of a MFW that modified the landfall of the AR and caused changes in precipitation and runoff. This event demonstrates that skillful forecasts are currently available but could be improved and refined through research investments associated with AR behavior.

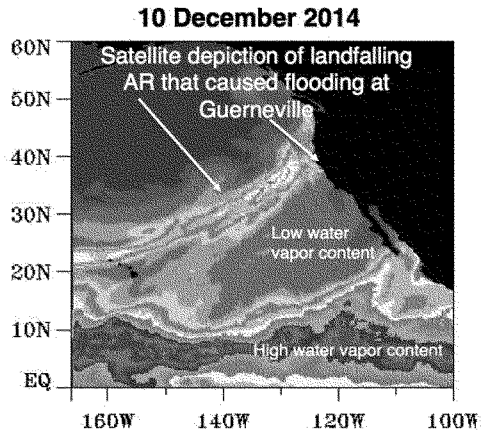

Figure 1: SSMI imagery of a landfalling AR on 10 December 2014 (from the CW3E report)

The PVA identifies that additional efforts targeted at the development of weather prediction models tailored toward improving forecasts of precipitation and landfalling ARs over the Russian River (such as the development of the "West-WRF" model being created at CW3E), additional unique performance and model evaluation metrics for precipitation and landfalling ARs that illustrate trends and improvements in forecast skill of existing models and derived decision support tools, and additional integration of existing and reconnaissance-based observational datasets (e.g., mesonets and aircraft data offshore, respectively) serve to improve the potential viability of FIRO at Lake Mendocino.

1.6 What are the findings of the PVA?

The PVA found:

- AR-type storms are, as found in previous research, the key drivers of both water supply and flood risk in this region, as these events produce heavy and sometimes prolonged precipitation and runoff.
- High-impact AR-type storms were observed at the coast in and near the Russian River watershed during record-setting water year 2017. These observations included some of the strongest IVT observations made on land and, occurring after the lengthy drought, illustrate the type of extremes that this watershed can experience on relatively short interannual time-scales.
- Predictive skill in the current forecast system, especially during extended dry periods, provides an opportunity to implement some elements of FIRO. However, significant uncertainty remains in the strength, timing, duration, and orientation of landfalling ARs and the associated precipitation and streamflow that can be reduced with further research.
- In the cases considered in SCWA's simulations, integrating forecasts of reservoir inflows and local flows downstream in release decision making would permit operators to more

reliably meet water management objectives and environmental flows in the Russian River basin.

- In the cases considered in HEC's simulations, operating based on forecasts of reservoir inflows and local flows does not adversely affect flood risk management. (Results showed no significant increase in AAD or EAD.)

- The greatest improvements for reliability of meeting water management objectives and ability to meet environmental flow requirements come if WCM rules are modified to integrate FIRO, rather than relying on temporary deviations from the WCM rules.

-

1.7 Considering the preliminary results, what does the project team recommend as next actions for the FVA?

Considering results from the PVA, the SC recommends that the FVA of FIRO for Lake Mendocino proceed. The SC recommends:

(1) investigating viability in detail, considering and selecting components of the system and FIRO strategies that could be implemented in the near-term using current technology and scientific understanding (e.g., forecast of near-term dry conditions); and

(2) identifying and developing new science and technologies that can ensure FIRO implementation is safe and successful, and to enhance FIRO where possible.

(3) working with USACE and SCWA, the SC should develop a plan for utilizing deviations to the WCM for each of the next few years. Each deviation request by SCWA to USACE would be designed to explore the viability of implementing certain FIRO strategies using current forecast skill and technology with the appropriate constraints and limitations that meet USACE conditions for deviations per SPD (South Pacific Division) policy (*Engineering and Design Guidance on the Preparation of Deviations from Approved Water Control Plans*, 2014). It is anticipated that each subsequent deviation request will build on the prior year's experience and will be modified as appropriate with the concurrence of USACE, SCWA and the SC. The SC should also work with USACE and SCWA to determine what types of changes to reservoir operation rules are most effective to allow various levels and components of FIRO implementation, and what types of changes to reservoir operation rules will be acceptable to USACE (for example, rules that shift to accommodate forecasts of an extreme event). To implement FIRO, USACE approval will be required through updates of the WCM. USACE guidance on developing FIRO alternatives is needed.

The SC acknowledges the need for and recommends additional research be conducted by the contributing agencies and centers, including CW3E, SCWA, USACE ERDC, and others. The results of these additional studies should be included in the FVA to answer the following key questions that arose during the PVA:

- Although elements of the PVA considered the possibility of encroaching into the conservation pool prior to a predicted flood-producing storm, the PVA mostly emphasized consideration of retaining extra water to reduce drought impacts. A greater emphasis should be put on exploring how changes to the operating rules to permit pre-releases before a major landfalling AR could enhance flood-risk mitigation capacity of Lake Mendocino.

- What forecasting methods and technology (e.g., meteorological and watershed observations and models) must be enhanced to enable implementation of FIRO? While hydrometeorological forecasts of sufficient accuracy may be available for the Russian River watershed in many instances, important gaps remain in the details, even for

shorter lead times. In addition to better skill in the details of extreme event prediction at short lead times (up to 5 days), enhancements are also required for forecasting with longer lead times (5 days to several weeks) to realize fully the potential improved reliability in meeting water management objectives.

- Given the potential predictability of synoptic scale systems/circulation and ARs at these lead times, pursue the reliable and skillful outlooks at 6 to 10 days of the low risk for extreme precipitation events in the vicinity of the river basin that can provide guidance for operational decisions to hold additional water in the flood pool for another day rather than immediately evacuate water from flood.
- AR-specific forecast skill metrics should be developed. Skill should be considered as release decisions are made. Improvements to skill should be monitored.
- In addition to forecasting days to weeks ahead of ARs, enhancements that permit seasonal forecasting would provide even more opportunity for wise decision making about Lake Mendocino operation. Scientific inquiry is needed to support this.
- Evaluate the opportunities for significant improvements in forecast skill and reliability for extreme precipitation events and ARs using the state-of the-art operational and emerging weather forecast systems such RAP, HRRR, NGGPS, NBM, and other post-processing innovations.
- Evaluate emerging watershed and runoff forecast systems such as the National Oceanic and Atmospheric Administration's (NOAA's) National Water Model (NWM) and USACE's Gridded Surface Subsurface Hydrologic Analysis (GSSHA) model run at temporal and spatial scales that directly support FIRO goals and objectives.
- In addition to forecasts, successful FIRO depends on, and can leverage for improvements, whatever knowledge is available regarding the current hydrologic state of the reservoirs, river (and tributaries), and watershed at the time of decisions. Scientific inquiry and plans to ensure that monitoring of the state of the system is adequate, or to improve monitoring, is needed.
- What is the full range of potential benefits that FIRO can provide? Additional assessments are needed to quantify costs and the socio-economic benefits of FIRO for agriculture, fisheries, recreation, water management reliability, flood risk management, and other societal and environmental needs.

Senator FLAKE. Thank you, Ms. Zane.

Ms. Sheils.

STATEMENT OF MARTHA SHEILS, DIRECTOR, NEW ENGLAND ENVIRONMENTAL FINANCE CENTER, UNIVERSITY OF SOUTHERN MAINE

Ms. SHEILS. Good morning, Mr. Chairman and Ranking Member King. Thank you for this opportunity to appear today.

I am Martha Sheils. I'm the Director of the New England Environmental Finance Center at the Edmund Muskie School of Public Service at the University of Southern Maine.

Knowing how busy you all are, I'd like to make three key points. First, that clean water is essential for growing our economy, protecting our health and ensuring the security of our nation. Second, there is cause for hope in the numerous examples around our country on how state and local governments are saving money by investing in watershed conservation and sustainable management practices. And finally, that the Federal Government's support, although helpful, should be expanded.

Clean water is a critical component of the main brand and essential for attracting and retaining businesses, residents and tourists.

In Maine, we now have two computer chip manufacturers with high-paying jobs, as well as a proliferation of microbreweries, all of which require high quality tap water in plentiful supply. In the Casco Bay Watershed alone, almost 20,000 jobs in the tourism sector depend on the Bay's health.

Just as in Maine, our entire country is ripe with numerous opportunities to protect and manage our watersheds that promote cost savings and provide multiple economic benefits from them. A great example, located in Senator King's backyard, is the Sebago Lake Watershed. It supplies some of the cleanest drinking water in the country to the greater Portland area which is the economic engine of the entire state.

The Portland Water District has a sustainable forest management program to keep the watershed healthy and resistant to invasive species and fire threats, all with the primary objective of protecting the water quality of Sebago Lake. The bad news is that 90 percent of the watershed is privately owned and development pressures are threatening the district's EPA filtration waiver. The district is considering a mix of management scenarios for private lands that include riparian buffers, culvert upgrades, conservation easements and sustainable forestry. These nature-based solutions cost approximately one-third of what it would cost to build a new filtration plant. If we add the other benefits, like wildlife habitat protection, recreation, carbon sequestration and others to the avoided costs of not building a filtration plant, the net positive benefits increase tremendously.

On a larger scale, New York City invested $1.4 billion to purchase conservation land at its drinking water source in the Catskill Mountains, ultimately saving approximately $5 billion compared to the constructing of a new filtration plant.

Protecting natural infrastructure also pays off by mitigating flood damages. Tropical Storm Irene caused extensive damages in Rutland, Vermont, in 2011 but downstream at Middlebury, where

flows should have been even higher, they were actually far less because a large, conserved wetland complex absorbed the floodwaters.

Same with coastal flooding. Maine's shoreline is increasingly vulnerable from sea level rise and there are clear economic benefits from preserving and restoring coastal wetlands.

In urban areas, built green infrastructure that mimics nature, things like bio-retention areas, green roofs and rain gardens, are much more economical than sewer separation projects to manage storm water and because green infrastructure installments are many and diffused, they very well increase security by relying on a diversity of approaches rather than centralized facilities.

The challenge for Maine and the rest of the country is to better use existing available funds to, first of all, protect existing natural infrastructure. And second, to promote built green infrastructure that mimics nature in more urban watersheds. And finally, financing programs at the federal and state levels should require or at least encourage economic analysis in the evaluation of projects that clearly show the costs, benefits and tradeoffs of projects as in the Portland Water District and New York City examples.

By doing so, the most cost-effective project should be chosen to encourage savings and to generate multiple benefits, such as water quality protection, resistance to invasive species, fire risk reduction, wildlife habitat and recreation opportunities, all at the same time.

We need your help to tell these stories widely so that private and public landowners adopt sound financial evaluation practices that achieve multiple benefits.

I'll leave you with this. An ounce of prevention is worth a pound of cure. Help us work together to implement the most cost-effective strategies that protect our vital water resources and also provide multiple benefits at the same time.

Thank you for your time.

[The prepared statement of Ms. Sheils follows:]

Written Testimony

Senate Committee on Energy and Natural Resources' Subcommittee - August 2, 2017

Martha Sheils, Director, New England Environmental Finance Center

The three key points of this testimony are 1) Water in sufficient quality and quantity is essential for growing our economy, protecting our health and ensuring the security of our nation; 2) There is cause for hope in the numerous examples around our country on how state and local governments are saving money by investing in watershed conservation and the use of green infrastructure; and 3) that the Federal government's support, although helpful, needs to be expanded.

Water defines Maine, it is Maine's most essential resource. The image of Maine as a naturally beautiful state depends on safeguarding its water resources. Water resources are vital to keeping and attracting vibrant businesses and residents, as well as to keeping tourists returning year after year. This image of Maine and its high quality of life and access to natural amenities plays a big role in Maine's robust tourism industry and its economic growth. Maine needs high skilled workers that are fundamental to the innovation economy and Maine's future prosperity, and clean water and outdoor amenities are a big part of the draw. Notable examples from Maine of the role that clean water plays include the siting of 2 computer chip manufacturers with high paying jobs that rely on the quantity and quality of available clean water in their manufacturing process. Similarly, the proliferation of micro-breweries in Maine also requires high quality and a massive quantity of tap water as an input to the brewing process. Finally, Maine's colleges and private High Schools have seen an increase in foreign student attendance and when parents were surveyed and asked why they send their children across the world to Maine for school, one of the reasons sited was to give their children access to clean air and water for 4 years.

Tourism is one of the biggest industries in Maine. The Casco Bay watershed alone employs almost 20,000 people in tourism and recreation which is directly and indirectly supported by the Bay's health. Frenchman Bay (where Bar Harbor is situated), Acadia National Park and the Katahdin Woods and Waters National Monument all depend on the maintenance of Maine's clean waters.

Just as in Maine, our entire country is ripe with numerous opportunities for using natural and green infrastructure approaches to protect our water resources.

Maintaining Drinking Water Quality: Maine is changing, and like much of the country, its dispersed population growth has spread development into large undeveloped areas that once functioned as filters and distributors of water flow. New suburban house-lots and impervious roads contribute polluted runoff directly into our waterways, harming water quality, wildlife habitat and exacerbating flooding downstream. And, increasingly frequent and extreme precipitation has increased the likelihood of floods and infrastructure damages. For example a few tears ago, York County on Maine's southern coast, experienced 100 and 500 year floods within a single year.

When federal water quality standards are reached and exceeded, cash strapped municipalities and regions need to find solutions they can afford. There are numerous opportunities for Maine and the rest of the country to meet the demands for new, upgraded, and expanded water resources management by

34 Bedford Street, PO BOX 9300, Portland, Maine, 04104 efc@maine.edu

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incorporating "natural infrastructure" (forests and wetlands that naturally infiltrate, absorb, and clean non-point source runoff) and "built green infrastructure" (which are lower cost decentralized engineered structures that mimic natural systems like bio-swales, raingardens, green roofs, cisterns, etc.), and to do it at a much lower cost than is often thought possible.

Sometimes NOT building new infrastructure could be the most efficient and effective way to manage water. It has become clear that water resources are most effectively and efficiently managed by both building, and not building, new infrastructure.

New York City confronted this problem a decade ago. After a cost/benefit analysis, the City decided it would be more cost effective to conserve land by purchasing it for the substantial sum of $1.4 Billion, which was still less than $3.0 to $6.0 billion in capital construction costs (plus $250 million in annual operating costs) that would have been required in the alternative. New York's approach requires that land conservation be on a strictly willing seller-willing buyer basis and the conserved lands are open for an array of recreational uses from hunting and fishing to hiking and cross-country skiing.

While a water system serving nine million people may seem an out-of-scale comparison for Maine, the New York experience has very useful lessons for Maine. A great example, located in Sen King's backyard, is the Sebago Lake watershed. It supplies high quality drinking water in plentiful supply to the greater Portland area, which is the economic engine of the entire state.

Waivers from the Federal Safe Drinking Water Act's Surface Water Treatment Rule are relatively rare, and require a water system to maintain stringent standards for source water protection in their supply watersheds. The Portland Water District's supply, Sebago Lake, has some of the cleanest water in the United States, but it is threatened by development pressure, which, if unchecked, could foul the supply. Should the quality of the water supply fall below the Federally-mandated thresholds, the Portland Water District could lose its filtration avoidance waiver and would have to build a filtration plant—an extremely expensive proposition. Alternately, Portland Water District could follow a similar path to New York City, and argue to maintain its filtration waiver through investment in the permanent conservation of the Sebago Lake watershed.

A complex mix of scenarios involving different options for investment timing and costs were analyzed, and a study found that a combinations of riparian buffers, culvert upgrades, conservation easements, and sustainable management of forests were less expensive than building new water filtration facility. In one case examined, $44 million in expenditures on these natural and diffused infrastructure options could save over $110 million to build a new filtration plant. The cost to protect the existing natural infrastructure that would support a continued healthy watershed is approximately 1/3 of what it would cost to build a filtration plant, and if we add the other benefits of protecting land such as recreation, wildlife habitat, carbon sequestration, and other ecosystem services, the net benefits become even greater. There are also "ancillary benefits" such as carbon sequestration or Atlantic salmon habitat associated with the choice to use natural infrastructure options. The economic value of these "nonmarket benefits" are not insignificant. They are estimated to range from $72 to $125 million over a 20 year time period.

Portland's experience is likely to be shared to one degree or another with other Maine public water systems in places like Lewiston, Auburn, Damariscotta, Bangor, Mt. Desert Island, and Brewer. These are

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among nine Maine systems that currently hold waivers from the EPA relieving them of the requirement to build filtration systems. Maintenance of those waivers is a very high priority for each system.

While much of the concern about adequate water resources infrastructure is centered on the challenges likely to result from a much wetter climate in the future, a changing climate is also likely to result in periods of drought in some or all of Maine at irregular intervals (Gupta et al, 2008). While drought may reduce the need for flood hazard protections, it will increase pressure on the maintenance of adequate safe drinking water supplies. The types of benefits for the PWD are likely to be significantly larger if natural infrastructure can be used to maintain drinking water quality even in periods of low water replenishment and flows.

The economic assessment of the alternative approaches to water resource management falls within the general field of benefit-cost analysis. This type of analysis seeks to enable the comparison of gains from a particular approach with the resources that must be given up. For water resources, the gains fall into two general categories: "avoided costs," which are possible future losses or alternate expenditures to achieve the same outcome, and "non-market benefits," such as the value of wildlife habitat, scenic lands, or healthy ecosystems. Extensive studies of both types of benefits have been done, but the measurement of non-market benefits requires more complex methodologies that have generally not been used in Maine. Nonetheless, the differences between what must be spent now to manage water resources and the spending that can be avoided in the future are often so large that, even though it would be beneficial to have it, no additional measurement of benefits is needed to make a compelling case.

Maine is fortunate in still having abundant land that can provide a variety of natural infrastructure services. A recent analysis estimates the amount of land in Maine whose conservation could help to maintain drinking water quality to range from 17,000 acres (including places where both drinking water and flood control benefits would accrue) to 825,000 acres (where either one could be protected). (If places providing water-related wildlife habitat are included, the number goes up to 1.6 million acres.). Maine has a quarter century of experience in acquiring conservation easements and purchasing lands through state programs. At prices ranging from $755 per acre in Piscataquis County to nearly $6,000 per acre in Cumberland County for an overall average price of $2,100 per acre. Taking the average price for conserving land, the 17,000 acres that provide both flood control and drinking water benefits would require around $28 million, which is about 10% of the value of current public water supply infrastructure exempt from property taxes under Maine law. Purchase of fee or conservation easements on all the land estimated to be valuable for drinking water protection or flood control would cost $1.36 billion at this average price, less than 1% of the total value of land in Maine, which is estimated to be $153 billion.

Flood Damage Control: Numerous studies have shown the importance of maintaining open space, forestlands, and wetlands to mitigate flood damages. A particularly clear example arises from Vermont's recent experience with Tropical Storm Irene. The Otter Creek in mid-Vermont saw flows increase from a normal 1,000 cubic feet per second (cfs) to over 12,000 cfs at Rutland in the days immediately following the storm, causing significant damage to Rutland and the surrounding towns. Further downstream at Middlebury, VT., where flows should have been even higher, it was a dramatically different story. Peak Flows were less than half the level at Rutland because a largely conserved wetland complex between Rutland and Middlebury was able to absorb much of the flood waters, releasing them slowly over time.

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To examine the potential for reducing flood damages in Maine through the use of such natural infrastructure, a simulation of the risks of flood damages in three York County watersheds was undertaken. That analysis found that possible reductions in flood damages would yield over $275 million in present value benefits over a thirty-year period. These savings are compared against the cost of conserving land to mitigate flood damages, an estimated $15.0 million. In small watersheds, the costs may not exceed the benefits, but in large watersheds, the benefits of conserving land for flood control can be more than 100 times the costs.

Using natural infrastructure to mitigate coastal flooding damages is already embedded in Maine law in the Natural Resources Protection Act as applied to coastal sand dunes and other wetlands. Studies have shown the increasing economic vulnerabilities along Maine's shoreline from sea level rise. To date, no specific studies have been done in Maine to assess the costs in damages and repairs to public and private property that could be avoided by investments that protect and restore coastal wetlands. Still, such studies in other parts of the country clearly demonstrate the economic benefit and importance of preserving and restoring coastal wetlands.

Upgrading Culverts: Culverts are perhaps the least visible elements of the infrastructure that we use every day, but roads collapse when culverts fail. The vast majority of culverts in Maine were designed to meet standards half a century out of date. When storm waters overwhelm these too narrow culverts, they undermine the substrate and leave travelers stranded. Road commissioners face pressures to replace the culvert and reopen the road as quickly as possible. Unfortunately, the default is to set in place a culvert no larger than the one that just failed. That is because smaller culverts cost less and require no new engineering plans and because federal policy for assistance to states and communities after major storms requires that replacements be of the same size as those damaged. These decisions simply set the stage for failure in future storms.

Studies cited in Maine, New Hampshire, and elsewhere show that a large number of culverts will not accommodate expected increases in extreme precipitation events. The choice is between upgrades to more appropriately sized structures now to prevent catastrophic failures or much higher costs in the future when they do fail. While both the costs and benefits of upgrades depend on the specific location, some estimates indicate that upgrades now are likely to cost about half again the cost of simply replacing substandard culverts with similarly sized culverts. Rough projections suggest that a total investment of approximately $14-28 million would be required to cover the increased costs of upgrading Maine's highest priority culverts. While these upgrades are expected to result in significant future savings, estimates of these savings have not been modeled in Maine.

Managing Stormwater: After years of delay, the Environmental Protection Agency has moved to enforce the requirements of the Clean Water Act directing municipalities to reduce pollution overflows into water bodies. When rainstorms overwhelm the capacity of sanitary sewers to treat wastes, large quantities of untreated sewage are released in rivers and coastal waters. Retrofitting sewer systems to separate stormwater from waste water can be enormously expensive, so cities are looking for ways to reduce the flows of water resulting from rainstorms that enter the waste water systems. The goal is either for current systems to handle the runoff or for separated stormwater systems to be reduced in size.

Conservation of open space, forests, and wetlands to reduce flood damages also provides benefits in the management of stormwater. But rain that falls in the more developed urban areas often has the greatest impacts in terms of stormwater runoff, and this must be managed by employing a variety of

34 Bedford Street, PO BOX 9300, Portland, Maine, 04104 efc@maine.edu

strategies to reduce flows. Collectively known as Low Impact Development (LID), these include innovations in roof design, porous paving materials, and biological retention areas. Such diffused infrastructure systems come at much lower cost than building complete separation systems. In a study of eleven municipal stormwater management programs, ten showed lower costs using Low Impact Development than building separation systems.

The diffused nature of LID infrastructure systems also likely increase security by relying on a diversity of approaches rather than centralized facilities.

Finding alternatives to high cost separation systems is a matter of some urgency for Maine. The Maine Department of Environmental Protection estimates that communities have already spent $415 million to address stormwater issues and will invest an additional $142 million between 2012-17. Portland, Maine was on a path of relying heavily on gray infrastructure and had plans to build detention systems for tens of Millions of dollars to reduce flows into the Back Cove. After years of public process the Portland Stormwater Task Force made a unanimous recommendation to the Portland City Council to form a stormwater utility. The enterprise fund was set up in a fair and equitable way that was based on non-pervious area lot size and included non-profit entities (Hospitals, churches, universities, etc.) and businesses to pay for their share of non-pervious areas. Because of the thorough process and the fair distribution of costs, the stormwater utility was approved unanimously at the Portland City Council. The utility collects fees that goes solely to stormwater management projects and has not been challenged to date. The use of a mix of gray (pipes) and green infrastructure is a priority for Portland, Maine, in order to reduce the total cost of needed stormwater infrastructure.

Municipalities in the Bangor area as well as South Portland are actively promoting the use of LID techniques in current and new construction to reduce the need for expensive new systems in the future. The Bangor Area Stormwater Group claims a savings of over $400,000 to date by using LID approaches.

There is strong evidence both within Maine and elsewhere of the economic benefits of new strategies for water resources infrastructure that maintains, restores, or mimics the functioning of natural systems. The system-level evidence provides clear support for funding policies that enable the use of natural infrastructure and diffused built infrastructure to meet water resource management needs. Not surprisingly, the evidence indicates the necessity of case-by-case analysis of costs and benefits. Still it is important to note that the projections included here are significant underestimates of the benefits associated with natural infrastructure. This is because the economic benefits associated with preservation of wildlife habitat, open space, and recreation are not included in the analysis. This compelling, though incomplete, picture of the economic benefits suggests that financing programs should require or encourage the use of economic analysis in the evaluation of projects and that state agencies should develop the data and support systems to enable the most cost effective strategies to be chosen.

Evidence from Maine and elsewhere clearly supports serious and detailed consideration of using natural infrastructure approaches to mitigate flood risks in river watersheds and to avoid having to invest in expensive filtration plants to protect drinking water. There is also strong economic support for finding ways to use lower cost built infrastructure approaches like Low Impact Development for managing storm water runoff. Studies in Maine and elsewhere indicate that natural and low cost built infrastructure may be cost effective in coastal flood damage mitigation and in upgrading culverts to reduce damage to transportation systems and ecosystems.

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Financing Water Management: The challenge for Maine and the rest of the country is to find the resources to make the needed investments to protect natural infrastructure and to have financial incentives to increase the use of green infrastructure, LID and best management practices (built green infrastructure) to manage stormwater at the local level.

A number of federal and state funding programs exist that can enable states, municipalities and non-profit organizations to invest in natural and built green infrastructure. Federal and state funding programs such as WIFIA (the Water Infrastructure Finance and Innovation Act) and State Revolving Funds exist but provide far too few resources to meet the substantial investment needs of states. Innovative local governments like the City of Portland, Maine and many other communities in the country have enacted stormwater utilities and are investing in green infrastructure. Help from the Federal government such as matching funds to communities that have enacted stormwater utilities or other enterprise funds for the purpose of managing stormwater would go a long way to incentivize many more innovative actions to use built green infrastructure at the local level.

Significant reductions in federal funding for land and water conservation, combined with a gradual reduction in state funding levels, yield far too few resources to meet the substantial investment need described in this testimony. There is a genuine need for new sources of funding focused on securing the natural and built green infrastructure that sustains Maine's and other states' water resources. Such new funding sources, if carefully designed and strategically implemented, could avoid considerable future costs for Maine and other states, secure valuable benefits and services now, and catalyze investment by municipal, federal and private sources.

The compelling picture of economic benefits presented here suggests that financing programs should require or encourage the use of economic analysis in the evaluation of projects and that state agencies should develop the data and support systems to enable the most cost effective strategies to be chosen. Careful choices about water infrastructure will require careful maintenance of data.

Water is so fundamental to the image of the state of Maine that one of its most successful business, which bottles and exports huge volumes of it, brands it as "what it means to be from Maine." For many and sound reasons, investing in water resources makes sense for Maine and the rest of the country and those investments can be made at lower costs and with greater benefits than was previously thought possible.

Much of the evidence in this testimony comes from *An Assessment of the Economics of Natural and Built Infrastructure for Water Resources in Maine*, Colgan, C., Merrill, S., Yakovleff, D., 2013.

34 Bedford Street, PO BOX 9300, Portland, Maine, 04104 efc@maine.edu

Senator FLAKE. Thank you.
Mr. Markhoff.

STATEMENT OF HEINER MARKHOFF, PRESIDENT AND CHIEF EXECUTIVE OFFICER, GE POWER – WATER AND PROCESS TECHNOLOGIES

Mr. MARKHOFF. Good morning, Chairman Flake, Ranking Member King and members of the Subcommittee on Water and Power. Thank you for the opportunity to testify regarding the importance of securing a sustainable water future.

My name is Heiner Markhoff and I'm the President and CEO of GE Water and Process Technologies, a division within the GE Power business. GE Water is one of the world's leading, advanced water treatment technology companies with more than 50,000 customers, operations in approximately 130 countries, employing roughly 7,500 people worldwide. Our comprehensive set of chemical and equipment solutions and our growing portfolio of predictive analytics help to enhance water, wastewater and process productivity and helps businesses and communities overcome scarcity challenges, strengthen environmental stewardship and comply with regulatory requirements.

So far, more than 4,000 of our customers have connected over 40,000 assets into our digital platform called Inside, which helps us optimize the water efficiency through real-time responsiveness to changing operating conditions.

Overall, our installed base of technologies enables customers to treat over three billion gallons of water per day.

To continue our leading position within the water industry, we expect to invest about $500 million in research and development over the next 10 years.

I would also like to mention that in March, GE announced it had signed a definitive agreement to sell the water and parts technologies business to SUEZ, a global services and solutions company with operations primarily in water and waste management. The deal remains subject to customary closing, and we expect to close by the end of the third quarter. Our strategy for water reuse programs and technology development will remain and strengthen as we transition.

According to market research, the global population will grow by another three billion people by 2050. This growth in population will require 55 percent more water and approximately 70 percent more energy, a demand that cannot be met with current resources.

Even though the world is facing increasing demands on limited water supplies, we believe that greater water reuse can materially help address scarcity. It is estimated that globally only four percent of wastewater is currently reused, but we know that it is possible to reuse much more water. For example, in Israel nearly 80 percent of wastewater is reused. In Singapore, 40 percent of water demand is met with what is called "new water." Here in the United States, approximately seven to eight percent of all municipal wastewater is reused, but in areas like California nearly 16 percent of the 1.6 trillion gallons of municipal wastewater per year is reused with an increasing trend.

Our business surveyed the public on World Water Day in March of this year regarding its perception of reusing wastewater for potable consumption. The response was reassuring with 49 percent willing to drink reused water, up from 30 percent just a few years ago.

Even though we work with communities around the world to help them reuse their wastewater, we also focus on water reuse for industrial processes where water does not have to be treated to a potable standard to be safely used.

The majority of my written testimony focuses on how advanced water treatment solutions can be adopted by communities and industries to help address water scarcity, address the economics of reuse and energy efficiency and the adoption of digital solutions. Deploying these technologies across the water ecosystem will help secure our water future, and I believe that our company and other technology providers and research institutions will continue to find ways to bring innovation to market.

In addition to developing and implementing water reuse technologies, we have released a series of reports highlighting policy options for promoting more rapid adaptation of reuse solutions and we have some publications that we'll make available here for the Committee. The major policy options include: education and outreach, to provide information on and recognition of water recycling and reuse efforts; reducing or removing regulatory or cost barriers, such as the fact that there are currently no nationwide quality standards for reused water; providing financial regulatory or other incentives for water recycling and reuse; and mandating more water recycling and reuse.

We believe that our technology can help unlock the economic power of water by adopting water reuse programs, to weather climate cycles by harnessing the energy in wastewater for energy-neutral plant operation and by leveraging data analytics via the industrial internet to solve complex water infrastructure and treatment challenges.

Thank you for holding this important hearing and for the opportunity to present this testimony. I look forward to your questions and working with you to address these challenges.

[The prepared statement of Mr. Markhoff follows:]

STATEMENT OF HEINER MARKHOFF

PRESIDENT AND CHIEF EXECUTIVE OFFICER

GE POWER – WATER AND PROCESS TECHNOLOGIES

BEFORE THE U.S. SENATE COMMITTEE ON ENERGY AND NATURAL RESOURCES - SUBCOMMITTEE ON WATER AND POWER

"INCREASING WATER SECURITY AND DROUGHT PREPAREDNESS THROUGH INFRASTRUCTURE, MANAGEMENT AND INNOVATION"

AUGUST 2, 2017

INTRODUCTION

Chairman Flake, Ranking Member King, and Members of the Subcommittee on Water and Power, thank you for the opportunity to testify before you today regarding the importance of securing a sustainable water future. My name is Heiner Markhoff. I am the President and Chief Executive Officer of the Water & Process Technologies division within the GE Power business. My business provides industrial and municipal customers with innovative equipment and chemistry technologies, connected and optimized by digital solutions; and we work with our customers to solve the world's toughest water challenges as they pertain to water availability, water quality and meeting regulatory requirements. We are driving toward energy neutrality in the treatment of wastewater, ridding wastewater of harmful contaminants prior to discharge back into the environment and capturing the valuable byproducts from wastewater treatment to generate new revenue streams.

GE WATER & PROCESS TECHNOLOGIES

With operations in approximately 130 countries and employing roughly 7,500 people worldwide, GE Water & Process Technologies is one of the world's leading advanced water treatment technology companies. Known for its comprehensive set of chemical and equipment solutions, and a growing portfolio of predictive analytics, GE Water & Process Technologies enhances water, wastewater and process productivity. The business strives to enable customers to meet increasing demands for clean water, overcome scarcity challenges, strengthen environmental stewardship and comply with regulatory requirements. Over 4,000 customers have chosen to connect over 40,000 assets into GE Water & Process Technologies' InSight platform, allowing real-time responsiveness to changing operating conditions. Its installed base of technologies and solutions enables customers to treat over three billion gallons of water per day. To continue its leading position within the water industry, GE Water & Process Technologies anticipates an investment of $500 million in research and development over the next 10 years.

On March 8, 2017, GE entered into a definitive agreement to sell the Water & Process Technologies business to SUEZ, a global services and solutions company with operations primarily in water and waste management. The deal is anticipated to help the company achieve growth in new regions with a complementary suite of products that will continue to solve customers' toughest water challenges. Although the business's name will change, we will continue to be headquartered here in the United States, and continue to serve our customers' needs throughout the United States.

GAINING CLARITY ON THE WATER ECOSYSTEM

According to market research, the global population will grow by another three billion people by 2050. This growth in population will require 55 percent more water and approximately 70 percent more energy[1]; a demand that cannot be met with current resources. Communities worldwide cannot be fed or fueled without a sustainable supply of water.

[1] http://unesdoc.unesco.org/images/0022/002257/225741E.pdf

A common misconception regarding water use positions residential customers as the biggest water consumers. Repeatedly, residents are asked to conserve water, when in fact the biggest impact lies within agriculture and industry. Industry is the second largest consumer of water after agriculture. It takes vast quantities of water to produce items people use every day; everything from electricity and food products to clothing and paper all require water for production. While consumers indirectly use the most water via the products and services they purchase, manufacturers and industrial producers are the primary stewards of this precious resource.

Our industrial and municipal customers face a number of challenges in providing for growing populations. One of the biggest challenges industrial users face is reduced access to water, often termed water scarcity. Water resources are increasingly scarce with populations and industry growing in regions where water may have already been in short supply, where climate cycles impact the regeneration of this normally abundant resource and where water delivery is impacted by aging and damaged infrastructure[2].

It is important to recognize that in many cases our natural environment is changing because of human interaction. This in turn stresses water supply and storm and wastewater systems[3]. As humans use land for residential and commercial construction purposes, the interruption in groundwater flows heightens the effect of strengthened weather events. When water can no longer be absorbed into the ground, the volume of water routed around foundational structures requires better storm water management to prevent overflows with disastrous consequences.

Finally, industrialized and developing regions often not only lack access to right-sized and sustainable infrastructure, but they also lack the ability to treat the increased volumes and severity of wastewater being produced to an acceptable level before recharging the ecosystem. As water experts study the origins and impacts of contaminants in wastewater, new problems are often discovered that need to be solved. The rise of micropollutants in wastewater from humans and a growing bio pharmacological industry, as well as an increase in heavy metals from wet scrubbers in power plants to reduce emissions, drive the need for new technologies and solutions to help customers. What we have realized is that by treating wastewater to a level near that of what is found naturally in the environment, in certain circumstances, we can provide a new stream of water supply. This is water reuse at its core.

It is estimated that globally only four percent of wastewater is currently reused[4]. In Israel, nearly 80 percent of wastewater is reused[5], and in Singapore, 40 percent of water demand is met with what is called NEWater, the brand name given to reclaimed water produced by Singapore's Public Utilities Board[6]. Although it is difficult to find data, in the United States, approximately seven to eight percent of municipal wastewater is reused[7], but in areas like California, nearly 16

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[2] American Society of Civil Engineers, Infrastructure Report Card 2017

[3] http://oilandgas.ohiodnr.gov/portals/oilgas/pdf/stormwater/rld_11-6-14all.pdf

[4] WateReuse Association

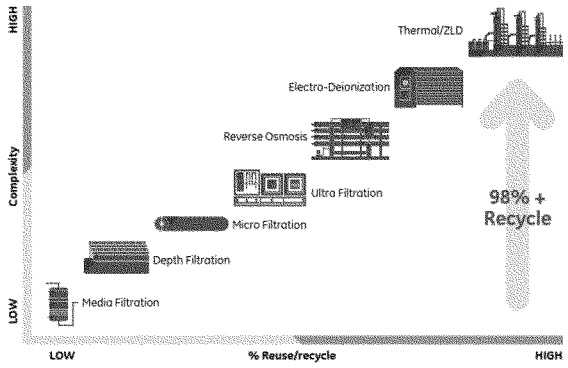
[5] http://www.haaretz.com/israel-news/science/.premium-1.648332

[6] https://www.pub.gov.sg/watersupply/fournationaltaps/newater

[7] Miller, 2006 and GWI, 2009

percent of the 1.6 trillion gallons[8] of municipal wastewater per year is reused. This is an increase of about 6 percent between 2009 and 2015[9]. Whether for municipal, industrial, or agricultural purposes, we have a huge opportunity to tap into that wastewater and reuse it for productive needs.

To help our customers capitalize on this opportunity, GE Water & Process Technologies has built a comprehensive portfolio of technologies and solutions to treat water, wastewater and processes. Our technologies can be configured and combined to treat varying flows and quality of water specific to a customer's plant. One of the areas we focus on is treating wastewater for reuse. As shown in the chart below, we have a complete suite of reuse technologies that can recover 98 percent or more of wastewater, depending on the application.



As Chief Executive Officer for GE Water & Process Technologies, my mission has been to listen to customer needs, to help create solutions for their growing challenges and to sustainably optimize and maximize their industrial growth while preserving water resources.

OVERCOMING WATER SCARCITY THROUGH TECHNOLOGY

Traditionally, technology to increase water supply has often been focused on the desalination of seawater and brackish water. Desalination is a very important part of the mix to enhance supply, and may be the best option for some communities based on specific geographic needs. We supply these systems, but we know they are often challenging to implement and operate, and they are energy intensive. When comparing costs to treat drinking water, some studies have shown that both seawater desalination and indirect potable water reuse cost about six to seven

[8] https://www.nrdc.org/sites/default/files/ca-water-supply-solutions-reuse-IB.pdf
[9] https://www.newsdeeply.com/water/community/2017/07/18/california-is-poised-for-big-gains-in-recycled-water-use.

times more to treat than conventional means[10]. However, since it is often not necessary to treat wastewater to potable standards (e.g., for many industrial uses), reuse often costs far less than seawater desalination. In addition, by streamlining project implementation, by using energy efficient wastewater technologies and by directly reusing treated wastewater in a closed-loop system or routing it for agricultural and industrial purposes, we can reach the point where annualized water reuse costs will begin to achieve parity with conventional water treatment.

Another advantage of water reuse over desalination, when and where possible, is the avoidance of a concentrated byproduct discharged back into the original water source. With desalination, often times the brine (salt) that is extracted in the water treatment process, is added back into the original water source at much higher levels per volume than when it was extracted, which can have a negative impact on the water ecosystem. Embracing the importance of the circular economy, we have solutions that can treat these byproducts for use in other marketplaces. While this is not a common practice today, it is one example of what is possible when looking at a holistic approach to water and resource management.

As I mentioned, one of the biggest opportunities the world has yet to capitalize on is the reuse of wastewater streams to alleviate the pressure of finding and creating new water resources. Our business surveyed the public on World Water Day (March 22, 2017) regarding its perceptions of reusing wastewater for potable consumption. The response was reassuring with 49 percent willing to drink reused water, up from 30 percent just five years prior. Even though we work with communities around the world to help them reuse their wastewater, we also focus on water reuse for industrial processes where water does not have to be treated to the same standard to be safely used.

For example, we have customers in upstream oil and gas production, refining and power generation worldwide that are adopting our water reuse solutions.

In Orlando, Florida, a coal-fired power plant is using our brine concentration and crystallization technologies. This combination of technologies create what is known as zero liquid discharge, or ZLD, to treat cooling tower blowdown wastewater. This solution enables the reuse of 95 to 98 percent of that wastewater within the cooling tower unit, with the remainder contained in the salt produced by the ZLD system.

In addition to facing water scarcity challenges, many of our power customers also face the challenge of meeting effluent limitation guidelines (ELGs). Flue gas desulfurization or FGD systems are used to limit emissions from thermal power plants from being released into the air with the use of wet scrubbers. The contaminants that are removed from the air end up in wastewater streams that often need to be treated before they can be discharged into water bodies such as rivers. In Petersburg, Indiana, our ZLD solutions will be used to treat FGD wastewater, allowing it to be reused within the cooling tower unit. Creating a closed-loop cooling system is one solution that lessens the demand for freshwater withdrawal and protects surrounding water bodies.

[10] Global Water Intelligence

Our solutions for tough-to-treat wastewater also help refineries and petrochemical customers to reach 100 percent reuse. In Canada, the Federated Co-Operatives Limited's Co-op Refinery Complex in Regina, Saskatchewan has been recognized as the Industrial Water Project of the Year by Global Water Intelligence. Combining a membrane bioreactor with a High Efficiency Reverse Osmosis (HERO[11]) system, the refinery is able to process two million gallons of its wastewater and reuse it for steam production for heating, for powering equipment and for use in cooling towers. This system will reduce the refinery's use of freshwater by 28 percent.

In Stockholm, Sweden, membrane bioreactor (MBR) technology is used to treat wastewater at the Henriksdal municipal wastewater treatment facility. It is the largest MBR plant in the world, and it treats two-thirds of the municipal wastewater for the city of Stockholm, Sweden. As a city with one of the fastest growing populations in Europe the facility can process approximately 228 million gallons of wastewater per day. With increasing discharge restrictions on phosphorous and nitrogen into the Baltic Sea and with physical plant expansion limitations, MBR technology can keep up with demand in a smaller footprint while using less energy.

At Doubletree Paper Mill in Arizona, production expansion was limited by capacity at the city water treatment plant. By using GE's membrane bioreactor technology, Doubletree doubled its paper production capacity while demonstrating good environmental stewardship in the water constrained southwest through the use of reuse technology.

In nearby Tempe, Arizona, the Kyrene Water Reclamation Plant was able to double its municipal wastewater treatment capacity with the use of GE's LEAPmbr[12] membranes in the same footprint. The reused water meets Arizona's Class A+ water reclamation standards and is pumped into networks that serve irrigation systems and industrial processes.

LEAPmbr systems for municipal wastewater reuse in the southwest are some of our best examples of how technology is working to help cities hedge against water scarcity. In North Las Vegas, the membrane bioreactor system treats nearly three times the volume of wastewater, 25 million gallons per day, as that of the Kyrene plant. This application enables the city of North Las Vegas, Nevada to reduce its energy and maintenance costs including an estimated 29 percent reduction in membrane scour energy costs.

These noteworthy projects demonstrate the feasibility of reuse and energy savings in multiple settings across the globe. While these larger projects have created a precedent, it is not to overshadow similar, smaller projects that aim to achieve the same goals, and when combined, create the biggest impact in the environments and communities where they operate.

CREATING SUSTAINABLE WATER NETWORKS

Water and energy have a symbiotic relationship, referred to as the water-energy nexus, that presents unique challenges to our customers. Water is needed for energy production, and likewise, energy is needed to purify or transport water to where it is needed.

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[11] A trademark of Debasish Mukhopadhyay.

[12] Trademark of General Electric Company; may be registered in one or more countries.

The focus for industries and municipalities alike lies in how each can first reduce their energy consumption, and second, increase water production or utilization. This is an opportunity to transform the economic and environmental sustainability of how we use, treat and manage our water resources.

If we focus on the treatment of wastewater, we realize that the consumption of energy is substantial. Publicly owned wastewater systems use 75 billion kilowatt hours of energy per year – that is enough electricity to power over 6.5 million homes[13].

The energy used for water and wastewater treatment at a typical municipal plant in the United States accounts for 35 percent of that municipality's energy budget[13].

Looking at municipal water systems, electricity can constitute 80 percent of the costs associated with processing and distributing water for human consumption, while electricity costs for wastewater treatment comprise between 25 and 40 percent of a typical plant's operating budget[14]. By implementing technology that focuses on reducing energy consumption, there is a very real opportunity to optimize the water-energy value network.

Consider the fact that the energy content of municipal wastewater is two to four times greater than the energy required to treat it. At Water & Process Technologies, we have existing technologies and solutions that reduce plant energy demand, capture energy from wastewater, and turn that energy into biogas, which can then ultimately be turned into electricity or other valuable byproducts such as fertilizer.

The Metropolitan Water Reclamation District (MWRD) of Greater Chicago is a great example of a municipality that is embracing technology to make significant changes in their water-energy value network. As one of the largest wastewater utilities in the country, MWRD has a progressive goal to be energy neutral by 2023.

Power needed for aeration and pumping accounts for 50 percent of the electricity consumed onsite. Using membrane aerated biofilm reactor (MABR) technology at MWRD's O'Brien Water Reclamation Plant (WRP) estimates that it can save up to 30 percent of the current amount of electricity used for aeration. Compared to conventional fine bubble aeration systems, MABR technology is four times more efficient.

We continue to see plants upgrading equipment to help with energy efficiency and to start on a path of energy neutrality.

These case studies aim to highlight the importance of adopting energy efficient wastewater reuse technology and their impact on water-energy value networks; networks that, when connected to digital monitoring platforms, can create cost savings and productivity gains that move industry toward making technology adoption possible at scale.

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[13] EPA http://www.epa.gov/region9/waterinfrastructure/training/energyworkshop/docs/2009/energystar-benchmark.pdf.

[14] EPA Energy Efficiency in Water and Wastewater Facilities, 2013

BARRIERS TO THE ADOPTION OF TECHNOLOGY IN THE WATER INDUSTRY

In our journey to drive water reuse globally, we have come to understand common barriers. These include scaling advances in technology for increasingly tough-to-treat water, developing financial instruments and mechanisms for project investment and implementing policies that help municipalities operate and reinvest at the rate of population growth.

The majority of this testimony has focused on how advanced water treatment solutions can be adopted by communities and industries to help address challenges. Deploying these technologies across the water ecosystem will help secure our water future, and I believe that GE Water & Process Technologies, and other technology providers and research institutions, will continue to find ways to bring innovation to market.

In addition to developing and implementing water reuse technologies, GE Water & Process Technologies has released a series of reports highlighting a menu of policy options for promoting more rapid adoption of reuse solutions. The major policy options include:

- Education and outreach to provide information on and recognition of water recycling and reuse efforts.
- Reducing or removing regulatory or cost barriers that prevent more water recycling and reuse.
- Providing financial, regulatory or other incentives for water recycling and reuse.
- Requiring more water recycling and reuse.

CONCLUSION

Businesses and communities rely on technology solutions to improve the security and reliability of water supply and delivery networks, to optimize operations for increased productivity and to decrease the impact on the environments and communities where they operate. We are looking forward to collaborative partnerships for the development and creation of business and service models that make investment feasible and more accessible.

We believe that our technology can help unlock the economic power of water by adopting water reuse programs to weather climate cycles, by harnessing the energy in wastewater for energy neutral plant operation and by leveraging data and analytics, via the industrial internet, to solve complex water infrastructure and treatment challenges.

We would welcome the opportunity to collaborate with the Water and Power Subcommittee in furthering the adoption of technology for water reuse and the optimization of our precious water resources for our communities and industries.

Thank you for holding this important hearing and for the opportunity to present this testimony. I look forward to your questions and to working with you over the longer term to help create a sustainable water future.

-ends-

Senator FLAKE. Thank you.
Mr. Riva.

STATEMENT OF CARLOS A. RIVA, PRESIDENT AND CEO, POSEIDON WATER, LLC

Mr. RIVA. Chairman Flake, Ranking Member King, good morning and thank you for inviting me here today.

My name is Carlos Riva, and I'm President and Chief Executive of Poseidon Water. We're a development company that delivers large-scale, complex infrastructure projects to public water agencies through public-private partnerships.

My written testimony describes the key characteristics of a P3 business model which is now widely used in areas such as the UK, Canada and Australia and is gaining acceptance around the world as a way to speed up infrastructure delivery without adding to public debt.

My own company, Poseidon Water, has been developing water infrastructure projects in North America using the P3 approach for more than 20 years. Our signature project is a 50-million-gallon-per-day seawater desalination plant which is the largest and most technically advanced desalination plant in the Western Hemisphere and it is now serving San Diego County, California. After a very lengthy permitting and development period, it was constructed on time and on budget and today supplies about 10 percent of the county's daily water needs.

Today, I'd like to make four brief and simple points.

First, we must anticipate and plan for future water supply challenges that are brought on by factors such as population growth, economic growth, the aging of existing water systems and changing climatic factors. It takes years to implement projects to meet large-scale regional water needs. We simply cannot afford to wait until we're in crisis.

Second, now more than ever is the time for closer cooperation between the public and private sectors to meet this challenge. Across the U.S. many of our water systems have gone three or four decades with very low investment and the capital needs to bring our water systems up to modern standards is estimated to be in the hundreds of billions of dollars. Given today's harsh political realities, public water agency capital budgets simply cannot cover this gap. Fortunately, many private investors are willing to invest through the vehicle of P3s for the modest but steady, long-term returns offered by infrastructure projects.

Third, to skeptics who fear a loss of public control over crucial public facilities, let me emphasize a key point. A well-designed P3 project is very different from outright privatization. It is, in reality, an alternative method of project delivery over a defined concession period with specified performance obligations. I'd be happy to illustrate the difference by focusing on the example of our partnership with San Diego County Water Authority. In this case, the water agency exercises a high degree of control over the design and operation of the project and ultimately will assume ownership of the plant at the end of the contract period.

Fourth and finally, there are simple but significant steps that Congress can take to remove barriers to this business model. My

testimony describes a few proposed reforms such as caps on the use of private activity bonds, or PABs, which could be lifted. Also, the Bureau of Reclamation's financing authority could be broadened through a program similar to the recently enacted WIFIA program at EPA which was itself based on the successful TIFIA model for transportation projects. And restrictive budget scoring rules related to P3 repayment streams should be re-examined.

Let me close by noting that in the United States we've long since come to accept and embrace private financing for many other types of infrastructure serving public needs such as transportation, energy and telecommunications. I feel the time is ripe to bring this approach to renewing our water systems, specifically through the model of public-private partnership. Where this model fits, it offers a win-win for everyone at a time when our country needs some non-partisan wins.

Water agencies can meet their service obligations and conserve their borrowing capacity. The private sector puts up the capital. The consumers get the benefit of much needed infrastructure on a faster schedule and on more predictable terms. Everybody works together for the good of the citizens and the overall economy.

Thank you, and I look forward to any questions you may have.

[The prepared statement of Mr. Riva follows:]

Written Testimony
Hearing of the U.S. Senate Energy and Natural Resources Committee
Subcommittee on Water and Power

Carlos A. Riva
President and CEO
Poseidon Water, LLC

August 2, 2017

Introduction

Good morning. My name is Carlos Riva. I am President and CEO of Poseidon Water, LLC. Poseidon is a leading private developer of water infrastructure projects in North America. My testimony this morning is offered to help members of the Subcommittee better understand the potential for using the model of Public-Private Partnership as an additional option to meet the nation's pressing water infrastructure needs.

My central message today is simple. America faces two harsh realities: an acute need for public infrastructure renewal, and severe fiscal constraints at all levels of government. Under these conditions, the time is right for Congress to take steps to encourage and remove barriers to the wider use of such partnerships. Commonly referred to as P3s, they have become quite common in other developed countries. Uptake of the P3 model in the US, though, has been much slower due to legacy attitudes and a variety of legislative and policy barriers. It is time to overcome these barriers. Properly-constructed P3s, used in the right circumstances, can yield a broad array of benefits to the public. They can help to ensure timely project completion; contain overall project costs; strengthen performance guarantees; reduce risks to ultimate consumers; and avoid the need to take on the burden of additional debt – all while maintaining a strong degree of public control and oversight.

About Poseidon Water

Poseidon, which is headquartered in Boston and majority-owned by a unit of Brookfield Asset Management, was founded in 1995. Our company delivers large-scale, complex water projects to public water agencies using the model of non-recourse, project-based finance. This is a disciplined and capital-efficient model that is now widely used in energy and other infrastructure sectors. It has not yet been widely adopted in the US water sector, where the dominant share of financing for water projects has historically been provided by tax-exempt municipal borrowing. As public sector budgets have been squeezed over time, this reliance on public borrowing has become a major factor in the growing shortfall in infrastructure investment.

Poseidon has also been an early pioneer in using the P3 model to address this gap between infrastructure needs and available public funding in the water supply and wastewater treatment sectors. Our company's experience in P3s dates to the late 1990s when we led the successful

development of one of the first P3s in the US water sector, a wastewater treatment facility modernization and long-term operating agreement serving the city of Cranston, Rhode Island. Recently, in 2015, we successfully completed and brought online the Claude "Bud" Lewis Carlsbad Desalination Plant in Carlsbad, California. Today, that plant, which is the largest desalination facility in the western hemisphere, provides nearly 10% of the water supply of San Diego County. We are also in the final permitting stages for a similar desalination facility in Huntington Beach, California to augment local, drought-resilient water supplies for Orange County. Poseidon is exploring the potential for water reuse and desalination projects, using the P3 model, in several other regions of the US. The need for such solutions, in our view, will only grow in the future as stress on our water supplies continues to intensify. Key factors driving this increased stress include such factors as changing climate patterns and ongoing population growth nationwide, most notably in our country's coastal areas. Many large coastal communities are especially vulnerable to water stress due to such factors as naturally-arid climates, episodic drought and/or seawater intrusion.

Overview of America's Water Infrastructure Needs

Over the past few years, and especially since the 2014 Flint water crisis, there has been growing consensus on the urgent need to renew our nation's deteriorated water infrastructure. Our nation's water systems – including water supply, storage, conveyance and wastewater treatment facilities – are a source of special concern given how critical they are to ensuring public health, environmental protection and economic vitality. Too often, as we've seen, water is simply taken for granted until we suddenly find we have too much or too little. Then, all of a sudden, water overrides every other issue. In this time of partisan division, it is notable that support for infrastructure renewal crosses partisan lines, making it an issue that cries out for political cooperation. Nevertheless, decade after decade, actual investment to maintain, renew and expand these systems has continually fallen short. As a result, the investment backlog required to bring our water systems up to acceptable standards is now commonly measured at several hundred billion to as much as a trillion dollars.[1]

Public Financing vs. Outright Privatization: A False Choice

Discussion of how to move forward on infrastructure renewal often falters over the difficult issue of financing. In an era of constrained public budgets, where can we possibly find the capital resources to meet needs on such a massive scale? The reality, in fact, is that there is abundant private capital available and willing to meet these needs, on very competitive terms given today's comparatively low interest rate environment. However, privately-backed financing of

[1] See, for example, the following reports:
American Society of Civil Engineers (ASCE), "2017 Infrastructure Report Card: A Comprehensive Assessment of America' Infrastructure" (March 2017)
Deloitte University Press, "The Aging Water Infrastructure: Out of Sight, Out of Mind?" (March 2016)
American Water Works Association, "Buried No Longer: Confronting America's Water Infrastructure Challenge" (February 2012)

water infrastructure – now used quite commonly in other countries – has simply not been the norm in the US.

What is the reason for this disconnect? All too often, the issue is presented in terms of a choice between massive and unaffordable public spending or borrowing on the one hand, and outright privatization and loss of control over critical public resources and services on the other. I believe this is a false choice. Frankly, a well-crafted public-private partnership is very different from privatization; it is more accurate to describe it as an alternative method of project delivery. A well-designed P3 ensures close public oversight, and brings public and private sector actors together into a disciplined, cooperative long-term relationship that leverages the skills and strengths of each.

I would offer the model of our Carlsbad facility, and our relationship with the San Diego County Water Authority, as an example of how a well-designed P3 agreement can promote cooperation and mutual benefit. Poseidon underwrote the cost of developing this facility at no risk to San Diego consumers and oversaw its completion on-time and on-budget. We have committed to operate the Carlsbad facility on a strict pay-for-performance basis for the duration of a 30-year concession period. The Authority has contractual rights to buy out the contract at intervals throughout this term and, at the end of the term, to purchase the facility in sound working order for one dollar. A member of the County Water Authority's staff works inside our facility on a daily basis, ensuring full visibility into operations. We are pleased to have forged an excellent and highly communicative, day-to-day relationship with the Authority. It is a true partnership, and we are especially gratified that this landmark desalination facility, by augmenting local supply and easing pressure on the County's other water sources, has earned such strong public support within the larger community of San Diego County.

Global and US Experience in P3s

Let me now turn to the broader potential for using the P3 model to address broader needs in the water sector. The US has been far from alone in facing challenges in infrastructure financing. As far back as the 1970s and 1980s, a worldwide infrastructure investment backlog began to develop due to the sharp economic dislocations that occurred at that time. Due to the combination of economic and population growth along with the aging of legacy facilities, many countries have been challenged throughout this period to modernize and expand their transportation, energy, telecommunications, railway, water and other infrastructure systems. The United Kingdom was the first country to adopt the P3 model in earnest beginning in the early 1990s. Use of this approach spread to other countries including Canada, Australia New Zealand. These countries now commonly use the P3 model to deliver infrastructure projects without triggering the need for public sector borrowing, and the model is also gaining acceptance in continental Europe, Asia and Latin America.[2] More recently, within the past decade many US states have begun to adopt this model for highway project construction. Today, some 35 states have statutes that enable the use of various P3 structures, principally for transportation projects.[3]

[2] See, for example, EY Report, "Public-private partnerships and the global infrastructure challenge: How PPPs can help governments close the 'gap' amid financial limitations (2015).
[3] See https://www.fhwa.dot.gov/ipd/p3/legislation/

All of these earlier experiences in other countries and states here in the US have yielded valuable lessons to guide the federal government on the uses and limitations of P3s. Let me outline some of the key criteria for determining whether and where this project delivery model may provide a good fit in the water supply space.

Definition and Requirements for Success

To begin with, there is no single agreed definition or structure for a P3. In fact, a common feature of the most successful P3s is that they are carefully tailored to the circumstances and needs of a specific project. Appended to my testimony are excerpts from a brief and useful fact sheet produced by the National Council for Public-Private Partnerships[4]. It defines a P3 as follows:

> "a contractual arrangement between a public agency (federal, state or local) and a private sector entity. Through this agreement, the skills and assets of each sector (public and private) are shared in delivering a service or facility for the use of the general public. In addition to the sharing of resources, each party shares in the risks and rewards potential in the delivery of the service and/or facility."

As outlined by NCPPP, a number of preconditions are considered key to ensure the success of a P3. These include: a strong public sector champion; a solid statutory environment; a dedicated public sector team focused on P3s projects or programs; a detailed contract; a clearly-defined revenue stream; broad stakeholder support; and well-chosen partners.

From Poseidon's own experience, I can attest how important each of these elements is to the success of a public-private partnership. The P3 model is by no means applicable for all or even most types of infrastructure projects. In truth, most water infrastructure projects are modest in size and employ commonly-accepted technology. Generally speaking, standard models of procurement are perfectly appropriate for such projects; it is simply not worth the up-front time and costs to negotiate complex agreements and risk allocations for projects that are relatively low-risk, simple and straightforward.

However, as projects become larger in scale and cost, or if they use newer, unfamiliar or as-yet non-standard technologies, they can bring additional risks that can be difficult to anticipate. In these circumstances, there is real value to be realized by rigorously identifying and quantifying such risks, and undertaking a detailed contracting process that assigns risks to expert project partners who are in the best possible position to manage, retire or mitigate them. A P3 for a large water supply project using new technology for desalination or the potable reuse of wastewater, for example, would require an extensive teaming arrangement with a broad array of partners. As the lead developer for such a project, Poseidon has been responsible for working with public water agency clients to assemble world-class, expert teams and negotiate very complex P3 arrangements. Such contractual arrangements typically include world-class design firms, engineering, procurement and contracting (EPC) firms, and operations and maintenance

[4]Source: http://www.ncppp.org/ppp-basics/7-keys/

(O&M) contractors that have day-to-day involvement in water infrastructure development and current knowledge of cutting-edge trends in technology. In the case of non-recourse project finance, the key to achieving financial closure on competitive terms lies in the ability to attract sophisticated debt and equity capital sources by demonstrating how all relevant project risks have been identified and managed. The rigor, discipline and transparency of this process helps to ensure that only the most viable projects win financing. This approach helps to protect consumers – as both taxpayers and utility ratepayers – from the consequences of imprudent decisions. These process attributes increase the likelihood that those projects that do move forward are completed on-time and on-budget, and perform to specification over their contract term.

Removing Obstacles to the Wider Use of P3s

In the United States, the reality is that the great majority of water infrastructure projects are funded, not at the federal level, but at the state or local level. However, many local projects rely to a greater or lesser extent on federal funding, for example, through access to the EPA's State Revolving Fund (SRF) program. As members of the Subcommittee contemplate infrastructure and tax reform legislation over the remainder of this session, it is my strong hope that you will consider adopting rules and policies that encourage and incentivize state and local jurisdictions to make wider use of this P3 model.

The federal government also provides direct funding for water projects, for example, through the Department of Interior's Bureau of Reclamation and the Army Corps of Engineers. It is public knowledge that these agencies have publicly expressed interest in using the P3 model, but find themselves constrained from doing so by existing federal budgeting rules. To ease these constraints, let me mention a few specific steps the Congress could take to encourage or remove barriers to the wider use of P3s:

- Reforms to the annual federal budgeting process. Under federal law including the Anti-Deficiency Act, federal agencies may not make multi-year, forward commitments to provide for repayment over time of investments in infrastructure projects. As a result, infrastructure investments funded on the basis of year-to-year, annual appropriations. In cases where appropriations are reduced or eliminated, construction is pared back or stopped, with disruptive effects on project schedules and long-term costs. To address this problem, Congress should reexamine its budgetary rules and allow interpretations that would enable federal agencies to contemplate longer-term, future-year payment streams in their annual budget submissions. While existing law prevents agencies from making binding long-term commitments to future-year outlays (other than short-term concession contracts), they might be expressly permitted to make commitments that, in calculating future-year budget requests to Congress, will include repayment streams associated with a P3 contract agreement.

- Lifting the cap on Private Activity Bonds or PABs. As I mentioned earlier in my testimony, there is an artificial difference in the cost of a project undertaken by a private entity like Poseidon rather than a public agency, simply because public agencies have traditionally enjoyed access to tax-exempt financing whereas interest on private lending instruments used

by P3s is typically taxable. Privately-financed infrastructure projects may qualify, to a limited extent, for tax-exempt private activity bonds (PABs), tax-exempt bonds issued by or on behalf of local or state governments for the purpose of providing special financing benefits for qualified, privately-developed projects. However, the quantity of PABs available in the financing marketplace is subject to caps on a state-by-state basis. We are aware that legislation has been introduced in the House of Representatives (H.R. 3009) to raise the caps that limit the availability of these PABs. To stimulate additional lending for the public infrastructure sector and close the gap in infrastructure investment that is the focus of today's hearing, I would strongly encourage Congress to enact this legislation, whether as a stand-alone action or as part of any comprehensive legislative infrastructure package developed during this session.

- Enact Reclamation RIFIA: We urge the Congress to expand the Bureau of Reclamation's financing authority and attract investment in water infrastructure P3s by authorizing the proposed Water Infrastructure Finance and Innovation Act, or WIFIA, for Reclamation (The New WATER Act – H.R. 434). This bill would expand Reclamation's flexibility to support infrastructure development in the 17-state western region where water stress and drought resilience are especially acute issues. This proposed program is largely modeled on the proven and successful TIFIA program under the jurisdiction of the Department of Transportation, and recently-enacted and funded WIFIA program at the Environmental Protection Agency. The Congressional Budget Office has found that WIFIA's expanded loans and loan guarantees and support for joint private sector participation in planning with local and state water management agencies represents a highly cost-effective way to increase needed investment in water infrastructure. In fact, a small outlay of $6-$10 million on the back end (to cover the low default rate associated with public water projects) equates to over $11 billion in loans under a WIFIA-like program for Reclamation – and resulting in over $22 billion in new water infrastructure. These low interest/long term loans can help bring costs down and help P3s to thrive in the water space.

- Legacy attitudes. Finally, the shortfall in investment in infrastructure arises in large measure very simply from longstanding habit and practice. There remains an enduring presumption that these needs must be funded with public dollars, simply because provision of water supply and treatment services is a matter of public interest. This presumption has long since been overcome in any number of other capital-intensive infrastructure sectors. Private developers of America's energy, railway, airport and, increasingly, highway infrastructure routinely attract tens of billions of dollars in private capital annually to meet evolving needs.

Conclusion

In closing, I would like to thank the Subcommittee again for the invitation to appear today and applaud your decision to convene this timely hearing. The issue of water infrastructure renewal is critical to our country's future in many ways. It is certainly true that the investment requirements to meet these needs appear daunting, while public financing resources are scarce and under great pressure in today's political climate. Nevertheless, for projects that fit the necessary criteria, there is abundant private capital available to help meet this important public

need. The vehicle of public-private partnership provides an effective way to tap into private capital resources to support infrastructure development, while assuring strong public involvement, participation and oversight. Our company's experience convinces me that this approach represents a timely and effective tool to help close the infrastructure funding gap, and to meet the very real water challenges in our country's future.

* * *

Appendix 1

Biographical Statement
Carlos Riva
Chief Executive Officer, Poseidon Water LLC

Carlos Riva joined Poseidon as the Chief Executive Officer in 2011. Mr. Riva has over 25 years of experience in infrastructure project development and finance. He has extensive knowledge in growing new companies and leading technologically sophisticated businesses in the fields of renewable energy, electric power generation, biotechnology, engineering, and construction.

Prior to joining Poseidon, Mr. Riva was the President and Chief Executive Officer of Verenium Corporation, an industrial biotechnology company dedicated to commercializing next generation biofuels and specialty enzymes. Previously, he was Chief Executive of Amec Group, Ltd. a major British engineering and construction firm. Mr. Riva has also had extensive experience in the electric power industry, having served as the founding Chief Executive of Intergen and as President of J. Makowski Company, developer of the first independent power project in the United States. In these roles, he oversaw the development of over 17,000 megawatts of greenfield electric power generation projects worldwide.

Mr. Riva holds B.S. in Civil Engineering from Massachusetts Institute of Technology, an M.S. in Civil Engineering from Stanford University and an MBA from Harvard Business School.

Appendix 2
Public-Private Partnerships Defined and Described

Public-Private Partnerships Defined
A public-private partnership (P3) is a contractual arrangement between a public agency (federal, state or local) and a private sector entity. Through this agreement, the skills and assets of each sector (public and private) are shared in delivering a service or facility for the use of the general public. In addition to the sharing of resources, each party shares in the risks and rewards potential in the delivery of the service and/or facility.

7 Keys to Successful P3s
The following are to be considered "best practices" in the development of public-private partnerships (P3s). It is recognized that the methodology for implementation of P3s can vary, depending on the nature of a given project and local concerns. Given this, it is the position of the NCPPP that these are "best practices":

1) PUBLIC SECTOR CHAMPION:
Recognized public figures should serve as the spokespersons and advocates for the project and the use of a P3. Well-informed champions can play a critical role in minimizing misperceptions about the value to the public of an effectively developed P3.

2) STATUTORY ENVIRONMENT:
There should be a statutory foundation for the implementation of each partnership. Transparency and a competitive proposal process should be delineated in this statute. However, unsolicited proposals can be a positive catalyst for initiating creative, innovative approaches to addressing specific public sector needs.

3) PUBLIC SECTOR'S ORGANIZED STRUCTURE:
The public sector should have a dedicated team for P3 projects or programs. This unit should be involved from conceptualization to negotiation, through final monitoring of the execution of the partnership. This unit should develop Requests For Proposals (RFPs) that include performance goals, not design specifications. Consideration of proposals should be based on best value, not lowest prices. Thorough, inclusive value for money (VFM) calculations provide a powerful tool for evaluating overall economic value.

4) DETAILED CONTRACT (BUSINESS PLAN):
A P3 is a contractual relationship between the public and private sectors for the execution of a project or service. This contract should include a detailed description of the responsibilities, risks and benefits of both the public and private partners. Such an agreement will increase the probability of success of the partnership. Realizing that all contingencies cannot be foreseen, a good contract will include a clearly defined method of dispute resolution.

5) CLEARLY DEFINED REVENUE STREAM:
While the private partner may provide a portion or all of the funding for capital improvements, there must be an identifiable revenue stream sufficient to retire this investment and provide an

acceptable rate of return over the term of the partnership. The income stream can be generated by a variety and combination of sources (fees, tolls, availability payments, shadow tolls, tax increment financing, commercial use of underutilized assets or a wide range of additional options), but must be reasonably assured for the length of the partnership's investment period.

6) STAKEHOLDER SUPPORT:
More people will be affected by a partnership than just the public officials and the private sector partner. Affected employees, the portions of the public receiving the service, the press, appropriate labor unions and relevant interest groups will all have opinions, and may have misconceptions about a partnership and its value to all the public. It is important to communicate openly and candidly with these stakeholders to minimize potential resistance to establishing a partnership.

7) PICK YOUR PARTNER CAREFULLY:
The "best value" (not always lowest price) in a partnership is critical in maintaining the long-term relationship that is central to a successful partnership. A candidate's experience in the specific area of partnerships being considered is an important factor in identifying the right partner. Equally, the financial capacity of the private partner should be considered in the final selection process.

Source: "7 Keys to Success," Fact sheet by National Council for Public-Private Partnerships (NCPPP), http://www.ncppp.org/ppp-basics/7-keys/

Senator FLAKE. Thank you all for your testimony. I appreciate it.

We will start a round of questions. I will start with Tom. You point out in your testimony the cuts to Arizona's Colorado River supplies taken under a shortage declaration and efforts underway to keep water in the lake. You talk a lot about this.

Last year the Department of the Interior provided an assurance that Arizona's conserved water would not be delivered to farmers across the river in California. It is my understanding that DCP has a permanent fix for this so-called system water. If the DCP will not take effect until next year, at the earliest, are we operating once again without DOI assurances?

Mr. BUSCHATZKE. Chairman Flake, we do not have those assurances in writing. We would like to see that happen this calendar year. The assurances we had last year ran out at the end of 2016.

It's imperative that that conserved water stay in the lake. The efforts of Arizona, Nevada, California and Mexico over the last several years, to conserve water in the lake, actually avoided shortage in 2015, 2016 and 2017. So it's critical that that water stay in the lake.

And the certainty that commitment in writing from the Department of the Interior would give us would allow us to continue to go ahead with confidence that the money we're spending to conserve that water in the lake is going to be well served.

Senator FLAKE. The perception by some is that the drought ended in the West with all the rain and particularly in the Sierra Nevadas. Has the wetter winter that we had in the Upper Basin changed the equation at all for Colorado, the Lower Basin?

Mr. BUSCHATZKE. So it has reduced the probabilities that Lake Mead will go into shortage or fall to lower shortage levels in the future. But the wet winter that started kind of petered out in the spring. In between March and June, we lost about a two million acre-feet out of the runoff projections. So it gave us a brief respite, but there's still more to do. And again, without the water conservation that we've done in Lake Mead, right now, we might even be in shortage in 2018 despite the good winter we had this year.

Senator FLAKE. I was glad to see in your testimony you covered the reuse of reclaimed water, recycling, that we have in Arizona. Frequently, we hear about water recycling. When it is talked about, it comes with a request for the Federal Government to come in and build a treatment plant for recycling projects.

In Arizona, we have seen projects from Tucson, to Phoenix, to Prescott, to treat effluent that do not require federal funds. Can you explain how Arizona state water law treats effluent and how it has created situations where private entities have incentives to invest?

Mr. BUSCHATZKE. Yes, Chairman Flake. The Palo Verde Nuclear Generation Station effluent contract that I talked about earlier spurred a lawsuit in Arizona, and the Supreme Court in 1989 did rule that treated wastewater is the property of the entity that treats it.

That really did incentivize folks for doing reuse, building the plants, building the infrastructure, and I think the certainty that that legal framework created in Arizona, certainly, has led to Arizona using quite a bit of its water for reuse in the Phoenix metro-

politan area—almost 100 percent, the same in the Tucson area. So we've long been leaders in reuse, and that was one of the key factors that allowed us to achieve that goal.

Senator FLAKE. Thank you.

Mr. Markhoff, you mentioned you use predictive analytics to better utilize these systems and private investment that you have. Explain that. I think people have—predictive analytics are being used just about everywhere, but explain how they are used here with regard to water.

Mr. MARKHOFF. What we're really talking about is in different areas.

One, just looking at the plant operation itself through tools of asset performance management. It's really about improving productivity, improving efficiency, predicting downtimes and taking preemptive measures against it and basically protect and prolong the asset life of the plant operation.

If you look outside of the plant itself, we have large infrastructure, piping infrastructure, pumping infrastructure and there is a whole slew of different tools to protect pipeline health, to detect leakages, to address non-revenue water, basically, you know, preventing leakages through preemptive maintenance activities. And, you know, together with analytical tools and analysis up front, this prediction clearly helps to drive improvements and operating productivity and efficiencies.

Senator FLAKE. Senator King.

Senator KING. Thank you, Mr. Chairman.

Ms. Zane, I was struck by your testimony in the desire for more certainty and more science, in terms of predictability which is a crucial element.

What bothers me is that the budget that was recently submitted by the Administration cuts the NOAA budget by 16 percent, cuts research in NOAA by 32 percent and even cuts the National Weather Service by 6 percent.

You said we need better data to better manage. I would say we also need better data to make better policy, and I find that very concerning for all of the work that we are doing here. If we do not have the data, if we do not have the predictability, it is simply going to aggravate this problem. Would you agree?

Ms. ZANE. Oh, 100 percent. We've got to invest in technology and just to remember what it costs us when we don't invest in technology. We went down to 25 percent of our reservoir because the Corps of Engineers were following a rule based upon the upcoming precipitation.

On the other hand, we've been able to keep more water this last season where we had our Russian River flooded three times. So, basically in one year, Sonoma County was declared both an emergency in terms of drought and in terms of flood. So that is an example of the extreme differences.

I think it's all about investing in the innovation. It's about better forecasting of the skies so we can better manage water on the ground.

Weather is an integral part. And we do know that, even with the science that we've now been working on, if we install the proper radars along the coast there in Northern California, we're going to

have, basically, a forecast that gives us three to four days in advance to both prepare for floods and to keep that water in the reservoirs. The atmospheric river has dumped over 50 percent of the precipitation in California, and that's the thing that we've got to track.

We're seeing, again, extreme weather differences and I couldn't agree more, NOAA has been an integral partner of ours in terms of looking at the forecasting, increasing the technology and then, really, it's about efficiency and cost savings.

Senator KING. I want to get to that.

Ms. ZANE. Okay.

Senator KING. Mr. Buschatzke, is there some calculable maximum—I am looking big picture here—of gallons needed per year, per person, in a given area or in the country or in the Southwest, and are we bumping up against that or how do we calculate what we need? Can we just continue to absorb growing population in Phoenix and Los Angeles?

Mr. BUSCHATZKE. So certainly, Senator King, there is a calculation for gallons per day per person. I think it varies in different parts of the country. Certainly, in Arizona, where it doesn't rain much, the outdoor use that attaches to a home, for example. You need water to meet that demand so it would be a very different number than perhaps on the East Coast. So perhaps on the East Coast it's 50 or 60 gallons per day. In Arizona, 170, 150, somewhere in that range is a more reasonable number.

Senator KING. Well, okay.

Is there some sort of global calculation of what is the potential for either conservation or reuse? Is it a third, a half? I mean, can we invent our way out of this problem?

We have not gotten to desalination yet, but let's talk about the potential for simply low-flow toilets, or more conservation measures.

Mr. BUSCHATZKE. So at least in Arizona, Senator King, we have been doing conservation since 1980. We reduced in the population centers, our gallons per day by 25 to 30 percent, in some cases more. We have projected out our future supplies and demands and we know that conservation alone will not achieve the goal of keeping up with growth in population and economy. We do know, however, that reuse might fill as much as 50 percent of our future growth projections.

Senator KING. So those are two areas that we just, absolutely, have to concentrate on?

Mr. BUSCHATZKE. Yes, absolutely.

Senator KING. Ms. Sheils, I think you gave this calculation, but it is an important one—can you dollar value the natural protections, buffers and the like, versus filtration? I think you gave a figure on that.

Ms. SHEILS. Yes, in the case of the Sebago Lake Watershed, in order to preserve the needed natural infrastructure of the forests around the lake, it costs a third less than to build a new filtration plant that would do the same work that the forest floor does now.

Senator KING. To follow up on that, are there differences in abilities to finance those two solutions? In other words, can you get fed-

eral grants, for example, for a filtration plant but not for acquiring buffers?

Ms. SHEILS. You can get some grants for filtration plants through state revolving funds and some federal programs, but for acquiring land, it's much different. Some state revolving funds do finance purchase of land by drinking water utilities, but they don't allow the coordination of purchase with land trusts who might be interested in that same piece of land.

Senator KING. I would be interested, if you could supply this for the record, in a comparison between buying a filtration plant and protecting naturally, and what policy, tax policy, grant policy—how it works. I am interested in whether we are providing sufficient incentives to do it naturally, as opposed to mechanically.

Ms. SHEILS. Well, for one thing doing it naturally is always less expensive. In the case of Sebago Lake, it's——

Senator KING. I understand that, but my question is are there perverse incentives, penalties, or tax benefits. That's what I am looking—you don't have to answer me now.

Ms. SHEILS. Yeah.

Senator KING. But for the record, if you could supply that, I would like to see a comparison of how tax policy, grant policy and regulatory policy affects the two forks of the solution.

Ms. SHEILS. I can provide you that. But let me just say that it's really difficult to know all the benefits and to put that in the avoided cost number. We know the avoided cost of building a filtration plant is the cost of that filtration plant that you don't have to build.

Senator KING. No, no, I understand.

Ms. SHEILS. Because—but to value the non-market values of recreation and carbon sequestration and all those other non-market values, there's really not an easy way to do that and if we don't count those costs, then we're underestimating the benefits. So, I will get you that analysis.

Senator KING. Thank you, I appreciate it.

Ms. SHEILS. Thank you.

Senator KING. Thank you, Mr. Chairman.

Senator FLAKE. I will turn to the man who has more lakes than constituents in his state.

[Laughter.]

Senator Franken.

Senator FRANKEN. No, we actually have more, I have more constituents. It is called the "Land of 10,000 Lakes." We have about 14,000 lakes, and I have about five and a half million constituents.

Senator FLAKE. That is why I am a politician. Math is not my game.

Senator FRANKEN. Yes.

[Laughter.]

Well, let's talk science, which I believe involves math sometimes. Scientists project that by the end of the century the Western United States will face higher temperatures coupled with more intense droughts. In the Midwest, we will face weather events and the resulting flooding. As a result, we need to prepare for these changes by adapting or modifying our infrastructure, including our dams and levees.

Ms. Zane, you have been working to manage water infrastructure during both droughts and flooding in the past few years. What can the Federal Government do to help communities prepare water infrastructure for a changing climate?

Ms. ZANE. You have to invest in technology. It's that, pure and simple. Without the technology, you're not going to have more accurate forecasting.

We are basically using a Midwestern—no offense to the Midwest, but you have more thunderstorms there. We're using that technology to give us our forecasts on the West Coast. The problem is, is that you have radar at a certain elevation and the atmospheric rivers come well underneath that elevation and it's not being detected. If we invested in technology today, we would be able to know four days, five days in advance, when those atmospheric rivers hit.

You know, we literally lived in a state of emergency throughout the wintertime because the Russian River crested over three times and we had to evacuate, literally, thousands of people and animals. We got a $6 million FEMA grant to repair our roads and we're putting another $4 million into the general fund. And that, to me, is wasted dollars because if we could better prepare for these floods and keep that water in our reservoir, and we have a $6 billion agricultural industry in Sonoma County and a biological opinion that works and our fish are coming back, in terms of our endangered species. But if we had that technology today, I believe we could do such a better job and not waste one dollar or one drop of federal funding when it comes to those emergency disasters.

So I couldn't be more disappointed that technology and research was cut in this recent budget. I think it is the wrong way to go, and I think I agree with Senator King. It's got to be technology and data that is the foundation for all good policies.

Senator FRANKEN. I am concerned about a lot of the cuts that are being made, NOAA, of course. The whole Energy Committee is talking about less investment on energy efficiency, renewable energy, that sort of thing.

Ms. Sheils, welcome. My wife is from Maine, I love Maine.

In your testimony, you highlight the importance of green infrastructure and rebuilding natural systems, like wetlands, as a cost-effective way to protect water by avoiding the more expensive forms of traditional infrastructure projects.

I just had the Commanding General of the Army Corps of Engineers in because they dredge the Mississippi a lot to keep the channels open for shipping and that is absolutely important. And we had a situation where they dredge material—they are at a point where they are going to have to dump it on somebody's farm, you know? One thing he talked about was creating wetlands, and he is hoping that he can find that solution.

So can you talk about these types of green infrastructure projects and how they can be beneficial, especially in light of a changing climate?

Ms. SHEILS. Right. Yes, definitely.

More extreme weather events up and down the east coast, it's affecting communities tremendously, and protecting the wetlands that are already in place is the least—the most cost-effective way

to manage floodwaters on the coast. Restoring wetlands is another way to do that.

And then the last thing is creating wetlands, like you were talking about. That can also be cost-effective, as opposed to the flood damage that you can get if you don't have that natural system to absorb the waters.

I talked about Vermont and how Hurricane Irene hit Vermont so hard and Rutland got all these damages because it's basically impervious surfaces, but downstream from that where there was this enormous wetland, conserved wetland, the flows were much less and damages were much less as well. So we have to just weigh the costs and the benefits we get from preserving these natural areas that will always be cheaper than to deal with the consequences.

Senator FRANKEN. There are significant conservation benefits for mediating a fish and wildlife habitat and re-establishing local species.

Ms. SHEILS. Not only environmental but also social benefits and economic benefits at the same time.

Senator FRANKEN. You are nodding a lot, Ms. Zane. Why are you nodding?

Ms. ZANE. Well, because we've been spending the last nine years with the Corps of Engineers and our private landowners, basically implementing a biological opinion. We have yet to be sued. We've worked really well with our landowners and we are seeing great restoration in terms of some of our endangered species, fish in particular.

I grew up with a fishing pole in my hand and fished all over the West with my father. So, you know, we will often say at the Sonoma County Water Agency, "If our fish are healthy, our water supply and quality is healthy."

We really use that as a measuring stick and I would invite you all to come out and take a look at some of those construction projects, in terms of restoring fish habitat along the tributary of the Russian River which is Dry Creek. They are quite incredible, some of the best wines you'll ever drink. The people who own that property are making those wines and they are working hand-in-hand with us, as well as the Corps, to implement that biological opinion.

Senator FRANKEN. Well, thank you.

I am over my time, but Sonoma is just unbelievably beautiful, as is Maine.

Ms. ZANE. Yeah.

Senator FRANKEN. Arizona is gorgeous.

Where are the rest of you from? I forgot.

[Laughter.]

But I am sure it is beautiful. We have a beautiful country, which we should be very proud of, and thank you for working on our water infrastructure.

Ms. ZANE. Thank you.

Senator FLAKE. Thank you, Senator Franken.

Mr. Riva, you talk about desalination. I have taken a couple of survival trips where the only water I could drink was what I used a manual desalinator for, and I know that it takes a lot of time to

produce enough water and a lot of pressure with a little manual desalinator, for sure.

So the big issue is power use, and I assume that is the big cost. Tell me, with California producing a lot of intermittent power, particularly with solar, does that provide benefits and opportunities for desalination where you can, kind of, pick the times that you actually use the hardware? Tell me about power and intermittent use and how that is aiding or helping your industry.

Mr. RIVA. Thank you.

Power is a major component of the cost structure of desalinated water. For instance, for every gallon of water that we produce, roughly half of it represents capital, a quarter of it represents operating costs that are non-power and another quarter represents the cost of power.

Over the course of the last decade the amount of that percentage of power in the overall cost has been declining as there have been a lot of technology innovations starting with the improvement in filters, improvement in different energy recovery systems and the like.

But in terms of where we get that power from, in the first instance, well, let me back out and say this, at Poseidon, we feel very strongly that we need to find ways to maximize the use of renewable energy in order to address the power supply.

There are limits that we can do, actually onsite, because there's just not enough room to put a massive solar or wind array in order to do that, but we will do some. We'll do rooftop solar where we can.

What we would like to do is to be able to access some of the renewable energy that's being produced remotely, say in the desert areas in California, and find ways to bring it to the site. That's currently not possible for us under California law, but it's something that a number of people are working on, direct access.

And then finally, the issue that you raised which is the ability to take low-cost power, or what there's excess of power, and then alter your operating mode in order to accommodate that. That's another potential area which we're looking at.

In our Carlsbad unit, there's less potential to do that than in other, say, a new build, like a project we're building in Huntington Beach where there's much larger water storage. And that's really the issue if you have more capacity to store, then you can produce more in off-peak and cut back on on-peak.

This is all very active work for us and working with the California Electricity Commissions because there is, really, a power/water nexus that is important to understand.

Senator FLAKE. Between the hours of 11 am and 2 pm every day, California is pushing no-cost power——

Mr. RIVA. Right.

Senator FLAKE. ——on the Eastern grid to Arizona and we talked about how that could be used in terms of pumping—the biggest, single water user in Arizona is the Central Arizona Project—to pump water. If that can be done in times when intermittent power is cheaper, then it certainly helps out.

Mr. RIVA. Right.

Senator FLAKE. Mr. Buschatzke, we have talked a lot about the Colorado River with regard to storage, water banking, and wheeling, but one thing we really haven't talked about is surface water in Arizona and how that is utilized.

Talk for a minute about the importance of Arizona's own watershed, our Northern forests, for example, and how we can better utilize or make sure that we're taking full advantage of every drop of rain that falls in Arizona, not necessarily in the Upper Basin, that flows into the Colorado River. How important is that to Arizona's water future and what do we need to do?

Mr. BUSCHATZKE. So, Senator Flake, our in-state supplies are critical. Out of our seven-million-acre-foot water budget, about 17 percent of that comes from the Salt, Verde and Gila Rivers. On the Salt and Gila Rivers, or the Salt River itself, Roosevelt Dam is the main reservoir there. It has flood control capacity dedicated to it.

Again, if we could use that flood control capacity to store water in the summertime when it's very unlikely that we're going to get any kind of major runoff events and we can increase the yield out of the Salt River by, as I mentioned earlier, about 70,000 acre-feet, on average. It's highly variable, but we need to maximize every drop of water that we have from our in-state sources.

Senator FLAKE. A healthy forest with fewer trees, less choked, that is a better system to have, certainly, than what we experience now in the Ponderosa Pine forest.

Is that true and how important is it to manage our forests? There are a lot of benefits, obviously, economic and otherwise, but in terms of water, is there an imperative to better manage our forests?

Mr. BUSCHATZKE. Senator Flake, absolutely.

We estimate that in pre-settlement days there were less than 50 trees per acre. That has grown now to over 1,000 trees per acre.

So using a lot more water, also——

Senator FLAKE. Kind of like straws underground, isn't it?

Mr. BUSCHATZKE. Right, also creating a lot of fire danger. We've had an increase in the number of acres burned over the last several decades from about 85,000 acres in the '80s to over two million acres in the 2000s. Again, choking the runoff and the sediment that comes after those fires, reducing our reservoir capacity, causing issues there. So the health of the forest is key.

We do have a four forest restoration project underway. What we've seen is that we need to find ways to incentivize private industry to come in so that they can take advantage of those wood products. So the restoration that's been underway so far has, kind of, been hampered by the fact that we can't create these industries to actually come in and use the wood products, and the cost of just doing the thinning without being able to market the wood products is prohibitive. We need to get private industry in there.

Senator FLAKE. Well, great.

We talk a lot in this full Committee on these issues of forest restoration. I just wanted to bring it back to the importance for water as well because that is not talked about as much.

Senator King.

Senator KING. First, I want to ask each of you as you leave here—everybody always leaves a situation like this and says, I

wish I had said this, or I wish I had made this recommendation—what can we do in federal policy to help in the areas that you are working on, whether it is tax policy, incentives or regulation? Because that is our business here, making laws, and to the extent you can provide some backup thoughts or white paper explanation, that would be very helpful.

Mr. Riva, on desalinization, obviously huge potential. I mean, gigantic oceans. What is the cost of a gallon of desalinized water created by desalinization versus a gallon of water that comes through a public water supply from traditional sources?

Mr. RIVA. I think it's fair to say that it's more expensive than existing water supply because it's a new water supply.

Senator KING. My question is how much more expensive is it? Twice as much? Three times as much? Four? Five?

Mr. RIVA. It depends on the system but it could be on the order of twice as much.

Senator KING. Okay.

Mr. RIVA. But I think the reason for that is that the existing supplies have basically committed all of the existing inexpensive water.

Senator KING. Right.

Mr. RIVA. And so then you're left with what——

Senator KING. It is hard to beat free. It comes out of the sky.

Mr. RIVA. Well, that's right or it's in a pond that requires minimal treatment or groundwater, but, and if that's available to you freely then I think any community is going to go to that.

But it's where you get beyond that, whether because those supplies are diminishing or there are restrictions on them or because there's growth, population and the like, and conservation is, obviously, a critical part of that.

But I think that for a healthy system that's resilient to the type of events of climate and the like, that Senator Franken was talking about, you need a diversified supply system. To me, resilience equals diversification, and I think desal is an important part, piece of that. It's not the silver bullet.

Senator KING. And will likely become more so as population pressure increases.

Mr. RIVA. Right.

Senator KING. And the amount of fresh water remains constant.

But that raises a question. I am not quite sure who to address this to, maybe you, Mr. Buschatzke, is the issue of cost.

I have a friend who is a car dealer and he tells me that you can graph to a precision—when gas prices go down he sells more trucks. When gas prices go up, he sells more Priuses. I mean, it is very clear.

We haven't really talked about cost. To the extent that there is going to be conservation technology invested in reuse, all of those things, don't those go back to what the cost of the commodity is, and people will conserve more if it is more expensive, and there will be more creativity in terms of results?

My friend from GE, you are nodding. Is that an accurate perception?

Mr. MARKHOFF. Yeah, I would definitely agree with that point, Senator King.

Senator KING. If gasoline were $.20 a gallon we would all be driving Humvees or something.

Mr. MARKHOFF. Well, you see that in the Middle East where they drive big cars, but it is clearly, and we see that where they perceive or where the price of water reflects more the real value of water, that's where you have more conservation activities and that's where you have more new technology being applied to be able to reuse water and provide a different and broader mix of water sources, you know, to address future needs. So I think you're absolutely right there.

Senator KING. Well, as demand increases and supplies either stay constant or dwindle, that is going to be a logical outcome, it would seem to me, just in terms of the market. And then, we will see more developments in terms of conservation.

I am not advocating higher prices for water, but it seems to me that is an inevitability as we go to different technologies, whether it is filters or desalinization or reuse or dual systems within cities for drinkable water versus water use for other purposes.

Ms. Zane.

Ms. ZANE. Yeah, I want to get back to investing in technology too, because we've got to understand what the weather is going to do if we're going to save water and conserve water, that so——

Senator KING. I was going to ask you—would more storage be a partial answer here from when you have these storms so you can buffer the effect of the flood and also store the water for when it is dry?

Ms. ZANE. I don't think so. I think the storage has to be in the ground at this point. You know, California is the last state in the Western states to have any type of regulation in terms of groundwater and we're just beginning to kick that off now.

But I think the answer is that we need to find better innovative ways of storing our water in the ground and at the same time, maximizing the reservoirs.

You asked what we would like to share with you. We would like to work with you to include projects like ours that do involve the Corps and, kind of, emphasize that those projects need to be implemented or initiated by the local water sponsors only because I did a little research and found out that the Corps operates projects in all of your states.

And so, we'd like to be able to be included in some of the legislation that Senators Flake, Risch and Feinstein have authored, which we really appreciate that legislation.

So it's, again, I just want to stress technology and better science. I think we would have saved this country billions of dollars in emergency mitigation funds if we could figure out the technology and the forecasting.

Senator FLAKE. Thank you all for your testimony. We have just a couple of minutes left in the vote that Senator King and I have to run to.

We have certainly had scheduling issues to get this hearing to come off. We are pleased that we were able to do so today.

I want to thank the witnesses for the testimony. We really touched on some helpful issues here.

Last Congress we were able to put together a drought bill that addressed many of the needs that we have, and I think between that bill and the testimony that we have heard today, we will have the material to put together another water supply and drought bill that deals with a lot of the issues that we touched on today.

For the information of members, questions must be submitted for the record before the close of business on Thursday. The record will remain open for two weeks. We ask the witnesses to respond promptly, if possible, and your responses will be made part of the record.

With the thanks of the Committee, this hearing stands adjourned.

[Whereupon, at 11:14 a.m. the hearing was adjourned.]

APPENDIX MATERIAL SUBMITTED

BOARD OF SUPERVISORS
575 ADMINISTRATION DRIVE, RM. 100A
SANTA ROSA, CALIFORNIA 95403
(707) 565-2241
FAX (707) 565-3778

SHIRLEE ZANE
Supervisor, Third District

U.S. Senate Committee on Energy and Natural Resources
Subcommittee on Water & Power

Oversight Hearing:
Increasing Water Security and Drought Preparedness through Infrastructure, Management and Innovation

August 2, 2017

Questions for the Record Submitted to Director Shirlee Zane

From Subcommittee Chairman Jeff Flake:

Question 1: In your testimony you mentioned a diverse portfolio of water supplies for Sonoma County Water Agency, including surface storage, ground water and recycled water. Can you explain how this diversity helps the Water Agency meet its customer's needs and the importance of having all of these asset types in your portfolio, along with how additional water temporarily stored as a result of the forecast informed operation of your reservoir help boost the available water supply and resilience of your system as a whole?

> *Diverse supplies of water allow Sonoma County Water Agency to be resilient in the face of extreme weather events. This past year, when our County had both a drought and flood stage emergency in effect, the diversity of our water portfolio allowed us to draw upon different sources at different times and afforded us flexibility as we worked to meet our customers' needs. Our Agency works collaboratively with state and federal agencies to continually provide the most robust water supply possible. Additional stored water allows us to better survive a prolonged drought when no significant precipitation is in the forecast, and means that we do not need to curtail water deliveries to our customers. These water supply goals precipitated our efforts on the Forecast Informed Reservoir Operations project.*

Question 2: As we work to get you the flexibility you need related to updating of Water Control Manuals and Rule Curves, there is some discussion about how to ensure this is a helpful tool rather than a disruptive one. Can you explain Sonoma County Water Agency

views on who should be responsible for requesting flood control manual updates, who should contribute funds, and how the consultation process should work?

> *The option to review and update rule curves should be an opt-in program. In our opinion, it makes sense to allow the non-federal sponsor to request an updated rule curve when done in collaboration with the Corps or other appropriate Federal agencies. Funding should come from both the project sponsor and the Federal agency overseeing the rule curve revision. The consultation process should be led by both the federal and non-federal sponsor of the facility.*

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Question from Senator Joe Manchin III

Question: Several successful watershed improvement projects have occurred in West Virginia the last few years. The West Virginia Watershed Network is a group of state and federal agencies, as well as nonprofit groups, committed to providing resources for watershed management in West Virginia. Other non-profit organizations that have done great work include the Nature Conservancy, the Conservation Fund, the West Virginia Land Trust, among others. These organizations have done great work to improve water quality all over West Virginia. Last month, the West Virginia Conservation Agency announced it will begin work on an $8 million rehabilitation of the Upper Deckers Creek No. 1 dam in Preston County. The update to this nearly 50 year old dam project will ensure safety and also ensure drinking water needs are met for the surrounding areas. The majority of the funding for this project comes from the 2014 farm bill. The state of West Virginia will pick up 35% of the cost, approximately $2 million dollars. In West Virginia there are 170 small watershed flood-control dams and many which have been designated as high hazard and need work like the Upper Deckers Creek No. 1 dam.

Do you have any specific recommendations for this committee on how to increase watershed improvement restoration efforts?

Answer: Management of water quality in a diverse geographic, social and economic area requires a coordinated regional effort to unify the many different and highly fragmented management efforts in watersheds. Effective management should reflect regional planning goals concerning economic development, maintenance of high water quality, demographics, development and (re)development, and the needs of various voices across multiple groups.

The most economical and environmentally effective management strategy for watershed protection is to prioritize the protection of forests and riparian zones. This is the first line of defense to keep polluted runoff out of waterways, and much less costly than cleaning up rivers, lakes and impoundments or treating polluted water at a wastewater treatment plant.

The rehabilitation of the numerous small watershed flood-control dams in West Virginia reflects the need to consider all of the components mentioned above, including the priorities placed on these small dams by the local communities they are in. They have become a part of the local fabric of communities in West Virginia, and local priorities deserve an equal consideration in how the dams are managed.

Recommendations on how the Federal government can help:

- **Provide states incentives for holistic watershed planning** that consider water quality, water supply, flood hazard mitigation, aquatic and riparian habitat protection and restoration, and recreation;

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- **Require coordination as a pre-requisite for Federal financing** – require municipal and county elected and appointed officials, regional leaders in the private sector, academia, environmental organizations, and NGOS to have a unified vision and implementation strategy for watershed management;

- **Prioritize targeted land conservation/protection** to add resiliency of watersheds to protect water quality and to mitigate flood hazards for the lowest cost;

- **Promote broad nationwide, statewide and local education efforts** about why it is important to think at a watershed scale;

- **Provide state and local incentives and financing options** to plan water infrastructure (including nature based solutions like conservation of land and green infrastructure) ***in coordination with r***egional transportation plans, land use, and economic development and re-development;

- **Target the use of Section 319 Nonpoint Source Management Program** that are administered through the states to allow innovation and experimentation to advance the use of green infrastructure to manage stormwater;

- **Provide Federal incentives such as matching funds** to local and regional entities that enact stormwater financing programs (such as stormwater utilities) that include the use of green infrastructure and BMPs.

Background:

Managing water resources at the watershed scale, while difficult, offers the potential of balancing the many, sometimes competing, demands we place on water resources. The watershed approach acknowledges linkages between upland and downstream areas, and between surface and ground water, and reduces the chances that attempts to solve problems in one realm will cause problems in others[1].

Federal programs such as the Natural Resources Conservation Service through the US Department of Agriculture helps local communities through its voluntary Conservation Technical Assistance Program[2] to understand the many levels of watershed collaboration that are

[1] 6 Water Quality Improvement: Institutional and Financial Solutions." National Research Council. 2005. Regional Cooperation for Water Quality Improvement in Southwestern Pennsylvania. Washington, DC: The National Academies Press. doi: 10.17226/11196.
[2] One-on-one help through flexible, voluntary programs occurs every day in local NRCS offices across the country.

important to consider at the local level, including the importance to consider long-tern sustainability as lands are converted from rural to suburban and urban areas.

One of the most pressing urbanization problem in watersheds is stormwater runoff that is exacerbated by increased impervious surfaces as a result of development, and the loss of natural infrastructure like forests, riparian buffers, and wetlands. Financing the management of stormwater programs is an evolving field, and many communities have enacted local or regional stormwater enterprise funds, mostly as stormwater utilities. One of the regional leaders is the Chesapeake Bay area where, although land for conservation is scarce, many innovative financing methods are being tried to advance the use of built green infrastructure and to conserve coastal wetland areas.

There are many efforts within and beyond the metro areas that share common factors of success even without the advantage of innovation in regional organization. Collaboration, pursuit of more integrated environmental and economic benefits and multi-organizational involvement are key elements which can be fostered (or frustrated) by institutional policies. The World Resources Institute and the American Farmland Trust developed lessons learned from six water quality success stories and highlights key factors that allowed programs to achieve desirable environmental outcomes. **Water Quality Targeting Success Stories** concludes with recommendations for both public and private sectors to help other projects achieve and measure landscape-scale environmental outcomes. The report and its recommendations were developed based on literature reviews and interviews with USDA staff, farm conservation and water quality experts, and leaders of the six projects. Many other sources including the U.S. Environmental Protection Agency's Office of Water and Watersheds cite the similar lessons.

Watershed Improvement Funding Sources:

Financing watershed protection, coordination, collaboration and management requires communities to be familiar with a host of Federal, state and local financing sources and options. Many of the federal and state programs and financing options make efforts to integrate watershed level goals. Communities also have access to many technical assistance providers to help them maximize their efforts. There are 10 EPA Environmental Finance Centers that build local capacity to finance programs including stormwater management, climate resiliency and infrastructure financing, and 28 National Estuary Programs that focus on watershed / wetland management.

Some Federal and State Sources of financing:

U.S. Department of Agriculture Natural Resource Conservation Service –Conservation and innovative solutions to environmental challenges;

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U.S. Department of Agriculture Farm Services Agency – Farmland conversion and farm wetland restoration;

U.S. Army Corps of Engineers – Restoration and structural solutions;

U.S. Forest Service – Sustainability of non-industrial forests;

U.S. EPA – BMP Implementation and innovative approaches to reduce water pollution;

State SRF and Section 319 funds – NPS pollution control programs and low interest loans;

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Question from Senator Angus S. King. Jr.

Question: In your testimony, you helpfully mentioned that the cost of green infrastructure and conservation efforts are much more affordable than building water treatment plants.

To follow up on that testimony, can you detail the federal laws, programs, regulations or incentives that can assist the construction of water treatment plants or facilities, and compare them to any laws, programs, regulations or incentives that are out there for green infrastructure purposes for the purpose of protecting or cleaning watersheds and water sources?

Answer:

In my testimony I talked specifically about drinking water treatment plants, but the discussion below applies to other gray infrastructure as well, such as wastewater treatment and conveyance of non-point source pollution runoff (stormwater).

Available financing for green (nature based) solutions is far outweighed by financing for "proven" gray infrastructure solutions. However, communities large and small are increasingly willing to try natural and green infrastructure approaches as a compliment to gray water infrastructure. Cash-strapped communities pay attention to facts like while gray infrastructure depreciates, green infrastructure assets appreciate, have lower initial capital costs, lower long-term operations and maintenance costs, and provide social and health benefits. Many success stories and tools to measure green infrastructure performance all help communities trust and adopt the use of natural and built green infrastructure (bio-retention, raingardens, green roofs, and other Low impact Development and Best Management Practices).

The most economical and environmentally effective water infrastructure is our existing natural inventory of forests, riparian zones and wetlands. They should always be our first line of defense to keep effluents and polluted runoff out of waterways. Targeting natural areas to reduce drinking water contamination and for flood control is much more economical than building expensive solutions like water filtration plants, wastewater treatment plants, restoring or creating floodplains and wetlands, or building hard flood protection barriers.

The discussion of pre v. post-disaster sources of funding/financing is important. The protective benefits of natural infrastructure can be quantified by the "avoided costs" of the fixes that would need to be built in their absence. If the Federal and state governments adopt the principal that preventing a weather related disaster is more economical than post-disaster recovery, much more emphasis would be placed on promoting natural solutions that include land conservation and the use of built green infrastructure.

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Investments to conserve natural areas makes economic sense for investors and insurers of property. Natural barriers are less expensive than seawalls, conserving forests are less expensive than building drinking water filtration plants, and wetlands are less expensive than treatment facilities and holding tanks for stormwater.

There are public, private and increasingly, innovative public-private partnerships to finance water infrastructure. Many if not all Federal and state sources of financing designate some portion of their grants or loans for green solutions as well. However, financing for natural and built green infrastructure projects is still very limited compared to gray infrastructure projects.

Recommendations on how the Federal government can help:

- **Redirect post-disaster recovery funds to pre-disaster investments in risk reduction.** Flood risk reduction should be undertaken before the flood occurs, but we currently spend much more on recovery efforts than on risk reduction. The greatest opportunities to increase resources for risk reduction lie in combining funds for risk reduction with funds for flood recovery. ***Many of these pre-disaster investments should be in targeted natural infrastructure with more access to financing and incentives for innovative financing options.*** These investments will further reduce damages to lives, properties, and communities over time and provide a number of social and environmental benefits (Colgan et al);
- **Promote the use of recent financing innovations** such as catastrophe, resilience bonds, and green bonds that offer potential approaches to combining recovery and risk reduction, as well as incentivizing private participation where effective; (Highstead, 2017);
- **Increase New England's share of the two programs under the Natural Resource Conservation service: the Regional Conservation Partnership Program (RCPP) and the Conservation Innovation Grant (CIG).** New England states are poised to take advantage of the regional coordination that is already in place to protect connected land. New England has great capacity for regional collaboration and could look to these two federal programs in the future to slow the loss of forest and agriculture land critical to the region's economy and way of life (Highstead, 2017);
    - The **RCPP** invests in innovative regional conservation partnerships across the US. Since its inception in 2014 the RCPP has invested $787 million in 286 conservation partnerships, only 7% ($58 million) of which has funded work on a total of 23 projects in New England. Thirty-five percent of the program's funding ($278 million) has been reserved for eight specific regions designated as 'Critical

Conservation Areas.' **At this time New England does not have such a designation**, which limits its access to funds;

- The **CIG** program, which was established in 2002 to drive public and private sector innovation in conservation, has funded more than 700 projects for a total of $264 million since 2004. **Over this time New England only received $7.6 million, or 3%, of these funds** to support a total of 28 projects. Since 2016, approximately 30% of CIG awards have been set aside to invest in public-private partnerships that offer innovative pay-for-success and private investment-based conservation outcomes. These investments utilize markets for environmental services such as carbon sequestration and water purification to leverage small public investments in order to catalyze much larger private investments. These venture capital-like set-ups offer key opportunities for innovative conservation financing across New England in the future.

- **Safeguard the Federal and stateside Land and Conservation Fund (LWCF)**. LWCF is the primary vehicle for federal conservation funding. Despite the pivotal role it plays in funding conservation throughout the United States, the LWCF was allowed to expire for the first time in its fifty-year history in the fall of 2015.The fund was reauthorized in December 2015 for a period of three years. Total estimated funding available to New England as of 2014 had declined approximately 48% from a peak in 2008. The **Forest Legacy Program** falls under the umbrella of the LWCF and a substantial portion of the overall federal contribution to conservation spending in New England comes from this program, which specifically supports the conservation of forested land through acquisition and easements (Highstead, 2017);
- **Increase incentives in the well capitalized State Revolving Funds** to finance nature based solutions and green infrastructure, and increase the DWSRF source water protection land acquisition program;
- **Increase incentives in the WIFIA infrastructure financing program** to use natural and nature based infrastructure solutions;
- **Increase available WIFIA funds** to meet the needs of the infrastructure gap in the nation;
- **Adequately fund technical assistance providers** that increase local capacity to use the latest financing schemes and to diversify investment portfolios to meet the infrastructure needs of communities;

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- **Support financing innovation** in federal and state programs that provide financing for infrastructure, land conservation, climate related risk reduction and community resiliency.

Background: The two most critical environmental problems that communities need to manage in a changing climate are flood hazard risk reduction and maintaining and providing good quality and enough quantity of water. **Water quality** is a human health issue and the Federal and state governments are charged with providing safe potable drinking water and to maintain standards of water quality. **Flood damages** comprise by far the largest losses from natural hazards. Worldwide, from 1995-2015, floods accounted for 46% of all natural hazard costs; when storm related damage, which can also include flooding, is added in, the total rises to 71% of hazard costs (Colgan, C.S., M.W. Beck, S. Narayan, 2017). "More people live and work in coastal areas, increasing the absolute magnitude of properties and values at risk. The coastal regions where population is growing are highly dynamic in ways that increase flooding risks. Global sea levels have been rising for more than a century and the pace of sea level rise is increasing. Moreover, in many coastal areas the shoreline is eroding at a pace exacerbated by human intervention. The combination of rising sea levels and eroding shores are creating unprecedented risks." Sandy (Colgan, C.S., M.W. Beck, S. Narayan, 2017, Financing Natural Infrastructure for Coastal Flood Damage Reduction).

Pre-Disaster v. Post-disaster funding

There is a large difference between funds available after a disaster and funds available before. In both the U.S. and Europe, post-disaster funds are generally special outlays from national budgets enacted on an event to event basis (Jackson, 2013). The terms and conditions of this assistance are usually set for the specific situation, and may or may not permit use of the funds for flood risk reduction. For example, the responses of the U.S. and state governments to the 2012 Hurricane Sandy disaster provided some flexibility for risk-reducing measures. The FEMA Hazard Mitigation Grants Program received about $1.86 billion in additional funding after Hurricane Katrina and $822 million after Hurricane Sandy (Colgan, et al).

The funding from these two U.S. disasters point to the large difference between funds available before and after a disaster. In these two cases, the Federal Government provided nearly $2.7 billion in funding for risk reduction, most of it in six states (New York, New Jersey, and Connecticut for Sandy; Louisiana, Mississippi, and Alabama for Katrina). In contrast, the FEMA hazard mitigation program had $90 million available for one year, which represented the total funding in that program for the entire United States.

The recent extreme flood event in Houston hasn't been assessed for damages, but is expected to be on the level of Hurricanes Sandy and Katrina. The flooding was exacerbated by the miles of impervious surface area in metropolitan Houston. Post-disaster relief from FEMA will look

much like it did for other extreme floods, with Millions if not Billions of tax-payer dollars flowing into the area after-the-fact to clean up and rebuild the city and its surrounding area.

Will the post-disaster actions in the Houston area be willing to incorporate the best knowledge we have about the economic and environmental and social benefits of investing in natural infrastructure? Probably not. The following is an excerpt from Financing Natural Infrastructure for Coastal Flood Damage Reduction). Post-disaster spending on natural infrastructure have two sources of anti-resilience bias built in. The first is budgetary pressure. Incorporating risk-reducing actions in recovery funding raises the size (and cost) of catastrophe bonds, traditional insurance, and public post-disaster funding. When public funds are appropriated for disaster relief the pressure on government budgets may encourage focusing resources only on recovery. This bias could be reduced if governments budget for disasters over longer terms would consider the likely costs of multiple disasters. Such viewpoints would encourage investment in cost-effective risk reduction measures.

The second source of the anti-resilience bias is that, following a disaster, all organizations want to repair the damage and put things back "as they were" quickly. This is a general problem in supporting rebuilding in the same high-risk areas and following the same approaches. Environmental reviews of structure repairs may be expedited to meet these demands for a quick recovery. Further use of new approaches such as building natural infrastructure projects may be difficult under these time constraints. There are two means of addressing this bias. One is to gain experience with natural infrastructure so that its impacts can be evaluated more quickly. This need for experience has been emphasized by a number of studies (Huwyler et al., 2014; Gremli et al., 2014). Another is for jurisdictions intending to rely on post-disaster funding to support risk-reducing projects to design, evaluate, and perhaps "pre-permit" specific actions so that they can be implemented quickly as part of the "recovery to pre-disaster" process.

The FEMA Community Rating System (CRS) provides discounts on insurance premiums on properties insured by the National Flood Insurance Programs (NFIP) in communities that take some combination of risk-reducing actions specified by FEMA. The discounts range from 5% to 45% depending on which combination of eighteen specified actions are implemented by the community. The actions are assigned points, with the highest points awarded for construction of flood barriers and for adoption of local policies encouraging retreat from the flood zone. Using natural areas and open space for reducing flood risks are relatively high-scoring actions. Only about 5% of the communities covered by the NFIP participate in CRS maybe because it requires public actions (with sometimes high transaction costs) in order to create private benefits for property owners. Under the right circumstances, the premium savings capitalized as a funding stream for a green bond could fund a natural infrastructure project (Colgan, et al).

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Water Infrastructure Financing Sources:

Funding for specific purposes such as natural infrastructure for flood control is a byproduct of other purposes in the U.S., but recognized as a specific purpose in Europe and by development organizations. Funds available to communities may be from many and diverse Federal or state programs. This siloed nature of available funding makes it difficult for many smaller or economically disadvantaged communities to take full advantage of available funds, and when they need financing assistance they usually do what they are familiar with: float municipal bonds to fund "safe" gray infrastructure solutions for their water management problems, losing the advantages and future savings and safety of hybrid new approaches.

Below is a list of just some of the Federal and state loan and grant programs that communities can tap into for water infrastructure (both gray and green) and for land conservation (natural infrastructure) programs. *The list clearly demonstrates the complexity that especially smaller communities face when trying to determine the most effective action for the least amount of debt now and for the future.* Communities also have access to many technical assistance providers to help them maximize their efforts. There are 10 EPA Environmental Finance Centers that build local capacity to finance programs including stormwater management, climate resiliency and infrastructure financing, and 28 National Estuary Programs that focus on watershed / wetland management.

Gray and Green Infrastructure Financing (drinking water, wastewater, stormwater and for flood control):

US EPA:
Drinking Water State Revolving Fund (DWSRF) and the Clean Water State Revolving Fund (CWSRF), have the potential to support mitigation or post-disaster recovery and rebuilding projects. The low-interest loans mostly go to support gray infrastructure projects but acquiring property is allowed if it is integral to the project. The CWSRF has a land acquisition program to protect source waters. Cannot be used for O&M;
Water Infrastructure Finance and Innovation Act (WIFIA): Separate, but in coordination with SRF programs. Provides subsidized financing for large-dollar value projects. Just like the SRF program, WIFIA mostly provides low-interest loans for gray infrastructure but will allow acquisition of property if it is integral to the project or will mitigate the environmental impact of a project;

FEMA
Public Assistance Grant Program: AFTER Presidentially-Declared Disaster, and
***Pre-Disaster Mitigation grant Program*:** For areas covered by the National Flood Insurance Program. Funding levels for these programs can be volatile from year to year. For example, the funding for the FEMA Pre-Disaster grant program in 2016 was $90 million, a significant increase from previous years;

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USDA
Rural Development and Emergency Community water Assistance Grants: For rural communities that have significant declines in quantity or quality of drinking water due to an emergency.

HUD CDBG and Section 108 Guaranteed Loans - For entitlement communities;

SBA Disaster Loans - For small businesses and private non-profits after disasters;

U.S. Army Corps of Engineers - Mostly responsible for engineered structures for coastal protection. State and local governments sometimes contribute to funding, in some cases because of budget constraints and in others because of limitations on the eligible uses of Army Corps funds;

State and local levels: governments typically use muni bonds to finance infrastructure projects; **State Infrasrtucture Banks**: (Currently 32 IBs exist in the US). Most can provide a flexible vehicle that combines public and private funds for infrastructure projects. A proposal has been made for a federal infrastructure bank, but it has not advanced beyond the proposal stage (Congressional Budget Office, 2012);

Environmental Impact Bonds (EIBs) are promising green infrastructure investment strategies that use the "pay-for-success" model. EIBs use performance-based contracting between a public entity and the private sector where payment is based on measured outcomes;

Natural Infrastructure (Conservation) Financing Options:

Two **Natural Resource Conservation Service (NRCS)** programs authorized by the 2008 Farm Bill—the **Regional Conservation Partnership Program (RCPP)** and the **Conservation Innovation Grants (CIG)** are ideal for leveraging public and private investment and building multi-state conservation collaborations across New England (Highstead, 2017 The Role of NRCS Funding in Forwarding New England's Conservation Vision).

The CIG program: New England only received $7.6 million, or 3%, of these funds;
The RCPP program: New England only received $58 million, or 7%, of these funds. Thirty-five percent of the program's funding ($278 million) has been reserved for eight specific regions designated as 'Critical Conservation Areas.' At this time New England does not have such a designation, which limits its access to funds.

Using federal-level and state-level public conservation funding data, the total estimated funding available to New England as of 2014 had declined approximately 48% from a peak in 2008 (Highstead, 2017).

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Question from Senator Al Franken

Question: How can green infrastructure (in particular wetlands) be beneficial in light of climate change?

Answer: Wetlands are like sponges that absorb, retain and treat rainfall & runoff. They are the natural storage tanks that double as waste and chemical treatment plant. With increased extreme weather events and the steady rise in sea levels, wetlands will play an ever increasing critical role in protecting coastal communities from flooding and for providing habitat and other community benefits.

The most economical and environmentally effective flood control mechanism we have is our existing natural inventory of forests, riparian zones and wetlands. Targeting critical wetlands for flood control is much more economical than building hard flood protection barriers (such as seawalls) or restoring wetlands after they've been destroyed.

The discussion of pre v. post-disaster sources of funding/financing is important. The protective benefits of natural infrastructure including wetlands can be quantified by the "avoided costs" of the fixes that would need to be built in their absence. If the Federal and state governments adopt the principal that preventing a weather related disaster is more economical than post-disaster recovery, much more emphasis would be place on promoting natural solutions that include wetland conservation and the use of nature based solutions.

Recommendations on how the Federal government can help:

- **Fund the North America Wetlands Conservation Act .** This federal funding stream for land conservation coordinated by the U.S. Fish & Wildlife Service depends on Congressional appropriations and well as some revenue from fines, excise taxes, and interest;
- **Fund New England states with the Coastal and Estuarine Land Conservation Program** (administered by NOAA). This program provides matching funds to state and local governments to protect lands of coastal conservation value by acquisition or easement. Every New England state except Vermont received CELCP in the past, although none received any funding after 2010;
- **Require states to enforce legislation, policies, and programs**. Wetlands will not be protected if the regulations are not enforced. ***Perhaps the best way to protect wetlands is to educate the public of their benefits.*** If the public does not recognize the benefits of wetland preservation, wetlands will not be preserved. Protection can be accomplished

only through the cooperative efforts of citizens. (USGS https://water.usgs.gov/nwsum/WSP2425/legislation.html

- **Redirect post-disaster recovery funds to pre-disaster investments in risk reduction.** Flood risk reduction should be undertaken before the flood occurs, but we currently spend much more on recovery efforts than on risk reduction. The greatest opportunities to increase resources for risk reduction lie in combining funds for risk reduction with funds for flood recovery. ***Many of these pre-disaster investments should be in targeted natural infrastructure (including wetlands) with more access to financing and incentives for innovative financing options.*** These investments will further reduce damages to lives, properties, and communities over time and provide a number of social and environmental benefits (Colgan et al);
- **Promote the use of recent financing innovations** such as catastrophe, resilience bonds, and green bonds that offer potential approaches to combining recovery and risk reduction, as well as incentivizing private participation where effective; (Highstead, 2017);
- **Increase New England's share of the two programs under the Natural Resource Conservation service: the Regional Conservation Partnership Program and the Conservation Innovation Grant.** New England states are poised to take advantage of the regional coordination that is already in place to protect connected land. New England has great capacity for regional collaboration and could look to these two federal programs in the future to slow the loss of forest and agriculture land critical to the region's economy and way of life (Highstead, 2017);
    - The **RCPP** invests in innovative regional conservation partnerships across the US. Since its inception in 2014 the RCPP has invested $787 million in 286 conservation partnerships, only 7% ($58 million) of which has funded work on a total of 23 projects in New England. Thirty-five percent of the program's funding ($278 million) has been reserved for eight specific regions designated as 'Critical Conservation Areas.' **At this time New England does not have such a designation**, which limits its access to funds;
    - The **CIG** program, which was established in 2002 to drive public and private sector innovation in conservation, has funded more than 700 projects for a total of $264 million since 2004. **Over this time New England only received $7.6 million, or 3%, of these funds** to support a total of 28 projects. Since 2016, approximately 30% of CIG awards have been set aside to invest in public-private partnerships that offer innovative pay-for-success and private investment-based

conservation outcomes. These investments utilize markets for environmental services such as carbon sequestration and water purification to leverage small public investments in order to catalyze much larger private investments. These venture capital-like set-ups offer key opportunities for innovative conservation financing across New England in the future.

Background: Despite their environmental and economic importance, coastal wetlands in the eastern United States are being lost at twice the rate they are being restored[3]. More focused protection strategies are required to reverse this trend. Rising sea levels and increased severe storms raise the need for protections that are most often responded to by shoreline hardening of coastal properties. Hard barriers to keep out flooding and to control erosion reduce habitat value and the scope of wetland migration. Coastal habitats provide flood protection, erosion control, provide wildlife food and habitat, are nurseries for fisheries that support commercial fishing, maintain water quality by filtering runoff chemicals, provide recreation and sequester carbon.

Heavy development pressure in most coastal areas restricts the ability of wetlands to naturally migrate inward. Shorelines are often stabilized with hardened structures, such as bulkheads, revetment, and concrete seawalls. Ironically, these structures often increase the rate of coastal erosion, remove the ability of the shoreline to carry out natural processes, and provide little habitat for estuarine species. One response from coastal wetland managers is to promote "living shorelines" which consciously integrate the use of living organisms such as plants, oysters, sea grass, salt marsh plants, and rocks to protect eroding shorelines. An example of this is the Casco Bay Estuary Partnership's work with the Maine Coastal Program and other partners to facilitate environmentally preferable strategies to protect eroding shorelines in Maine…by developing living shoreline technologies that work in Maine. (Casco Bay Estuary Partnership http://www.cascobayestuary.org/wp-content/uploads/2017/08/Climate-Change-Summary-Report-final-8-4-17.pdf)

In the coastal watersheds of the Atlantic, Pacific, the Gulf of Mexico and the Great Lakes, wetlands were lost at an average rate of about 80,000 acres per year between 2004 and 2009. (US EPA https://www.epa.gov/wetlands/coastal-wetlands).

(The following text is largely taken from a US Geologic Survey report).

The people of the United States have begun to recognize that wetlands have numerous and widespread benefits. However, many of the goods and services wetlands provide have little or no market value. Because of this, the benefits produced by wetlands accrue primarily to the general public. Therefore, the Government provides incentives and regulates and manages wetland resources to protect the resources from degradation and destruction.

[3] https://www.epa.gov/wetlands/coastal-wetlands

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Section 404 of the **Clean Water Act** is the primary vehicle for Federal regulation of some of the activities that occur in wetlands. Other programs, such as the "Swampbuster" program and the Coastal Management and Coastal Barriers Resources Acts, provide additional protection. Coastal wetlands generally benefit most from the current network of statutes and regulations. Inland wetlands are more vulnerable than coastal wetlands to degradation or loss because current statutes and policies provide them less comprehensive protection[4].

Other mechanisms for wetland protection include acquisition, planning, mitigation, disincentives for conversion of wetlands to other land uses, technical assistance, education, and research. Communities face a complex mix of federal, state and local regulations and many rely on contractors to know the rules as development occurs. Federal programs have fractured authority over wetland management, which adds to local confusion about what applies in specific circumstances.

Although many States have their own wetland regulations, the Federal Government plays a major role in regulating wetlands. The five Federal agencies that share responsibility for protecting wetlands include: The Department of Defense, U.S. Army Corps of Engineers (Corps); the U.S. Environmental Protection Agency (EPA); the Department of the Interior, U.S. Fish and Wildlife Service (FWS); the Department of Commerce, National Oceanic and Atmospheric Administration (NOAA); and the Department of Agriculture, Natural Resources Conservation Service (NRCS) (formerly the Soil Conservation Service). ***Each of these agencies has a different mission that is reflected in the implementation of the agency's authority for wetland protection.*** The Corps' duties are related to navigation and water supply. The EPA's authorities are related to protecting wetlands primarily for their contributions to the chemical, physical, and biological integrity of the Nation's waters. The FWS's authorities are related to managing fish and wildlife-game species and threatened and endangered species. Wetland authority of NOAA lies in its charge to manage the Nation's coastal resources. The NRCS focuses on wetlands affected by agricultural activities.

Despite the current recognition of wetland benefits, many potentially conflicting interests still exist, such as that between the interests of landowners and the general public and between developers and conservationists. Belated recognition of wetland benefits and ***disagreement on how to protect them has led to discrepancies in local, State, and Federal guidelines***[5]. Conflicting interests are the source of much tension and controversy in current wetland protection policy.

Below is a list of just some of the Federal and state loan and grant programs that communities can tap into for wetland protection programs. *The list clearly demonstrates the complexity that*

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[4] https://water.usgs.gov/nwsum/WSP2425/legislation.html
[5] https://water.usgs.gov/nwsum/WSP2425/legislation.html

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especially smaller communities face when trying to determine the most effective action for the least amount of debt now and for the future. Communities have access to many technical assistance providers to help them maximize their efforts. There are 10 EPA Environmental Finance Centers that build local capacity to finance programs including stormwater management, climate resiliency and infrastructure financing, and 28 National Estuary Programs that focus on watershed / wetland management.

Wetland Protection Financing Sources:

Agricultural Conservation Easement Program, Wetland Reserve Easements
With the authorization of the 2014 Farm Bill, Wetlands Reserve Easements replaced the Wetland Reserve Program (WRP). Similar to WRP, Wetland Reserve Easements are designed to provide a financial incentive to private landowners to encourage the restoration of wetlands previously degraded and/or drained. The WRP and Wetland Reserve Easements has been a very popular program. It has enrolled approximately 2.6 million acres since the inception of WRP in 1990.

EPA provides several funding sources that can be used to support state and tribal programs, as well as restoration.

1. Wetland Program Development Grants
2. 5 Star Restoration Program
3. State Revolving Fund (SRF) and Wetlands
4. Other Wetland Grant Information
5. Catalog of Federal Funding Sources for Watershed Protection
6. CWA 106 Program
7. CWA 319 program
8. Indian Environmental General Assistance Program (GAP) funds

Natural Resources Conservation Service – Important program especially in the agricultural and forestry setting.

There are also important programs that are unique in each state. In Maine for example, there are the Maine Natural Resource Conservation Program and the Land for Maine's Future that support protection of wetlands.

Local government officials, land trusts and state and local officials implement local government wetland protection programs. **Many wetlands, and in particular many isolated wetland in the United States are unprotected unless states and local governments adopt wetland**

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protection programs. Less than one half of the states have adopted effective wetland protection programs for freshwater wetlands[6]. Association of State Wetland Managers

For additional recommendations to protect wetlands see https://www.aswm.org/pdf_lib/aswm_priorities_for_state_wetland_programs_in_new_administration.pdf The Association of State Wetland Managers (ASWM) has forwarded a paper describing 'Priorities for State Wetland Programs in the New Administration' to U.S Environmental Protection Agency Administrator Scott Pruitt. The paper outlines six areas of importance to state wetland managers: 1) Supporting open communications between Federal and State Agencies, 2) Encouraging state assumption of the Clean Water Act Section 404 Permit Program, 3) Fully funding Clean Water act programs including Wetland Program Development Grants, 4)Offering technical support and training to state wetland programs to ensure compliance with state requirements, 5) providing accurate maps of the nation's aquatic resources and 6) leveraging opportunities to reduce pollution and natural hazards, protect drinking water and reduce costs through natural infrastructure solutions. Healthy wetlands are intrinsic to sustaining clean water for the Nation as a whole and the work of individual state wetland programs is essential to sustain these and other aquatic resources. ASWM hopes to work with the new administration, its federal agencies and many others to address the priorities described.

[6] https://www.aswm.org/pdf_lib/6_localgov_6_26_06.pdf

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Questions for the Record Submitted to Mr. Heiner Markhoff

Question from Senator Jeff Flake

Question: What is GE Water's experience with the importance of various state and local policies regarding water reuse, and what are some of key factors that in your experience encourage the development of recycled water programs?

GE Water & Process Technologies has a great deal of experience with state and local water recycling and reuse policies. We have written several white papers highlighting examples of federal, state, and local policies that promote greater recycling and reuse, including a white paper published in June 2015 entitled, "Addressing Water Scarcity through Recycling and Reuse: A Menu for Policy Makers." In addition, one of our executives serves on the WateReuse Association's Board of Directors, and is active in the association's policy efforts.

In our "Addressing Water Scarcity through Recycling and Reuse: A Menu for Policy Makers" white paper, we write that governments can do four main things to promote greater water recycling and reuse:

1. Education and Outreach
   - Recognition awards and certification programs
   - Information dissemination and educational outreach efforts
   - Reporting of water consumption, discharge, and reuse data
2. Removing Barriers
   - Modifying local regulations that require that all water meet potable standards
   - Revising plumbing codes to allow dual piping
   - Alleviating stringent permitting and inspection requirements for recycled water
3. Incentives
   - Direct subsidies
   - Reductions in payments to the government
   - Payments for reintroduction of recovered water
   - Pricing mechanisms
   - Regulatory relief for recycled water users
   - Government procurement of water recycling/reuse equipment
   - Structuring of water rights to reduce the use of potable water
4. Mandates and Regulation
   - Requiring utilities to develop plans for recycled water
   - Restricting potable water to human or food related uses
   - Requiring the use of recycled water for certain large volume activities, e.g., irrigation
   - Requiring water recovery systems

The above menu of policy options provides a valuable starting point for governments to evaluate the appropriate mix of policies that will best fit their needs. In some cases, providing information will be enough to spur action; while in other cases, providing financial incentives or implementing regulatory changes will be more effective.

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Questions from Senator Joe Manchin III

Questions: In your written statement, you highlight technologies being used at some coal-fired power plants to treat cooling tower wastewater. You note that translates to reuse of 95 to 98 percent of that wastewater within the cooling tower and the remainder then gets treated and complies with discharge limitations[1]. You also highlight the challenges that many of your power customers face in meeting effluent limitation guidelines or ELGs. When you scrub these plants to comply with air emissions regulations the pollutants that are removed can be discharged into wastewater streams and that needs to be treated so you have these technologies that can help do that and allow the water to be reused within the cooling tower unit. These technologies are showing that we can reuse water and get energy savings too.

What is your estimate on the number of coal plants across using your technology or similar technologies?

GE Water & Process Technologies, and its heritage businesses, pioneered zero liquid discharge (ZLD) technology in the early 1970s, initially for use in power plants along the Colorado River Basin. This prevented wastewater from being discharged to the waterways, and resulted in reuse of all the power plant waste streams. Since then, we have supplied almost 200 such systems globally for power, oil and gas, synthetic fuels, mining, chemical processing and oil refining customers. Of these 200 ZLD systems, 70 of them were supplied to process power plant wastewater, and 12 were designed specifically to treat Flue Gas Desulfurization (FGD) blowdown from coal-fired power plants.

The use of ZLD for treatment of wastewater at a power plant is not only beneficial for water reuse and discharge mitigation but is recognized as a Best Available Technology (BAT) for the treatment of FGD wastewater. Since ZLD technology eliminates all plant liquid discharge, it provides certainty that any future regulatory changes will not result in the need to further modify the facility's wastewater treatment plant. Also, the risk of exceeding discharge limits due to power plant upsets is eliminated since there are no wastewater discharge streams when using a ZLD system. Finally, this process provides significant environmental protections beyond those achieved by treat-and-discharge systems because ZLD technology not only removes toxic metals, but also other dissolved solids and salts that would otherwise add salinity to the waterways into which they would be discharged.

If ZLD is not required, which is the case for many coal-fired plants in the United States, GE also has an EPA recognized Best Available Technology treat-and-discharge process, known as ABMet[2], for treating FGD blowdown steams to meet the required ELG limits for contaminants such as selenium, nitrate, and mercury. This process uses physical-chemical treatment followed by biological treatment for contaminant removal.

Treat-and-discharge systems for processing FGD blowdown have the advantage, in most cases, of lower installed capital and operating costs as compared to ZLD systems. The advantages of using a ZLD system include reduced long-term risk, "future-proofing" the plant for potential increased regulatory restrictions of wastewater discharge and freshwater intake, elimination of the need to discharge wastewater, and elimination of the associated

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[1] Correction to our written testimony in recent refile: the remainder of the water is contained in the salt produced by the zero liquid discharge system.
2 Trademark of General Electric Company; may be registered in one or more countries.

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discharge permits. The decision of whether to utilize ZLD or treat-and-discharge technologies is made by the end-user on a case-by-case basis, depending on the economics and risk profiles of each facility.

What is the primary barrier to expanded use of this technology?

Zero liquid discharge (ZLD) technology is a proven, mature technology that was initially developed in the early 1970s by GE heritage businesses and has been technically and economically optimized over the past 40+ years. The technology has been successfully implemented in dozens of industries worldwide. Typically, use of ZLD technology is driven by the need for a high degree of wastewater reuse, limitations on freshwater use and restrictions on liquid discharge to local waterways. In most cases, the primary barrier to expanded use of ZLD technology is cost. In other words, ZLD technology is frequently more costly to implement than treat-and-discharge methods. Use of ZLD technology continues to expand as water scarcity continues to increase and regulatory requirements around discharge limitations and freshwater use become more restrictive. ZLD technology can, in some cases, produce solid products that have beneficial use.

POSEIDON WATER

August 29, 2017

Hon. Lisa Murkowski, Chairman
United States Senate
Committee on Energy & Natural Resources
304 Dirksen Senate Office Building
Washington, DC 20510

Hon. Maria Cantwell, Ranking Member
United States Senate
Committee on Energy & Natural Resources
304 Dirksen Senate Office Building
Washington, DC 20510

Re: Subcommittee on Water and Power:
Hearing on Increasing Water Security and Drought Preparedness
Through Infrastructure, Management and Innovation

Dear Chairman Murkowski and Senator Cantwell:

Thank you again for your invitation to present testimony at the August 2 hearing on the topic area referenced above. I am pleased to provide the following responses to two follow-up questions related to my testimony that were posed by Sen. Flake and Sen. Manchin. I would be happy to provide any further requested information as the Subcommittee continues its deliberations on these important matters.

Sincerely,

Carlos A. Riva
President & CEO
Poseidon Water LLC

Attachment

Chairman Murkowski and Sen. Cantwell, Senate E&NR Committee
Follow-up Question to August 2, 2017 Testimony – August 29, 2017

> **Question:** In addition to the use of public-private partnerships for things like seawater desalination, what other types of water infrastructure is Poseidon working with water providers to develop and what opportunities or challenges do you see for using this type of financing for more traditional water infrastructure like dams or pipelines?

Answer: Poseidon is a technology-neutral developer of a variety of types of water infrastructure projects primarily using the P3 model. Although my direct testimony highlighted our experience in developing the Carlsbad desalination facility, the company's resume of completed projects includes projects with many other types of technologies and design approaches, including a major wastewater treatment facility upgrade and a number of on-site industrial water purification and wastewater treatment facilities.

Within the past twelve months, Poseidon has investigated and, in certain instances, developed full proposals to address a broad range of P3 opportunities with public water agencies. These include the following types of projects:

- Conveyance systems (pipeline and/or canal)
- Large-scale wastewater treatment facilities
- Drinking water treatment facilities
- Indirect potable use (involving treatment and injection for aquifer recharge)
- Non-potable reuse ("purple pipe" systems suitable for, e.g., industrial, agriculture, golf courses)
- Flood diversion projects
- Private reservoir development (a non-P3 opportunity)

In principle, the P3 model is suitable for addressing a very broad range of water infrastructure needs. However, in my view, this model is most appropriate for projects that are larger-scale, technically complex, and/or that use new or unfamiliar technology. Projects with these characteristics are most likely to pose cost, schedule, completion and performance risk to public water agencies that face funding limitations, are not routinely in the business of developing projects and may be less familiar with state-of-the-art water technologies. Projects with such features are most likely to yield potential to create value by enabling water agencies to contractually lay off such risks to a third party development entity.

Conversely, the cost and complexity of forming a P3 agreement makes this approach less suitable for projects that are smaller or that use conventional technology. As noted in my testimony, these represent the great majority of projects for most water agencies.

In addition, one of the key factors in determining whether the P3 approach is viable is whether a project gives rise to a predictable revenue stream. Projection and collection of revenue streams is a somewhat more straightforward matter in the case of urban water supply projects where costs

can be spread over many ratepayers, leading to a limited rate impact. For other types of water projects, the economic benefits – although quite large – may be diffuse and, by nature, difficult to capture internally through user fees. For example, some of the most socially valuable water projects are those that provide a broad range of important regional services such as reduced flooding risk, ecological services, ecosystem restoration, reduced transportation delays, abundant but relatively lower-value agricultural water, and opportunities for new land uses. These important but relatively diffuse benefits can be difficult to capture through user fees and internalize in a project-based approach to financing the effort.

To narrow the financing gap and enable wider use of P3s, one possible approach entails the use of government funding for a portion of project costs related to these general public benefits. A P3 structure can then fund the remaining fraction of overall project costs, recovering them over time through rates, charges and other types of user fees.

Chairman Murkowski and Sen. Cantwell, Senate E&NR Committee
Follow-up Question to August 2, 2017 Testimony – August 29, 2017

Questions: Mr. Riva, in your testimony you spend a lot of time discussing P3s (or public-private partnerships) as a solution for funding the modernization of our nation's water infrastructure. You also note that the EPA's state revolving funds are heavily relied on in many communities across the country. I would note that SRFs are in fact vital to a state like West Virginia and we appreciate your comments. But I would also note that public-private partnerships are often poorly suited to rural America because the "private" part of the P3 framework is not always incentivized and attracted to investing in rural communities - particularly economically distressed communities.

Have you considered the unique challenges that rural communities faced with ongoing economic distress face when confronted with infrastructure modernization?

What are some of the other funding mechanisms that you think could work in these areas?

Answer: I certainly agree with the key premises of these questions. The SRFs are a vital tool to meet infrastructure needs in rural states, and there is naturally less incentive to form P3s to address needs in rural areas – and, in particular, in economically distressed communities. Many rural communities face acute needs for new water supply and/or treatment projects that are likely to have high capital costs relative to the population of the region, and a lack of affluence can compound the problem of establishing creditworthiness required to back a project finance approach. In such cases it may simply not be viable to base financing exclusively on water rates, sewer charges or other types of direct user fees. Using traditional direct government funding and public debt to finance such projects, though, can quickly exhaust borrowing capacity.

As indicated by my response to Senator Flake's question, one possible approach to bridging the financial gap in such situations could be to find some form of supplemental funding, including but not limited to sources such as the new WIFIA program that has been founded on the successful TIFIA template used to fund transportation projects, to offset the overall project cost to a level that can be supported by water rates. The co-funding of projects in this fashion would reduce the level of capital investment that must be recovered through any type of P3 arrangement. There exist many examples around the world of projects that are partially financed via the traditional method and partially financed through a P3. For example, this is the approach the US Army Corps of Engineers is currently taking to the Fargo-Moorhead Area Diversion Project, in which the financing plan calls for a combination of federal, state, local and P3 financing.

The P3 model is by no means a "one-size-fits-all" solution for all water infrastructure needs. Our nation faces a complex and costly challenge as we seek to bring water systems up to acceptable standards of service and environmental protection. We hope that the Congress will recognize and, through legislative reform, afford a broader scope for P3s to play a role in meeting this challenge. It is Poseidon's considered opinion that, by enabling wider use of this solution in a well-targeted way for some of our nation's most acute and costly needs, Congress and other key policymakers can bring a large amount of needed capital into the water sector. This infusion of

private capital dollars would have the effect of relieving pressure on conventional funding sources, and augmenting the reach of those limited funding sources, so that they can accommodate more projects that truly cannot proceed without direct government funding.

August 8, 2017

Chairman Flake and Ranking Member King,

Thank you for holding a hearing to examine increasing water security and drought preparedness through infrastructure, management and innovation. These are critically important issues for our organizations, whose millions of members and supporters represent the views of the nation's hunters, anglers, and conservationists.

While the current year has been unusually wet in parts of the West, one wet winter does not alter or solve the fundamental problem that demand for water in the Basin exceeds average supplies. Your leadership in recognizing that fluctuations in the weather do not substitute for putting systems in place that encourage conservation and flexible water management will make our water systems more resilient.

As you are aware, the Colorado River provides critical water supplies for cities, irrigated farmland, and tribes throughout the seven basin states. More than 35 million people rely on the River for their water, and over five million acres of irrigated farmland provide food and storage for states across the country. The economic importance of the Colorado River has been estimated at over $1 trillion annually, with $26 billion attributable to the recreational economy alone. But seventeen years of drought and increasing demands and pressures in the Basin have led to challenging times. While these challenges are significant, there has always been a tradition of working in a bipartisan, multi-stakeholder fashion on these complex issues.

Some of the most pressing needs for action on the Colorado River include finalizing the Lower Basin Drought Contingency Plan, finalizing the successor agreement to Minute 319, finalizing a Drought Contingency Plan for the Upper Basin that includes continued support for system conservation to reduce demand, and addressing ongoing challenges at the Salton Sea.

We also support local water reuse and recycling efforts that can increase regional water security without relying on new sources of water. In addition, a recent report by the Walton Family Foundation highlights the need for these types of efforts and importance of moving forward with consensus-based, shovel-ready projects. That report, *Colorado River: Critical Infrastructure Needs* (June 2017), identified projects and basin-wide initiatives with significant water user support that stand ready for the addition of federal funding to existing public and private investment. This non-exclusive, representative sample of projects includes municipal, agricultural, Tribal and multi-use projects across sectors.

Again, thank you for your leadership in holding this important hearing and we look forward to working with you on solutions that build more resilient water systems to sustain communities and irrigated agriculture, while supporting fish and wildlife.

Sincerely,

Matthew Niemerski
American Rivers

Karen Hyun
National Audubon Society

Jimmy Hague
The Nature Conservancy

Melinda Kassen
Theodore Roosevelt Conservation Partnership

Steve Moyer
Trout Unlimited

P.O. Box 216 Klamath Falls, Oregon 97601
www.familyfarmallinace.org

Testimony of
The Family Farm Alliance
Mr. Dan Keppen, Executive Director

Submitted to the United States Senate
Committee on Energy and Natural Resources
Subcommittee on Water and Power

Hearing to Examine
Increasing Water Security and Drought Preparedness through
Infrastructure, Management, and Innovation
August 2, 2017

Good morning, Chairman Flake, Ranking Member King and Members of the Subcommittee.

On behalf of the Family Farm Alliance (Alliance), I want to thank you for the opportunity to submit this written testimony for the hearing record on water supply infrastructure needs in the Western United States. The Alliance is a grassroots organization of family farmers, ranchers, irrigation districts, and allied industries in 16 Western states. The Alliance is focused on one mission: To ensure the availability of reliable, affordable irrigation water supplies to Western farmers and ranchers. We are also committed to the fundamental proposition that Western irrigated agriculture must be preserved and protected for a host of economic, sociological, environmental, and national security reasons – many of which are often overlooked in the context of other national policy decisions.

In the world of Western water, a massive flood event or devastating drought is sure to get policy makers focused on the need to update and create more effective water management policy. The recent, multi-year drought in the arid Southwest ramped up Congressional interest in federal legislation to allow Western water providers to better address drought as well as improve preparations for future dry times. Earlier this year, the heaviest rains in a decade overwhelmed parts of the West Coast underscoring the critical importance of having modernized water storage and management infrastructure in place to optimize water resources management.

Many communities of the West – as well as the farms and ranches they are intertwined with – owe their very existence, in large part, to the certainty provided by water stored and delivered by

the Bureau of Reclamation (Reclamation) and other state and local water storage projects. The federal government has an enduring role in water supply infrastructure development and management that, consistent with state water laws, includes working with local water managers on both a policy and operational level and, in partnership with them, providing support for their efforts to secure a stable and sustainable water supply.

Importance of Water Infrastructure

Water is the lifeblood of our nation. Without reliable water, every sector of our economy would suffer – from agriculture, to manufacturing, to high-tech. Food cannot be grown, businesses cannot operate, and homes and schools cannot be built or operate without water. Critical water infrastructure must be maintained and modernized to ensure the delivery and safety of water today and for future generations. As Congress discusses the development of a potential infrastructure legislative package, it is of paramount importance that development, maintenance and rehabilitation of water infrastructure is a high priority.

Water managers throughout the West are actively investing in new water supply options, embracing technology, and looking to use water as efficiently as possible. Thanks in large part to these efforts, water usage in the U.S. for agricultural, industrial and municipal uses has declined since the mid-1980's while at the same time populations, crop production, and demands for water have increased. Local water managers are looking to their federal partners to ensure that this impressive track record of water innovation can continue and even be improved.

When Congress begins to deal with infrastructure issues later this year, water infrastructure projects that would qualify for any federal assistance and support should include water conveyance, surface water storage, aquifer storage and recovery, wastewater, water reuse, desalination, and efficiency investments. Any new infrastructure legislation must also apply to the remediation of aging infrastructure as well as to the development of new infrastructure. Moreover, meaningful infrastructure legislation should encourage integrated water planning from watershed to wastewater discharge. Investments in forest health and watershed management can have as high or greater water yield and return on investment as more traditional brick-and-mortar capital investments.

Western water managers also face significant regulatory and policy-related challenges. Water infrastructure that was built early in the last century is aging, and once-available federal grant and loan programs have been greatly diminished. Meanwhile, little progress has been made at the federal level towards supporting the development of new and improved water supply infrastructure to keep up with the growing water demands of expanding cities, energy production, and environmental needs. While water conservation, water efficiency, and water transfers are important tools for addressing certain water supply challenges, these tools must be

balanced with supply enhancement measures that provide long-term solutions for the varying and specific circumstances in the West.

Western irrigated agriculture is a significant contributor to the national economy. The Family Farm Alliance in 2015 published "The Economic Importance of Western Irrigated Agriculture" (prepared by the Pacific Northwest Project), a white paper specifically drafted for policy makers seeking to better understand the direct economic impact of Western irrigated agriculture and to acknowledge the growing chorus of voices bringing attention to food security and irrigated agriculture as a national economic issue. For the 17 Western states studied in the 2015 report, the total household income impacts from irrigated agriculture, associated service industries, and food processing sectors was $172 billion annually. Irrigated farming and ranching is a huge economic driver in the West, particularly in rural communities. Further, the fact that Americans spend less of their disposable income on food than any other nation in the world ensures a vibrant, consumer-driven economy. However, this economic force would virtually disappear, along with the rural American communities dependent on farming and ranching, if the water infrastructure that supports it crumbles or once-reliable water supplies are threatened. Given the magnitude of the food security issue to the nation's economic and social wellbeing, policy makers must prioritize protection of our water supply infrastructure.

This economically critical infrastructure is aging and is in need of rehabilitation and improvement. Most of Reclamation facilities are between 50 and 100 years old. Reclamation has reported an infrastructure and maintenance backlog of approximately $3 billion. Such aging infrastructure presents a further challenge because it requires ever increasing maintenance and replacement investments. As of 2013, the replacement value of Reclamation's infrastructure assets was $94.5 billion. Investing in this infrastructure on the front end will save ratepayers' money in the long run and allow us to preserve it, and the many benefits it provides, for future generations.

The Western Drought and Water Shortages

Droughts occur routinely in the West; that is why Reclamation made such important investments in water supply infrastructure over the past century. However, this infrastructure was never designed to meet the current burgeoning demands of growing communities and environmental needs, while continuing to serve farmers, ranchers and rural communities through periodic droughts and floods. Unfortunately, future droughts in the West are predicted to be more intense and longer than we have historically experienced in the 20th century.

Droughts come and go in the West. The larger issue, the underlying problem, is the ever-present and worsening shortage of water. Droughts only exacerbate water shortages. They also highlight the need to re-examine how we manage our limited water resources in the West. When we must deal with chronic drought and water shortages in the West, the Alliance believes that we must

also continue to maintain existing rural economies, support agricultural food production and enhance the quality of life and the environment, rather than to abandon those things in order to accommodate growing future water needs arising from population growth or environmental demands.

The simple fact is, in many areas of the West, we have outgrown our aging water supply infrastructure. We have been living off investments of our forefathers in water infrastructure and have not planned well enough (or in some cases at all) to replace or add to those investments to meet the ever-increasing demand for water into the future.

We must invest (and reinvest) in our important western water infrastructure that we continue to rely on in meeting both current and future demands for water. Our existing water infrastructure is aging and in need of rebuilding; new water storage facilities are needed in order to adapt to changing hydrologic conditions and to develop new usable and sustainable water supplies to meet growing demands.

As a bright spot, Reclamation's WaterSMART program continues to leverage small cost-shared grants with local and state funding for water management improvements and conservation projects, assisting many local water providers in making timely investments in their aging water delivery systems. However, by better coordinating federal conservation programs at the U.S. Department of Agriculture (USDA), such as the Environmental Quality Improvement Program and the Agricultural Watershed Enhancement Program, with WaterSMART programs at Reclamation, such investments could be much more effective in effecting on- and off-farm water management improvements.

Streamlining federal regulations and permitting processes, along with federally-backed loans that could provide more affordable financing tools for large, new water storage infrastructure investments can help replace the more traditional approach to water infrastructure development through the mostly federally funded and built water projects of the past. The federal government can continue to be a partner in solving these water problems in the West by using new, innovative and more affordable financing and funding tools at a very low (if any) cost to the federal treasury.

Principles to Consider

The Congress and the federal government certainly cannot change the hydrology of the West, but there is a role it can play to support family farmers and ranchers. As the Subcommittee continues its efforts to move legislation and develop policies to improve water management in the long-term, we will continue to gauge the level of our support for that legislation based on conformance with the following principles:

- State water laws, compacts and decrees must be the foundation for dealing with shortages.
- Water use and related beneficial use data must be accurately measured and portrayed.
- Benefits of water use must reflect all economic / societal / environmental impacts.
- Water conservation can help stretch water supplies, but has its limits in certain situations.
- Public sentiment supports water remaining with irrigated agriculture, and developing strategic new water storage as insurance against shortages.
- Technologies for water use, reuse and recycling are effective in stretching existing supplies for urban, environmental and other uses.
- Urban growth should be contingent upon expanding sustainable water supplies; using Western irrigated agriculture as the "reservoir" of water for municipal growth is not sustainable in the long run and can damage rural agricultural communities and the stability of our Nation's food supply.
- Planning for water shortage in the West must look to the long-term goals of meeting future water demands for agriculture, energy, cities, and the environment.
- Unintended consequences associated with reducing productive agricultural land/groundwater recharge/riparian habitat benefits should be avoided and, if unavoidable, minimized and fully mitigated.
- A successful water shortage strategy must include a "portfolio" of water supply enhancements and improvements, such as water reuse, recycling, conservation, water-sensitive land use planning, water system improvements, and new water storage infrastructure. New infrastructure and technologies can help stretch existing water supplies for all uses, but developing new water supplies must be part of that equation.

These principles for smart, effective management of Western water resources are intended to help decision-makers deal with the harsh realities of current and future water shortages due to drought and the re-allocation of water away from traditional agricultural uses to growing predominantly environmental and municipal demands.

The Role of the Federal Government in Modernizing and Expanding Water Storage

We need new water storage to adapt to our changing hydrology and develop usable and sustainable supplies to meet growing demands for water. New water supply infrastructure must be developed to capture water in good years and replace diminishing snowpack during drought conditions, provide for growing recreational and environmental needs, address climate change and variability, allow for continued economic and population growth, and protect the vitality of irrigated agriculture in the West.

Even with downward pressures on the budget, the federal government can be a partner with non-federal water users in solving water problems in the West by developing innovative policy and financing mechanisms with a very low federal cost. These types of programs should make water

infrastructure development more attractive and affordable for non-federal interests to invest in the types of projects the federal government can no longer afford to fund and construct.

a) Federal Funding and Competitive Cost-Shared Grant Programs

Western water providers have invested billions in local and regional projects and strategies in recent years to improve water supply reliability. Those investments have been a major factor in the West's ability to manage through years of severe drought.

The Alliance believes that new innovative federally-backed financing tools will be needed in the coming years to assist in constructing new and improved water infrastructure. One such example is the congressionally authorized and funded Water Infrastructure Finance and Innovation Act (WIFIA) program at the EPA. Water infrastructure is a long-term investment, and longer repayment and lower interest terms will be crucial to attracting investment in these water supply facilities. Such financing could help fund investments in everything from new water storage reservoirs (both on- and off-stream as well as groundwater storage), regulating reservoirs, canal lining, piping open channels, computerized water management and delivery systems, real-time monitoring of ecosystem functions and river flows to manage limited water supplies to benefit both fish and people, and watershed-based integrated regional water management project planning and implementation.

We need to develop innovative ways to encourage non-federal investments in new water infrastructure without requiring that the federal government actually build or fully fund that infrastructure. We believe such investments would allow for more cost-effective construction and operation and maintenance of much needed new water supply infrastructure and not impact federal budgets. Bridging the overall funding gap for water infrastructure will require a partnership between federal, state and local governments and the private sector. This partnership will necessitate diverse revenue streams to ensure that communities, both large and small, along with agricultural, municipal and industrial water providers are all able to meet the water infrastructure needs of the future.

We encourage Congress to:

- **Make water infrastructure a high priority in any infrastructure legislation.**
- **Maintain the tax-exempt status of municipal bonds, one of the most valuable financing tools used by our nation's water suppliers to build and improve infrastructure.**
- **Strategically target funding increases for the Bureau of Reclamation and the Army Corps of Engineers to assist in the development of projects that increase water**

supply, address current and future drought and water shortage concerns, meet aging infrastructure needs, address rural water needs, and increase federal project operational efficiencies.

- **Fully fund the Water Infrastructure Finance and Innovation Act (WIFIA).** The WIFIA program was recently updated by the 114th Congress in the passage of the Water Infrastructure Improvements for the Nation (WIIN) Act of 2016 (PL 114-322) and WIFIA loans were funded for the first time in the FY 2017 omnibus appropriations bill.

- **Consider a "WIFIA-like" alternative for water supply projects in the Bureau of Reclamation.** The proposed Reclamation Infrastructure Finance and Innovation Act (RIFIA) and the New WATER Act (H.R. 434) would authorize a new affordable financing mechanism for certain large water supply projects in the West. The RIFIA/New Water Act provisions are similar to WIFIA but focused on non-federal water supply infrastructure loans through Reclamation. The New Water Act would provide up to 49% financing for larger (minimum project size of $20 million) non-federal infrastructure projects through direct Treasury loans and loan guarantees. Such loans would carry longer repayment terms and low T-bill interest rates that are not currently available to water infrastructure proponents. And, the total "cost" to the federal government on the back end would be to cover the risk of default on these loans, which for the water supply sector is very low (less than 1% default rate for water infrastructure loans). As such, the New Water Act would authorize $175 million in budget authority for this new loan program, and would support over $11.4 billion in low-cost, long-term loans with actual out of pocket costs to the Treasury of less than $10 million, and affordably financing about $23 billion in new water supply infrastructure across the West.

- **Jump start investments authorized by the WIIN Act (PL 114-322) that provided critical new authorizations for water infrastructure development.** The FY 2017 omnibus appropriations bill and the House and Senate versions of the FY 2018 Energy and Water Development appropriations bills have included $67 million per year for water storage and $10 million per year for water reuse and recycling grants, both newly authorized provisions in the WIIN Act.

- **Expand Reclamation's Water SMART grants to include a larger (up to $20 million) competitive 50-50 cost-shared grant for water supply management projects integrated into a regional watershed plan could help fund larger water conveyance and conservation infrastructure.**

- **Find ways to improve coordination of WaterSMART and other water management programs at Reclamation with existing conservation programs at the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS).** This

would lead to more effective federal investments in on- and off-farm water management improvements.

- **Advance S. 1090, the "Water and Agriculture Tax Reform Act of 2017 (WATER Act)"**, introduced by Senator Mike Crapo. This important legislation seeks to reform section 501(c)(12) of the Internal Revenue Code to provide mutual irrigation and ditch companies with added flexibility that will promote new economic activity such as small-scale hydro power projects. The bill would reform outdated tax provisions that hinder ditch and irrigation companies' ability to raise capital to invest in infrastructure. Current law dictates that mutual ditch and irrigation companies must receive 85 percent of their income from shareholder investment to maintain its non-profit designation. The bill allows these companies to receive other sources of income for operations and maintenance and still maintain its non-profit status. The legislation requires that the extra revenue be used exclusively for operations and maintenance of the ditch and irrigation company.

- **Support new ways to encourage investments in non-federal water infrastructure that can support and enhance federally owned water projects, including the use of public-private partnerships (P3s) and other innovative arrangements.** We fully understand that the federal funding mechanisms used in the past to build the vast majority of Reclamation's water infrastructure are not available today. We view the future of water infrastructure as one where local districts plan, design, finance, construct, operate and maintain new non-federal water facilities, sometimes on federally-owned lands, as integrated features of existing federal projects. Innovative ideas currently being explored (and potentially in need of federal legislative authorities) include long-term leases of federally owned property, and full or partial title transfers of federally owned project features to project beneficiaries (see below). We need to encourage the innovative nature embedded in private-public partnerships (P3) to build non-federal water infrastructure, while also recognizing that a P3 relationship may not work for many smaller or rural water providers. More can be done to engage the unique relationships Reclamation has with project water users who depend on Department of the Interior infrastructure.

b) Bureau of Reclamation Title Transfers

The Alliance believes that in the water arena, a "one size fits all approach" dictated from Washington is counterproductive and ineffective. Federal laws and regulations should be drawn to recognize that facts and circumstances can vary significantly from region to region. Given the federal ownership and liability for each Reclamation-owned water project, bureaucratic inefficiencies sometimes overlay the process of managing and operating this important water infrastructure, even though operations and maintenance are typically performed by non-federal state-based local entities, such as irrigation or water districts. Such facilities, known as

"transferred works", where project operation, maintenance and replacement responsibilities (other than title) are contracted to the non-federal entity, are still owned by the federal government and many of these projects are ripe for title transfer. Yet, there remain many barriers to an efficient transfer of title out of federal ownership to these local operating entities.

Our members include irrigation districts and water agencies across the West that are responsible for the operation and maintenance of most of the Bureau of Reclamation's water supply and distribution facilities. Several of our members have worked with the federal government over the past two decades to transfer all or parts of Reclamation projects to these local operating entities. In fact, one of the first title transfers of a Reclamation district that was approved by 104th Congress to the Burley Irrigation District (IDAHO) in 1996 was facilitated by the Alliance.

The Alliance believes title transfers are one of several positive means of strengthening control of water resources at the local level. In addition, title transfers can help reduce federal costs and liability, and allow for a better allocation of federal resources. Operational decisions are timelier and many times are more cost effective when made at the local level. Further, maintenance and rehabilitation of our aging federally owned facilities is more effectively financed and constructed by the local agencies currently responsible for these activities anyway. Title transfer would allow for a broader portfolio of financing alternatives for cost effective reinvestment in these facilities to be made available at the local level.

Despite the potential benefits, local water agencies are many times discouraged from pursuing title transfer because the process is expensive and slow. Environmental analyses can be time-consuming, even for uncomplicated projects that will continue to be operated in the same manner as they always have been. National Environmental Policy Act (NEPA) and the procedures required to address real property and cultural and historic preservation issues are often very inefficient, time consuming and expensive. Moreover, every title transfer currently requires an act of Congress to authorize, regardless of whether the project covers 10 acres or 100,000 acres.

The Senate should introduce and advance legislation similar to the "Reclamation Title Transfer Act", H.R. 3281, which would authorize the Secretary of the Interior to facilitate the transfer to non-Federal ownership of appropriate Reclamation projects or facilities, and for other purposes. Reclamation should work with Congress to develop this legislative concept for a programmatic approach intended to simplify transfer of "non-complicated" facilities. This would greatly reduce the hurdles and expense that can impede title transfers beneficial to local interests and to the federal government.

c) Forest Health Threats to Water Supply and Infrastructure

Improving the condition of our nation's forested lands is of primary importance to water providers. National forest lands generally located in the headwaters of major river basins, are overwhelmingly the largest single source of water supply in the U.S. and, in most regions of the West, contribute nearly all of the water that supplies our farms and cities.

The unhealthy state of our national forests, which were reserved specifically to protect water resources, has led to catastrophic wildfires that threaten the reliability, volume, and quality of water for tens of millions of Americans, along with the wildlife, recreational, and multi-purpose values of these lands. In addition, water supply infrastructure can be severely damaged or rendered useless by wildfire and post-wildfire flooding and debris flows. Large-scale, catastrophic wildfires today are more frequent and significantly larger than in the past. In Colorado alone, from 2004 through 2007, fires burned an average of 40,000 acres annually. However, from 2008 to 2015, that annual average jumped to 140,000 acres. Unfortunately, Colorado is not alone.

We believe it is critical that both forest management reforms and resolution of the "fire borrowing" issue are addressed in comprehensive legislation focused on improving the health and resiliency of our federal forests. Only by addressing both issues together can we ensure that on-the-ground forest management and restoration activities will proceed at the pace and scale equal to the problem and begin to improve the forest conditions that led to the recent devastating and costly fire seasons.

d) Opportunities for Water Storage Infrastructure Development

For many reasons – political, economic, societal, environmental – the construction of traditional surface storage projects is undertaken on a much more limited basis than in decades past. The most frequent reasons center around economics or an inadequate water market associated with the given facilities. In other cases, environmental, safety or geologic challenges came to light during a project's development, rendering its construction, completion or operation unfeasible. Political opposition has often contributed to a project's demise, leaving the facilities "on the books" awaiting further action, but with external events and new priorities passing them by. Even if funding and authorization were to be secured for a new storage project, the existing procedures for developing additional water supplies can make project approval incredibly burdensome and time consuming with companion permitting and environmental review costs outstripping the ability of local water providers to accommodate.

Individual surface storage proposals must be evaluated and the associated benefits and risks must be viewed in a net, comprehensive and efficient manner. While some critics of new storage projects focus on perceived negative impacts associated with new facility construction (e.g., loss of habitat, disruption of "natural" stream flow patterns, and potential evaporative losses), these

perceived impacts must also be compared to the wide range of multi-purpose benefits that storage projects provide. Properly designed and constructed surface storage projects can provide additional water management flexibility to better meet downstream urban, industrial and agricultural water needs, improve flood control, generate clean hydropower, provide recreation opportunities, and create additional instream flows that benefit downstream habitat and water quality.

- **We strongly support Senator Barrasso's "*Water Supply Permitting Coordination Act*".** This important legislation would authorize the Secretary of the Interior to coordinate Federal and State permitting processes related to the construction of new surface water storage projects on lands under the jurisdiction of the Secretary of the Interior and the Secretary of Agriculture and to designate the Bureau of Reclamation as the lead agency for permit processing, and for other purposes. The "*Water Supply Permitting Coordination Act*" provides a critical first step towards addressing current regulatory and bureaucratic challenges that many times will delay or even halt the development of new water supply enhancement projects in the Western United States.

  As you are aware, developing new water storage projects is much easier said than done. For many reasons, existing procedures for permitting the development of additional water supplies can make project approval incredibly burdensome. In fact, on one project in Wyoming, a 20,000 acre-foot water storage reservoir took 17 years to build – 2 years to construct and 15 years to permit!

- **The Corps of Engineers, working with Reclamation where appropriate, should identify and study** (at the request of a non-federal water contractor or reservoir owner/operator) **flood control rule curves** at Corps-regulated reservoirs where additional water supplies could be stored and used in dry years without risking flood damages downstream of the facility. Congress should continue to provide the necessary authorities and direction to the Corps and Reclamation to maximize the use of existing infrastructure for both flood and water supply purposes.

e) Water Rights Protection

The Alliance has long advocated that solutions to conflicts over the allocation and use of Western water resources must begin with recognition of the traditional deference to state water allocation systems. The Alliance supports S. 1230, the "Water Rights Protection Act" (WRPA). This important legislation would prohibit the conditioning of any federal permit, lease, or other use agreement on the transfer, relinquishment, or other impairment of any water right to the United States by the Secretaries of the Interior and Agriculture. The WRPA would protect communities, businesses, recreation opportunities, farmers and ranchers as well as other individuals that rely on privately held state-based water rights for their livelihood from federal

takings. It would do so by prohibiting federal agencies from extorting water rights through the use of permits, leases, and other land management arrangements, for which it would otherwise have to pay just compensation under the 5th Amendment of the Constitution.

Our farmers and ranchers rely on their vested water rights to secure operating loans in order to irrigate and produce crops and water livestock. Federal agencies should not be able to leverage those private water rights against farming and ranching families who have long depended upon federal permits and leases to support actions like grazing.

Conclusion

As we have testified before this Committee in the past, and even though we have experienced a very wet winter and spring this year, there are no guarantees that the West will not experience even more intense multiple drought years in the future. In order to avoid disaster and to ensure that all reasonable water demands are met in the future, the West must begin to manage water as if every year was going to be a drought year. This will require everyone in the West to adopt a new paradigm, one that promotes wise management of this limited and valuable resource and protects carryover storage for future use in dry periods. This new paradigm will also mean additional investment in technology, conservation and new water storage and management infrastructure in order to deal with the uncertainties that lay before us. A strong commitment to water infrastructure must be made in any infrastructure package that Congress and the Administration considers.

The public infrastructure challenges our Nation is currently facing are daunting, and they will require innovative solutions. The infrastructure investments made by prior generations have benefited this country for over a hundred of years. Now it is this generation's responsibility to invest in infrastructure and invest for future generations.

Thank you again for the opportunity to testify and for your attention to the many infrastructure challenges facing our nation. The Family Farm Alliance and our members stand ready to assist you in your efforts and will answer any questions you may have; please do not hesitate to contact Mr. Dan Keppen, Executive Director of the Alliance at dankeppen@charter.net .

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GENERAL MANAGER
Thaddeus L. Bettner, P.E.

Statement of Thaddeus Bettner, PE
General Manager
Glenn-Colusa Irrigation District
Before the Committee on Energy and Natural Resources
Subcommittee on Water and Power
United States Senate

Hearing
"Increasing Water Security and Drought Preparedness Through Infrastructure, Management and Innovation"

Washington, D.C.
August 2, 2017

Chairman Jeff Flake, Ranking Member Angus King and Members of the Subcommittee, I am Thaddeus Bettner, the General Manager of the Glenn-Colusa Irrigation District (GCID), the largest irrigation district in the Sacramento Valley. Thank you for the opportunity to provide GCID's perspective on "Increasing Water Security and Drought Preparedness through Infrastructure, Management and Innovation."

GCID covers approximately 175,000 acres in Glenn and Colusa Counties, and is located about 80 miles north of Sacramento. Our district contains a diverse working landscape including a variety of crops such as rice, tomatoes, almonds, walnuts, orchards, vine seeds, cotton, alfalfa, and irrigated pasture. Just as important, we convey water to three Federal wildlife refuges totaling more than 20,000 acres, private wetland and habitat lands of approximately 1,500 acres, and in the fall and winter deliver water to more than 50,000 acres of seasonally flooded irrigated lands that also serve as surrogate wetlands for the Pacific Flyway. GCID is a Sacramento River Settlement Contractor and diverts water directly from the Sacramento River through the largest flat plate fish screen in the world. GCID's Settlement Contract was first entered into in 1964 and it resolved disputes with the United States related to the seniority of GCID's rights over those of the United States and, in fact, allowed the US Bureau of Reclamation (Reclamation) to obtain water rights from the State Water Resources Control Board (SWRCB) for the Central Valley Project (CVP). GCID's water rights originated with a filing in 1883 for 500,000 miner's inches under 4 inches of pressure, one of the earliest and largest water rights on the Sacramento River.

Other water right holders on the Sacramento River also entered into Settlement contracts with Reclamation. The Sacramento River Settlement Contractors (SRSC), covering approximately 480,000 acres, are various irrigation districts, reclamation districts, mutual water companies, partnerships, corporations, and individuals situated in the Sacramento Valley, and formed under the provisions of California law. Among Reclamation's hundreds of CVP water supply contracts, the SRSC have a unique history and nature. The SRSC divert water from the Sacramento River,

P.O. Box 150 • 344 East Laurel Street • Willows, CA 95988 • Tel: 530.934.8881 • Fax: 530.934.3287 • www.gcid.net

miles upstream from the Bay-Delta and the boundaries of the delta habitat, under water rights that were vested under California law well before the construction of the CVP began. The SRSC own and operate their own diversion facilities, and their water rights are not dependent in any way upon the operations or facilities of the CVP. The SRSC every year manage water for various beneficial purposes in the Sacramento Valley, including farms, birds and the Pacific Flyway, cities and rural communities and fisheries. This requires creative management and tradeoffs by water resources managers.

Notwithstanding the seniority of our water rights on the Sacramento River, the five years of consecutive drought that California experienced through 2016 significantly reduced natural inflow into reservoirs, including Lake Shasta, putting extreme pressure on our water supply and the CVP. The drought also greatly complicated the management of the system to benefit endangered species, like winter-run Chinook salmon. These pressures will continue to mount in future dry years and continue to exist even in normal water years.

Water Storage and Innovation

To help address the long-term water supply needs of our region and the state as a whole, we need new federal assistance tools to help local agencies better manage and develop new water supplies critical to a more drought resilient economy.

Sites Reservoir, for example, is foundational to the long-term economic health of our region and the state. Sites will bring 1.8 million AF of new water storage to California. The Sites Project represents the kind of new, smart storage that our State needs, one that will not only create additional supplies behind the dam itself, but will allow significant additional water to be stored in other upstream reservoirs (Trinity, Shasta, Oroville and Folsom) due to coordinated operations and integration efficiencies.

Sites will provide a needed backstop to help the state's primary water delivery system react to the potential impacts of climate change, which is expected to bring less snow runoff and flashier storms. During drought years, Sites can be refilled from just one or two high flow storm events. For instance, in the drought year of 2014-15, Sites could have captured 410,000 acre-feet from just two storm events that winter. If Sites were operational this past 2015-16 rainy season, it would have added over one million acre-feet from the El Nino storms. In an average water year, Sites will be able to add 500,000 acre-feet of water to be used by California homes, farms, and businesses, and the ecosystem. During critical dry years, Sites would boost water available to California during the summer by an estimated 250,000 to 300,000 additional acre-feet.

GCID, SRSC, and the Northern California Water Association (NCWA) strongly support the work of Rep. LaMalfa, working with Congressman Garamendi and others, through the introduction of H.R. 1269 and their work on other bills to advance the Sites Project. We support the work of this Committee to seek new ways to streamline the environmental review process for new water supply infrastructure investments, such as the Sites Project, including the water infrastructure environmental review streamlining provisions included in S 677 and HR 1654, the Water Supply Permitting Coordination Act, introduced by Senator Barrasso and Representative McClintock. While delays in the water supply project environmental review and permitting process are due, in part, to the complexities associated with multiple state and federal

agencies being involved in the project, other delays are attributable to shifting environmental requirements. We would only ask that these measures be amended to insure that the streamlining benefits apply to State-led storage projects as defined in the WIIN Act as well, not just projects constructed on lands administered by the Department of Interior or the Department of Agriculture.

In addition, we encourage the Committee to give favorable consideration to proposals like those included in HR 434, introduced by Representative Jeff Denham, and other bills that seek to authorize new funding and financing opportunities to support non-federal investments in needed water supply projects, like the Sites Project. Specifically, we strongly support HR 434, the New Water Act, which would provide local agencies with access to low-cost, long-term financing for much needed water infrastructure investments. If the New Water Act loan program were in place today, the program would provide water project sponsors with access to loans with a repayment period of up to 35 years at a rate of approximately 2.9 percent. For the Sites Project, this would drive down the cost of water by more than 20 percent.

Management and Innovation

While the SRSCs and NCWA, with participation by several environmental groups made progress on projects that have had a positive impact on salmon, more must be done to better understand the state of winter-run salmon, and ensure that the best available science is being utilized to determine the projects and actions that should be taken to ensure the survival of winter-run in the managed system in which we operate. The challenge we face can be summarized as follows:

- Continued low populations of winter run Chinook salmon have resulted in single species management decisions that are impacting available water supplies and not improving salmon populations.
- Activities and actions are being undertaken by different federal, state, and local agencies on the Sacramento River and as part of the Central Valley Project operations; however, these actions need to be better organized, structured, and improved.
- There is a lack of accountability and transparency to decision making
- There is no comprehensive plan to implement the actions needed to improve water supply, the fisheries and wildlife.

To more effectively address the winter run and other fishery, wildlife and water management challenges, the SRSCs believe it is imperative that the federal and state resource agencies, irrigators, and the conservation and recreation organizations come together develop what we are calling the Sacramento River Mainstem Integrated Plan, modeled after the Yakima Basin Integrated Water Resource Management Plan.

The Integrated Plan

The lack of action and accountability, which causes negatively impacts farmers, municipalities, fish, and wildlife, has resulted in the Sacramento River Settlement Contractors initiating an effort to craft a comprehensive water plan and habitat management that addresses existing problems. The Sacramento River Mainstem Integrated Plan (Integrated Plan) will provide water and habitat for agriculture, fish, wildlife and the region.

The Benefits

- Providing water for stream flows at times and temperatures that fish need to thrive.
- Providing greater water supply reliability for farmers and communities.
- Stretching the amount of water available by using it more efficiently.
- Enhancing and restoring fish and wildlife habitat along the Sacramento River.
- Incorporating water settlements into the Integrated Plan, including those that may be reached with the State of California related to the State Water Resources Control Board Bay-Delta plan update
- Development of an integrated science and monitoring program that will inform operational decisions and restoration activities under the Integrated Plan.
- Development of new modeling tools that will improve operations of reservoirs and diversions under the Integrated Plan.

The Cost

The initial cost of the projects in the Integrated Plan is projected to be approximately $100 million. That cost will be spread out over 10 years and will be shared by local, state, and federal governments and water users. We urge the Committee to provide opportunities for federal support for Integrated Plan of this type.

Thank you for the opportunity to testify.

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

SANITATION DISTRICTS OF LOS ANGELES COUNTY

August 14, 2017

The Honorable Jeff Flake
Chairman
Energy and Natural Resources Subcommittee on Water and Power
U.S. Senate
410 Dirksen Senate Office Building
Washington, D.C. 20510

The Honorable Angus S. King, Jr.
Ranking Member
Energy and Natural Resources Subcommittee on Water and Power
U.S. Senate
456 Dirksen Senate Office Building
Washington, D.C. 20510

Dear Chairman Flake and Ranking Member King:

The Metropolitan Water District of Southern California (Metropolitan) and the Sanitation Districts of Los Angeles County (Sanitation Districts) would like to thank you and acknowledge your leadership in presenting the August 2, 2017 Senate Energy and Natural Resources Water and Power Subcommittee hearing, "To examine increasing water security and drought preparedness through infrastructure, management and innovation."

Water reliability and security are vital issues for our nation and our region. To advance progress in meeting those goals, we would like to call the Subcommittee's attention to a proposal by Metropolitan and the Sanitation Districts to develop one of the world's largest water recycling programs. This project would bring a new and reliable source of drinking water to millions of water users in Southern California, and would increase both water security and drought preparedness for the entire region.

It is our hope that the Subcommittee will accept this correspondence and include the details herein as part of the August 2, 2017 subcommittee hearing record.

Project Information

The proposed Regional Recycled Water Program would take wastewater treated at the Sanitation Districts' Joint Water Pollution Control Plant in Carson, California, and purify it using reverse osmosis and other processes. These advanced treatment technologies have been used for decades in California and across the globe, and produce high-quality water that meets all state and federal

standards. This purified water would be stored in four groundwater basins in Los Angeles and Orange counties, allowing for additional natural filtration. Those basins, which serve 7.2 million people, currently are recharged with local rainwater, water imported from the Colorado River and Northern California and, in some cases, recycled water from other sources.

This fall, Metropolitan will begin construction of a demonstration plant that will be operated for at least one year to generate information needed for potential construction of a full-scale treatment facility. As currently envisioned, the program ultimately would produce and distribute up to 150 million gallons of purified water per day to local groundwater basins -- enough water to serve more than 335,000 homes. Feasibility studies completed in late-2016 estimate the full-scale treatment and distribution facilities would cost approximately $2.7 billion to construct, with annual operations and maintenance costs of approximately $129 million. Based on those estimates, water produced by the program would cost about $1,600 an acre-foot, which is comparable to other new local supplies.

Thank you for considering our joint public agency request to include the details about this innovative regional program as part of the hearing record. It is our hope that you will contact us if you have any questions and require additional information.

Cordially,

Jeffrey Kightlinger
General Manager
Metropolitan Water District of Southern California

Grace Robinson Hyde
Chief Engineer and General Manager
Sanitation Districts of Los Angeles County

cc: Senator Dianne Feinstein
Senator Kamala Harris
Southern California Congressional Delegation

To advance the economic, social and environmental sustainability of Northern California by enhancing and preserving the water rights, supplies and water quality.

Testimony of Todd Manley
Representing
The Northern California Water Association
Before the Committee on Energy and Natural Resources
Subcommittee on Water and Power
United States Senate

Hearing
"Increasing Water Security and Drought Preparedness Through Infrastructure, Management and Innovation"

Washington, D.C.
August 2, 2017

Chairman Jeff Flake, Ranking Member Angus King and Members of the Subcommittee, thank you for the opportunity to submit this statement for the record. My name is David Guy, and I am President of the Northern California Water Association (NCWA).

NCWA was formed in 1992 to present a unified voice to ensure that the Sacramento Valley has reliable and affordable water supplies–both now and into the future. Our members, who represent water districts, water companies, small towns, rural communities, and landowners that beneficially use both surface and groundwater water resources in the Sacramento Valley, greatly appreciate the Committee convening this hearing on "Increasing Water Security and Drought Preparedness through Infrastructure, Management and Innovation."

California and the Sacramento Valley are recovering from five consecutive years of drought. During this extended period of drought, there were significant surface water cutbacks throughout the Sacramento Valley, with some areas receiving no surface water as shown on "Planning for a Dry Year" (*See* http://www.norcalwater.org/wp-content/uploads/drought-flowsinfographic-062215.pdf). Reduced water supplies result in fallow fields. Fewer crops will directly impact rural communities, our economy and the related wildlife habitat. Family farmers in the Sacramento Valley grow a wide variety of crops on two million acres, generating more than $10 billion in economic activity each year. Reduced water supplies also mean less water for wildlife refuges and ricelands, which affect the food for millions of ducks and geese that migrate through the Sacramento Valley each winter, as well as important shorebird habitat. During the drought, there was less water in the rivers for migrating salmon in the region.

455 Capitol Mall, Suite 335, Sacramento, California 95814-4496 Telephone (916) 442-8333 Facsimile (916) 442-4035 www.norcalwater.org

To help avoid drought impacts in the future, Northern California urges Congress and the Administration to advance the following as important priorities in drought legislation for California and the Western United States.

Water Rights – The Foundation for the Economy and the Environment. Water rights and contracts are the foundation for water operations in California and provide the stability necessary for the state and federal administrations to help California and the West through this challenging time and future droughts. We support the express recognition of the important water rights foundation and the assurances that there will be no redirected impacts to Northern California.

New Water Supplies. Water infrastructure and storage projects that improve the operation of the state water system are critical to advancing water supply reliability throughout California, particularly during dry periods. Smart storage projects with dedicated environmental benefits and yield, such as the proposed Sites Reservoir, would give state and federal agencies greater flexibility to manage water during dry periods for all beneficial purposes.

Specifically, with respect to Sites Reservoir, we strongly support the bi-partisan H.R. 1269 (LaMalfa and Garamendi) and the inclusion of federally-backed financing, as proposed in H.R. 434, sponsored by Rep. Jeff Denham, and other bills, in any future drought legislation.

H.R. 434, the New Water Act, would authorize the Bureau of Reclamation to provide non-Federal entities with access to low-cost, long-term financing for much needed water infrastructure investments, including surface water and groundwater storage projects as well as other water management improvement projects. If the New Water Act were in place today, the program would provide water project sponsors with access to federally-backed loans that could cover up to 49 percent of total project costs, with a repayment period of up to 35 years at a rate of approximately 3 percent. On a project like the Sites Reservoir Project, the New Water Act could drive down the cost of water by 20-25 percent or more.

The New Water Act provides this critically important assistance at little to no cost to the Treasury. The $175 million in budget authority authorized in the New Water Act would support over $11.4 billion in low-cost, long-term financing, with actual out of pocket costs to the Treasury of less than $10 million.

The bill also has many other important benefits including: eliminating any requirement to borrow a debt service reserve fund (a savings of $6 million on every $100 million financed); deferring the initiation of repayment for up to five years following substantial completion of the project allows a project to be fully operational, generating revenue, before requiring the initiation of repayment; and, granting non-Federal sponsors the authority to refinance existing water infrastructure debt, if doing so will enable greater water infrastructure improvements (old, expensive debt frequently inhibits non-Federal entities from making additional water infrastructure improvements).

Again, we strongly support H.R. 434 and urge the Committee to consider including the provisions of H.R. 434 or similar legislation in any drought relief legislation the Committee considers. We believe the financing tools authorized in H.R. 434 represent an important step forward in efforts to help make our region, State and the West as a whole more drought resilient.

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Salmon Recovery: A Time for Action. NCWA also encourages the Committee to consider adding assistance for salmon recovery to any water supply-related legislation. In the Sacramento Valley, water suppliers are partnering with American Rivers, California Trout, Golden Gate Salmon Association, and The Nature Conservancy on the "Sacramento Valley Salmon Recovery Program," (http://www.norcalwater.org/efficient-water-management/fisheriesenhancements/) which is a partnership of our organizations and others to promote passage and habitat for salmonid species in the Sacramento Valley. Each of these projects support priorities in expert fisheries biologist Dave Vogel's 2011 comprehensive report, *Insights into the Problems, Progress and Potential Solutions for Sacramento River Basin Native Anadromous Fish Restoration* (http://www.norcalwater.org/wp-content/uploads/2011/07/vogel-final-reportapr2011.pdf), which serves as the foundational document for the recovery program. Importantly, these projects have all been designed to help advance and support objectives contained in the California Water Action Plan and the National Marine Fisheries Service's "Recovery Plan for the Evolutionary Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segment of California Central Valley Steelhead."

Birds and the Pacific Flyway. California serves as the winter home to millions of waterfowl, shorebirds and other wetland dependent species. Specifically, the Sacramento Valley contains considerable terrestrial habitat that makes up the Pacific Flyway. This habitat consists of varied land uses including agriculture, managed wetlands and wildlife refuges, all of which need water to provide these important habitat values.

Any drought-related legislation should recognize the tremendous value of waterfowl and bird populations along the Pacific Flyway. The protection of state granted water rights and priorities, for example, is critical to assure reliable water supplies for ricelands, managed wetlands and refuges in the Sacramento Valley. In the Sacramento Valley, the allocations under the settlement contracts and the federal refuge contracts have been treated similarly and we urge that the legislation recognize the importance of both of these supplies to the Sacramento Valley and the Pacific Flyway. Additionally, funding for infrastructure improvements and to purchase water supplies is necessary for the wildlife refuges, as well as the other land uses identified in the Central Valley Joint Venture 2006 Implementation Plan, to ensure the water supply reliability necessary to meet habitat targets in the Plan.

Regional Self-Sufficiency - Integrated Water Management. California is a diverse state—one of the most effective ways to achieve statewide reliability is to ensure regional water sustainability and self-sufficiency by facilitating integrated water management within hydrologic regions to maximize the reasonable and beneficial use of water within these regions. To promote regional sustainability and partnerships, we support congressional efforts to encourage and direct federal agencies to implement their policies and programs to facilitate regional sustainability and self-sufficiency through regional and local water management actions, including water use efficiency, water supply projects, water transfers, water banking, ecosystem restoration, and recycling that maximize and provide for the full utilization of water within the region for water supply, water quality and ecosystem purposes.

Thank you for your consideration of this testimony.

455 Capitol Mall, Suite 335, Sacramento, California 95814-4496 Telephone (916) 442-8333 Facsimile (916) 442-4035 www.norcalwater.org

Written Testimony for the Record of

Jeffrey P. Sutton
General Manager
Tehama-Colusa Canal Authority

Before the

Committee on Energy and Natural Resources
Subcommittee on Water and Power
United States Senate

Regarding

Increasing Water Security and Drought Preparedness Through Infrastructure, Management, and Innovation

August 2, 2017

My name is Jeffrey Sutton, I am the General Manager of the Tehama-Colusa Canal Authority (TCCA), a Joint Powers Authority comprised of seventeen Water Districts, all of which are Central Valley Project (CVP) Water Service Contractors. The 150,000-acre service area the TCCA serves spans four counties along the West side of the Sacramento Valley, providing irrigation water to a diverse agricultural landscape and over 1,000 family farms that produce a variety of high value crops, including: almonds, walnuts, olives, pistachios, grapes, and rice. The water provided to these lands results in an annual regional economic benefit of over $1 billion.

I appreciate the opportunity to submit testimony for the record on the importance of water management to communities throughout the west, and the nation. Water is a primary economic driver and must be included in the national discussion on infrastructure investment.

Specifically, my testimony is intended to highlight the proposed Sites Reservoir Project as a model collaborative effort that can help inform other efforts throughout the American West. Most importantly, Sites is a project being pursued by a diverse cross-

section of local, regional, and statewide stakeholders who have united behind a shared goal of developing water storage infrastructure that will benefit irrigators, communities, industry, as well as wildlife and fisheries simultaneously.

Sites JPA

The TCCA, and several of its member agencies, serve on the Board of Directors for the Sites Joint Powers Authority (JPA). Initially formed in 2010, by seven regional entities, which included local and regional water agencies and two Counties, the JPA has pursued the development and construction of the Sites Reservoir Project. To achieve this goal, the Authority has spent the last six years engaging the public, various stakeholders, state and federal agencies and landowners in facilitating the planning and permitting of this vitally important project.

Sites Overview

Located in Colusa and Glenn counties, the proposed Sites reservoir will provide 500,000 acre-feet of new water annually, and increase water storage in Northern California by 1.8 million acre feet, providing much needed banked water to greatly improved drought preparedness in California, to the benefit of our farms, communities and the environment. When constructed, the project will restore operational flexibility to the entire State's water system, greatly enhance the ability to achieve the goals identified in the 2009 Delta Reform Act, improve capacity and operational flexibility to meet the needs of both endangered anadromous and pelagic fish species, contribute to and improve water quality, and further California's renewable energy goals.

Sites Project Benefits

The operational flexibility that the Sites project would provide to the State's entire water system is what makes this project both unique and of vital importance. Among the reservoir's many benefits, Sites will provide for additional dedicated water for fishery and environmental flow purposes, a reliable water supply for California cities and agriculture, increased habitat for migratory waterfowl and improved flexibility and drought resiliency throughout both the Central Valley and State Water Projects.

Economic Benefits

When constructed, Sites will increase storage capacity within the Sacramento Valley by 21%, creating up to 500 construction jobs, more than 50 long-term jobs, and improving the long term economic stability of the entire region, as well as other portions of the

State whose water supply reliability will be greatly enhanced by this Project. Sites will also create new recreational opportunities, enhance groundwater recharge in the Sacramento Valley and provide emergency flood both local and regional flood protection. Furthermore, the project will provide a source of renewable hydropower – seasonally and daily – to help offset peak price demand and stabilize the electric grid.

Environmental Benefits

The public benefits from Sites Reservoir will include a block of "environmental water" that wildlife managers will have at their disposal to improve the health of various species throughout the state, including salmon, Delta Smelt, Giant Garter Snake, and migratory waterfowl. The allocation of this 'public benefit' water will be commensurate to the levels of investment by the state of California and, potentially, the Federal government. For example, if California funds 1/3 of the project, then 1/3 of the water in Sites would be dedicated entirely to priority 'public benefits' as dictated by the State.

The project will provide dramatic benefits to California's Sacramento-San Joaquin Delta (Delta) ecosystem – which is currently in steep decline, and some argue on the brink of disaster – by offering up to half of its in annual water deliveries for environmental benefits (e.g. flows and enhanced habitat for salmon and smelt, as well as improved Pacific Flyway habitat). The additional storage capacity provided by Sites will be particularly important during periods of drought, when water is in short supply and prohibitively expensive.

Model for Future Water Infrastructure Projects

The Sites reservoir project is a model for a number of reasons:

First, the Sites plan has been developed through a collaborative process tailored to ensure that water users throughout California, representatives of the sportsmen-conservation community, municipal, state and federal government entities, and others all have a seat at the table in shaping the project. The project is locally sponsored with participation from water agencies across the state. The Sites JPA currently already includes 33 investor partners, from all parts of the state, including Northern California, the Central Valley, Southern California, and the Bay Area, and is expected to grow as the project moves forward. In short, the Sites project is being developed by Californians for the benefit for the entire state of California and beyond.

Second, once constructed, Sites reservoir will have significant net conservation and environmental benefits. Classified as 'off-stream storage,' the project will not dam or

impede any river or streambed. Additionally, the reservoir's proposed footprint will have little, if any, detrimental impacts to natural and historic resources relative to the many net conservation benefits.

Third, sites will create operational flexibility to mitigate the impacts of future drought and floods. With a 1.8 million acre-feet (MAF) capacity, Sites is situated where it can divert flows during major storm events and maximize California's ability to effectively manage water resources to meet competing needs and priorities.

Fourth, Sites is being designed and developed utilizing an innovative and versatile funding model. Sites Reservoir is extremely cost effective and the benefit of this new infrastructure far outweighs the costs. The current plan for all the preconstruction study, engineering and design is being funded by public water agencies. The project proponents are seeking construction funding from the $7.5 billion California Water Bond, which included $2.7 billion for new water storage.

However, since half of the benefits from the project will be utilized to benefit wildlife, anadromous fisheries, and other conservation outcomes, the JPA and its broad array of partners and stakeholders are maintaining strategic flexibility when it comes to adding additional funding and partners to the public benefits portion of the project. For example, agencies within the Department of the Interior will have a welcome seat at the table to explore the potential to invest as a partner in Sites to achieve public benefits within their jurisdiction such as maintaining healthy and sustainable anadromous fish populations and ensuring healthy water levels at wildlife refuges for the Pacific Flyway.

Benefits to Central Valley Project Operations

The United States Bureau of Reclamation (USBR) is tasked with conducting the initial study of Sites, called a feasibility study, which will show that building Sites is technically and economically feasible. Once constructed, Sites will be integrated into the existing Central Valley Project, which is operated by USBR. Because of this, USBR will play a role in determining how Sites is operated.

Federal and state participation in the Sites Project presents an investment opportunity to acquire a new, flexible water asset in exchange for participation in the design and construction.

With local, state, and federal partnership, the return on investment in Sites is expected to increase for both water supply and environment benefits. Any state or federal dollars

used to acquire water-based assets for the environment produces significant, low-risk, return on their investment.

The TCCA is grateful for the Committee's interest in the critical topics of water security and drought preparedness. Additionally, we were pleased to see the provisions in the Water Infrastructure Improvements for the Nation (WIIN) Act addressing water supply conservation. Another tool that would be of great value to this effort and others like it is encapsulated in HR 434, which provides financing benefits under the RIFIA concept (based on the WIFIA and TIFIA models). Opportunities to apply lessons learned during the drought must not be wasted. The recent California drought, followed by this year's record-breaking rainfall, have illustrated how critical it is to develop smart storage that allows us to store more water in wet years for future use in dry ones. Sites Reservoir is that smart storage.

Thank you again for the opportunity to submit written testimony. I would welcome the opportunity to answer any questions members of the committee might have or to provide any additional information that might be helpful.