Title XVI

Reuse Legislation

Approach Shift

Supply Augmentation

Options/Costs

Water Security

TITLE XVI WATER REUSE & RECYCLING

A COST-EFFECTIVE OPTION FOR EXPANDING WATER PORTFOLIOS?

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Introduction

The US Department of the Interior's Water and Reuse Program (Title XVI) was established through the Reclamation Wastewater and Groundwater Studies and Facilities Act of 1992 (Public Law No. 102-575). It has since been amended through Section 4009 of the Water Infrastructure Improvements for the Nation Act (WINN Act) in 2016 (Public Law 114-322). Title XVI is limited to the 17 western states.

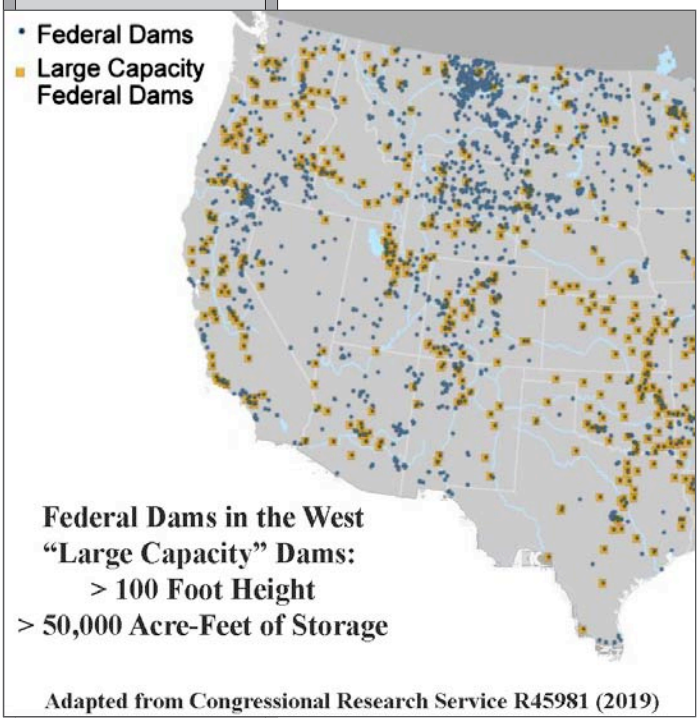
Until 1992 water reuse or recycling had not been recognized as a significant part of the US Bureau of Reclamation's water program. That changed after several converging events occurred, impacting Western water supply as the demands for dependable water supplies continued to increase.

Water reuse and recycling, both with surface and groundwater, required a shift in the traditional approach to providing water in the West. Changing hydrology along with existing structural deficits in the existing water supplies make it imperative that local and regional water suppliers find additional ways to expand their existing water portfolios and allow for the creation of additional "wet water" supplies. [Editors' note: in water management parlance "wet water" is water that exists in fact, distinguished from the "paper water" written into legal entitlements.]

Reused and recycled water will not replace the traditional sources of most of the water supplies for the West. Instead, reuse and recycling are intended to augment existing supplies and provide an expanded portfolio of available sources of water to provide more sustainable water supplies. This augmentation is needed in order to adjust to the uncertainty of traditional water supplies due to: drought; increased demand; and the challenges faced with the aging water infrastructure that transports water from great distances to agriculture and municipal users. Increasingly, water managers are looking to leverage funding from federal and state governments to expand and protect water supplies using: local municipal bonds; public financing; private public partnerships; and investment funds.

In 2012 the National Research Council (NRC) published a report on water reuse, exploring the potential for expanding the nation's water supply using municipal wastewater (NRC, 2012). The NRC recognized the use of water reuse should be made after careful consideration of both: 1) cost in comparison to other feasible water management alternatives; and 2) the cost of not pursuing any water management changes. New water supply options are likely to cost more than the existing supplies and therefore the cost of water reuse needs to be compared to the cost of other new-supply options.

The issue of water security has emerged as climate change impacts available supplies. Water is a critical element of a nation's security. Without adequate water supplies a nation's economy, health and environmental integrity can be threatened. Thankfully most water utility managers and leaders realize that maintaining water quantity and quality at an affordable price to all economic sectors is one of their most important jobs.



The objective of this article is three-fold: first, to discuss the history of the development of the Title XVI program; second, to outline how the program has been used to augment existing local and regional water supplies; and third, to discuss the role of Title XVI in the context of more traditional water development.

The Need for a Diversified Water Portfolio

The story of the American West is the story of the relentless quest to control and allocate the most precious resource: water. (Reisner, 1986)

So noted the jacket cover of *Cadillac Desert*, Marc Reisner's seminal book on water in the American West. *Cadillac Desert* was written at a time when water development in the West had largely been supported through large federal and state surface water construction projects.

Since the late 1990's and early 2000's the West has been in a period of variable water conditions (Ault et al. 2016). Drought has become more common, with low water supply years being the new condition. Current research indicates that low levels of available water are likely for the future, constraining the supply available from traditional water supply reservoirs (Stahle et al 2020). In several locations in the West, available water supply today is not adequate to provide the historic volume needed by growing population centers and their economies.

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Imported Water

Historically, water to support development in the West has been imported from the mountains or large rivers (Table 1). These traditional sources are now limited and either declining or becoming less dependable. Some additional supplies for urban consumption may be supplied from water marketing and the reallocation of water previously used for other purposes. Often, irrigated agriculture has made do with more pumping of groundwater.

Table 1. Percentage of Imported Water for Major Western Population Centers

Population Center	Percentage of Water Imported	Primary Source of Imported Water
San Diego	80%	Colorado River
Los Angeles	85%	Colorado River, northern California
Phoenix	90%	Colorado River
San Francisco	65%	Hetch Hetchy, northern California
Salt Lake City	50%	Colorado River system
Las Vegas	90%	Colorado River

Conservation & Efficiency

Initially, expanding water demands have been met through groundwater pumping, conservation, and water efficiency measures. Conservation and water efficiency measures have been the most cost-effective way to create more wet water (St. Marie and Zafar, 2016; Walton 2020). These methods continue to be important on a local and personal level.

Having adequate water supplies for citizens and industries provides economic and social security. Expanding the water portfolio by providing alternative water supplies to augment existing imported water provides resilience and long-term sustainability to cities and industries.

Non-Traditional Sources

New water supplies will need to come from non-traditional sources, including: stormwater capture; desalination; water pricing mechanisms (educated use management); economic incentives; water banks; stormwater capture; aquifer recharge; and recycling and reuse.

Title XVI Program

Background

It was in the late 1980's — after several years of drought — that the Title XVI program emerged in the West.

Drought

In February 1991, the headlines in the Los Angeles Times newspaper read:

> *With the wet season two-thirds finished, the amount of snow and rain on California's mountains continued to fall far short of normal. Statewide, precipitation is less than 1/4 of normal and is the lowest on record for this time of year, having dropped below that of the record-setting drought of 1977. The Sacramento River Basin, a main source of water for Southern California, has an all-time low precipitation level of 23% of average. This also remains the fifth unusually dry winter in the Eastern Sierra, another key Los Angeles source.*

Actions Initiated

As a result, the State of California and the federal government initiated several actions:

- State officials shut off water to farmers and cut deliveries to cities by half.
- US officials reduced water to farms by 75% and to urban areas by up to 50%.
- The Metropolitan Water District of Southern California reduced deliveries by 31%.
- Southern California water agencies implemented mandatory water rationing.
- A US House subcommittee began investigating ways to reform California water management.
- Governor Pete Wilson unveiled a five-point, $100 million, plan hinged on creating a "water bank" for the future.

Reclaimed Water

Also as s a result of the California drought, US Department of the Interior Secretary Manuel Lujan announced the implementation of a program to expand the water portfolio of Southern California using reclaimed water (DOI, 1991). The objectives were to: 1) expand the water portfolio for Southern California; and 2) to decrease southern California's dependence on imported water from northern California and from the Colorado River.

Title XVI: West

Subsequently, Congress passed and the President signed *Public Law 102-575*, which included Title XVI, entitled *Reclamation Wastewater and Groundwater Studies* (U.S. Congress, 1992). Title XVI authorized nine reclamation and reuse studies for demonstration purposes — six in California, two in Arizona, and one in Colorado. The legislation specifically limited the program to the 17 western states

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serviced by the Reclamation Act of 1902. It also stipulated that the funds could not be used to address drainage or agricultural wastewater generated from the San Luis Unit of the Central Valley Project in California.

Focus Areas

Title XVI initially had three areas of focus:

1) Appraisal Investigations to identify opportunities for water reclamation and reuse
2) Feasibility Studies (supported and recommended for study through the prior Appraisal Investigations)
3) Research and Demonstration Projects which would include the construction, operation and maintenance of cooperative demonstration projects for the development and assessment of appropriate treatment technologies for the reclamation of municipal, industrial, domestic, and agricultural wastewater, and naturally impaired ground and surface waters.

Eligible Programs

Title XVI Programs

The types of projects eligible under Title XVI program include (but are not limited to): water treatment facilities; pipelines to distribute reused water; and tanks and reservoirs to store reused water. The Title XVI program is administratively organized under the US Department of the Interior's (Interior's) WaterSMART (Sustain and Manage America's Resources for Tomorrow) Program. The objective of WaterSMART is to identify strategies to develop adequate supplies of clean water for drinking, economic activities, recreation, and ecosystem health. Interior's Bureau of Reclamation (Reclamation) implements its part of the WaterSMART program by: administering grants for water reuse; conducting research; and providing technical assistance and scientific expertise (GAO, 2018).

WaterSMART

Non-Federal Partner

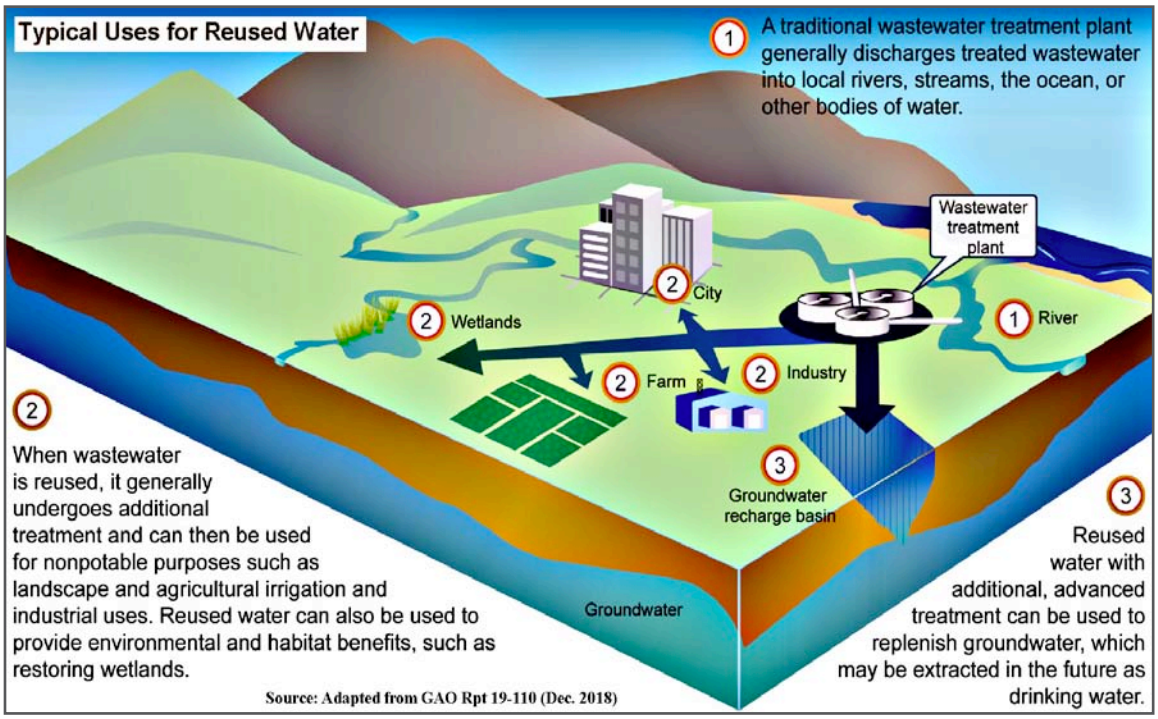
Title XVI projects require a local non-federal partner such as a water district, a water reuse authority, or a joint-power authority. These non-federal government entities often work with the private sector, in quasi Private-Public-Partnerships, to assess, plan, and develop water reuse infrastructure needed to meet local water supply needs.

Grant Types

Title XVI provides three types of grants to project sponsors:

1) Construction Projects associated with planning, design, and/or construction of water infrastructure for the treatment and distribution of water.
   Application: Fund up to 25% of total costs and/or up to $20 million in federal funding plus 75% nonfederal cost share
2) Feasibility Studies to identify specific water reuse opportunities, describe alternatives, and incorporate other considerations such as the financial capacity of the project sponsor.
   Application: Fund up to 50% of total study costs, up to $450,000
3) Research Studies to assist states, tribes, and local communities establish or expand water reuse markets, improved existing water reuse facilities, or streamline the implementation of new water reuse facilities.
   Application: Fund up to 25% of total study costs, up to $300,000

Reused Water Uses



Title XVI

Program Evolution

"Earmark" Labeling

Direct Funding (Reclamation)

Competitive Grants (WINN)

Projects & Studies

Evolution of Title XVI Program Funding

The appropriation of funding to support the Title XVI program has evolved through three primary phases since its inception. Collectively, from fiscal year 1992 through fiscal year 2017, Reclamation has awarded about $715 million in water reuse grants for 46 construction projects and 71 studies (GAO, 2018).

PHASE I: 1992-2010

From initiation of the program in 1992 through fiscal year 2009 Congress directly authorized 53 projects. During this initial phase of the program, Congress authorized each project via a separate line item in Reclamation's Water and Related Resources budget (Congressional Research Service (CRS), 2010). Individually authorized projects became subject to "earmark" labeling — which resulted in limited funding. The program received an infusion of support in 2009 when the *American Recovery and Reinvestment Act of 2009* (ARRA) (P.L. 111–5) was enacted.

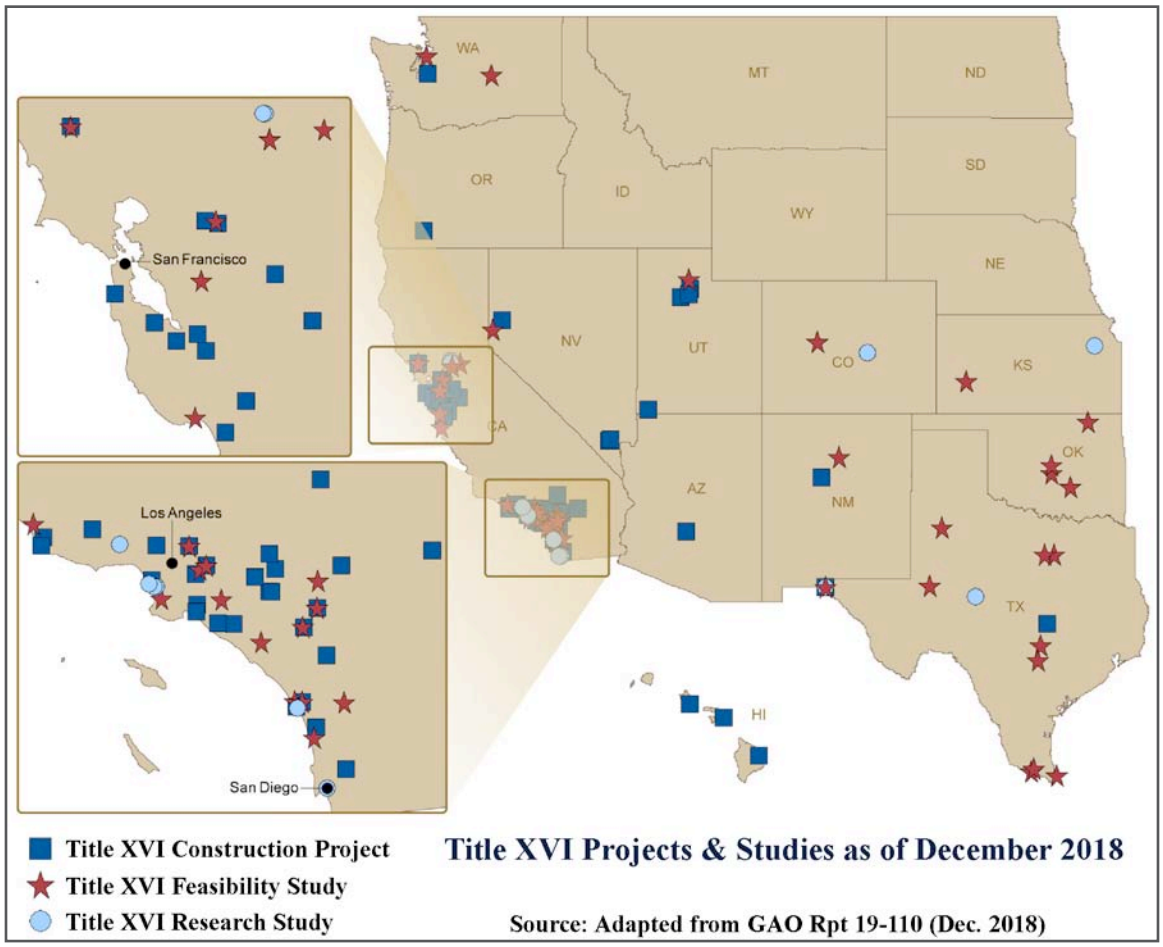
PHASE II: 2011-2016

In Fiscal Year 2011, Congress began appropriating funding directly to the Title XVI program through Interior's annual budget. This took away the need for Congress to appropriate funding for individual projects. This shift required Reclamation to develop and implement a competitive process to award Title XVI construction grants. Reclamation published criteria for prioritizing projects for funding. Eligible projects include those that have a completed Feasibility Study that has been reviewed by Reclamation and found to meet all of the requirements of *Reclamation Manual Release WTR 11-01*. *See*: www.usbr.gov/recman/

Only the 53 projects that were previously authorized by Congress were eligible to apply for Title XVI Construction grants and were required to meet Title XVI pre-construction requirements, including having a completed and Reclamation-approved feasibility study. In Fiscal Year 2011 Reclamation offered competitive funding for water reuse feasibility studies.

PHASE III: 2017-PRESENT

In 2016, the *Water Infrastructure Improvement Act for the Nation* (WINN) (P.L. 114-322) amended Title XVI into a competitive grant program subject to Secretary of the Interior approval after project proponents have completed agency-approved feasibility studies. This amendment allowed Interior to award grants for projects that had not received statutory authorization from Congress.



Title XVI

Research Studies

Three-Step Process

In Fiscal Year 2016 Reclamation offered the first competitive funding opportunity for Title XVI water reuse research studies. With the passage of the WINN Act, $50 million was authorized for new water reuse projects that *were not* individually congressionally-authorized through the traditional Title XVI process (GAO, 2018).

To be eligible for Title XVI funding under the WINN Act, projects must first submit a completed feasibility study to Reclamation for review and approval. The submitted study is then evaluated for technical and financial feasibility and whether it provides a federal benefit in accordance with reclamation laws. Subsequent to evaluations, Reclamation submits a report to Congress identifying projects eligible to apply for funding under the competitive grant program established by the WINN Act. This three-step process is intended to provide adequate review and vetting to ensure projects meet national, regional, and local water sustainability goals.

Title XVI Program Results

Leveraged Funding

Since the Title XVI program was enacted, over $640 million in federal funding has been leveraged with more than $2.4 billion in non-federal funding to design and construct water recycling projects in the Western US. With the increased advocacy of using Public-Private-Partnerships for water infrastructure, Title XVI appears to be a working hybrid approach to water development using appropriated funds to leverage local public and private funding.

Concerns

Several Members of Congress have voiced concerns over the Title XVI program costs and its impact on available funding for more traditional Reclamation activities and infrastructure replacement (CRS, 2010). Other Congressional Members have been interested to determine whether the Title XVI program helps provide additional water supplies quicker and at a competitive price. Some Members sought assurance that the program was supported by local water districts, municipalities, and small communities.

Proponents of Title XVI projects have listed numerous reasons they think their projects are worth the investment.

Project Benefits

These Project Benefits include:

- Costs per Acre-Foot are comparable to the development of new surface water supplies and costs are decreasing as technology evolves.
- Supply of Reuse Water Will Increase with time and will be dependable for years to come whereas surface water supplies will be diminishing due to hydrologic variability and increased demands.
- Regulatory Timeline: Regulations related to developing reuse and recycled water require much less in terms of time (months), money, and staff investment. This is because the footprint for most reuse and recycled projects are consistent with existing projects. New surface projects require a considerable investment in time (years), money, and staff support.
- Quicker Returns: Producing water that can be used for reuse and recycled water generally occurs within 12 to 24 months. Producing the first drop of useable water from surface development projects can range from five- to 20 years and some even longer.
- Local Input: Local water quality concerns can be more effectively addressed in reuse projects than in larger regional efforts.
- More Local Options: Expanding the portfolio of local water supplies provides options for local water utilities.
- Easier Financing: Leveraging federal funds against local public and private money avoids many of the headaches associated with having to get federal appropriations over multiple years.

Does Title XVI Provide Value-Investing for Water?

Cost Share

5:1 Ratio

In 2006, the US Senate held a hearing on Reclamation's Reuse and Recycling Program. It was reported by Inland Empire Utility Agency that the federal cost share often makes the difference in determining whether a project qualifies for financing (IEUA 2006). Reviews by the GAO (2018) and the CRS (2010) indicate that on average the federal investment is leveraged at a 5:1 ratio. In Fiscal Year 2017 the Federal investment of $714 million was leveraged against $2.8 billion, a factor of 5:1. Of this $714 million: 98% ($703 million) has been allocated to construction; 1.5% (49.9 million) was allocated to completion of feasibility studies; and 0.5% ($715 thousand) has been dedicated to research (GAO 2018).

Water Gains

The quantity of water provided from Title XVI projects annually in fiscal year 2009 was estimated to be 245,111 acre-feet for 16 projects (CRS 2010). In 2018, Reclamation estimated that 431,000 acre-feet (Reclamation, 2020) of water was supplied through Title XVI programs.

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Development Costs (Use)

The cost of new water development has been a criticism leveled at Title XVI programs. Comparing a variety of sources of developed water yielded the relative costs per acre-foot shown in Table 2. To be able to compare the actual costs per acre-foot of various sources of water it is necessary to know for what the water is to be used. Costs for development of water reuse is considerably lower if the water is going to be used for non-consumptive use. If the water is to be used for: irrigation; environmental purposes; groundwater recharge; or for landscaping — then the costs of development cost less than new surface water development. Historically developed surface water supplies benefited from the state and American taxpayers subsidizing the cost of water development. It is likely that those subsidies will not become available again and that new forms of public and private financing of water projects will become the norm.

Relative Costs

Table 2. Relative Costs of Water Supplies (per acre foot (af))

Type of Water Supply	Low End Cost (af)	High End Cost (af)	References
Surface Water			
Historical (subsidized)	$19.49	$99.67	BOR, 2019, CADWR 2019, Gleick 2020, SEA 2020, CDWR 2007
Current Costs:			
• Central Valley Project	$240.00	$1,325.00	
• State Water Project	$850.00	$1,456.00	
Reservoir Expansion	$1,700.00	$2,700.00	Stanford 2019
Stormwater Capture	$59.00 $150.00 (non-urban)	$250,000.00 $1,030.00 (urban)	Cooley 2019, Diringer et. al 2020
Groundwater Recharge	$90.00	$1,100.00	Stanford 2019
Desalination			St. Marie and Zafar, 2016, Cooley and Ajami 2012, Arroyo and Shirazi, 2012
• Seawater	$1,900.00	$3,000.00	
• Brackish	$317.00	$782.00	
Reuse/Recycling			Reznick et al., 2017, Cooley et al., 2019, St. Marie and Zafar, 2016, CA State Water Board and DWR, 2017
• Non-potable	$400.00	$5,800.00	
• Potable	$1,763.90 (large projects)	$2,319.00 (small projects)	
Urban Water Efficiency	$137.00 saved costs	$7,000.00 saved costs	Cooley, et al. 2019, St. Marie and Zafar 2016

Non-Monetized Benefits

In addition to the economic benefits, the value of new water supply results in multiple non-monetized benefits, including:

- Environmental benefits through the conversion of treated wastewater to new water supply
- Reduction of the volume of treated wastewater discharged to sensitive or impaired surface waters, including the ocean
- Avoidance of construction impacts of new supply development
- Reduced dependence on imported water
- Creation of dependable and controllable local sources of water for cities
- Reduced demand on existing potable supplies
- Energy benefits from reduced electricity demand and transmission line constraints during peak use periods
- Increased water security and resiliency to drought and water shortage conditions

Sustainability & Security

The combined result of developing new water supplies while realizing the non-monetized benefits of expanding the local and regional water portfolio is increased water sustainability and security. This does not mean that water scarcity and periodic shortages will not occur. Challenges will continue as the variability of climate change impacts on regional hydrology continues to expand. What it does mean is that the affect of the scarcity and shortages will be of lesser duration and will have fewer negative impacts on the local economy, population, and the environment.

Expanding Federal Role in Water Reuse

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Demands

The demand for scarce water supplies continues to expand in the west due to increased populations and continuing drought, as well as the challenges associated with increasing water demands associated with energy, environmental needs, and recreation.

Water Supply

Both the US Army Corps of Engineers (Corps) and Reclamation have been under increasing pressures to provide water supply for municipal and industrial purposes as their traditional water for irrigation, flood control, hydropower, and navigation have been either built out or have reached capacity. The era of building large new water projects to support regional development or to provide for safety has been completed. Increasing the federal tax burden to support expensive water projects has much less appeal for Congress and the public then it once did. In their place are demands associated with: growing populations; ecosystem and instream needs; changing agricultural requirements; energy costs of pumping and transporting water; pricing; and recreation desires. Supply factors, such as: water source contamination; environmental regulation; aging infrastructure; and adequate long-term climate change response are also on the agenda. All these pressing concerns are combining to focus interest on water sustainability and supply reliability.

Supply Factors

Major aspects of the evolving federal role in addressing these issues include the following:

Federal Role

Water Supply Act 1958

The federal role for municipal and industrial water development is vested in the Water Supply Act of 1958, which declared:

> …[it] to be the policy of the Congress to recognize the primary responsibilities of the States and local interests in developing water supplies for domestic, municipal, industrial, and other purposes and that the Federal Government should participate and cooperate with States and local interests in developing such water supplies in connection with the construction, maintenance, and operation of Federal navigation, flood control, irrigation, or multiple purposes. (Mountain Scholar, 2020)

Historically the federal agencies' role was focused on developing regional irrigation and water supply projects supplied by multiple-use dams and reservoirs.

State & Local Role

Development of water for municipal and industrial use has historically been the responsibility of the state and local governments. Where the federal government has played a more local role was when municipal and industrial water development was incidental to the federal primary purposes of irrigation, flood control, hydropower, and navigation.

Quality Issues

Clean Water Act 1973, Amendments 1987

In 1973, the United States implemented the Clean Water Act and with it a grant program to construct water infrastructure to improve and protect water *quality*. Concurrently the US Environmental Protection Agency (EPA) implemented — at Congress' direction — the Clean Water State Water Revolving Fund. In 1987, the Safe Drinking Water State Revolving Fund was created as part of the 1987 Clean Water Act Amendments (P.L. 100-4 1987). EPA provides annual capitalization grants to states to finance their State Revolving Funds, with the states then providing low interest loans to communities and water districts to construct water infrastructure — including water reuse projects.

State Revolving Fund

In addition to State Revolving Funds, EPA also makes grants for drinking water available through several independent programs:

Drinking Water Programs

- Water Infrastructure Improvements for the Nation (WIIN) Grants
- Public Water System Supervision (PWSS) Grant Program
- Tribal Public Water System Supervision (PWSS) Grant Program
- Training and Technical Assistance for Small System Grants
- Drinking Water State Revolving Fund (DWSRF)

Title XVI 1991

As noted above, initial development of Title XVI aimed directly at reducing Southern California's reliance on Colorado River water (CRS, 2010). In August 1991, Secretary of the Interior Manuel Lujan announced a program to develop a long-range strategy for the integration of fresh and reclaimed water management programs in Southern California (DOI, 1991). The objectives were four-fold: 1) increase water supplies to the area; 2) decrease the area's dependence on water imports; 3) help restore and protect the quality of existing groundwater reserves; and 4) assist in meeting environmental water needs.

Strategy Objectives

Water Infrastructure Finance and Innovation Act 2014

In 2014 — as part of the Water Resources Reform and Development Act (WRRDA) — Congress established the Water Infrastructure Finance and Innovation Act (WIFIA). WIFIA is designed to provide financial assistance for water infrastructure projects, including initiatives to build and upgrade wastewater and drinking water systems. The financial assistance is typically in the form of credit assistance through direct loans at US Treasury rates (which are lower than other forms of capital funding). During the three fiscal years of WIFIA use, $161 million has been appropriated for program credit assistance (CRS, 2019). Water reuse and recycling projects were considered priorities for funding for FY 2019.

WIFIA Infrastructure

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Reuse Collaboration

National Water Reuse Action Plan 2020

In September 2019, EPA and the Trump Administration announced the release of the draft National Water Reuse Action Plan (EPA, 2019). The Plan was not meant to be an EPA or federal plan. Instead the intent is for a collaborative effort between federal, state, and local entities across the water sector — with the goal of advancing water reuse. EPA laid out the business case for the Action Plan as an approach to replace the traditional, fragmented, "siloed" approach often applied to water resources management. The goal is to enable and integrate water reuse as part of a broader, more comprehensive, strategy to meet diverse water quality and quantity needs. The Action Plan specifically identified the need to include water reuse as part of an integrated water resource management effort at the watershed or basin scale. On March 3, 2020 EPA announced via the Federal Register the release of the *National Water Reuse Action Plan: Collaborative Implementation* (*Version 1*) (Federal Register 2020). *See TWR* #194 and #198, Water Briefs.

Agricultural Incentives (EQIP)

Natural Resources Conservation Service's Environmental Quality Incentives Program

Financial assistance is available to agricultural producers through the Environmental Quality Incentives Program (EQIP), administered by the Natural Resources Conservation Service (NRCS) of the US Department of Agriculture. Farmers and forest landowners are also eligible to apply for financial assistance to conserve and improve water resources. EQIP funding can be used to replace or improve the management of irrigation systems to conserve scarce water resources. EQIP is also used to manage nutrient applications to protect water quality. (NRCS 2019).

EQIP Purposes

In 2018, the Farm Bill expanded EQIP's purpose to include: new or expected resource concerns; adapting to, and mitigating against, increasing weather volatility; and addressing drought resiliency measures (P.L. 115-334). In addition, the legislation also expanded who could apply for EQIP funding to include: individual states; irrigation districts; groundwater management districts; acequias; land-grant Mercedes; or similar water distribution entities. Such entities are eligible to enter into an EQIP contract for implementation of water conservation or irrigation efficiency practices.

Myths/Options

Myths Regarding Federal Support of Water Reuse

The challenges facing the development of new local water supplies and improving local water reliability and sustainability are inhibited by several myths and agency perspectives. The fuel for these myths is the perception that the western United States is running out of water. It is true that water supplies are limited and in many locations over-allocated both administratively and physically. While it may be difficult to consistently satisfy the varied water demands of the agricultural, urban, and environmental needs — this does not mean that there are not options to satisfy those needs.

Myth #1. *Traditional water development coordinated through and funded by the federal government and taxes is a cost-effective use of taxpayer dollars*.

Traditional Options Limited

Traditional water development projects are faced with location, water supply, and financial challenges. Most of the locations in the west where dams could be built are:

- Already built-out
- Currently being used for other purposes (cities, towns, national parks, etc.)
- Geologically unsafe due to earthquake or land movement issues
- Located far-removed from where the water is needed, thus requiring extensive pipelines, canals, and pumps to move the water to where it is needed

While these are engineering issues and can be resolved, large costs and disruption of existing public use are entailed. The costs associated with planning, regulation compliance, construction, and operation are substantial. The appetite for the federal taxpayer to subsidize large water projects has diminished as the states have assumed more responsibility for water management.

Myth #2. *Imported water is more cost effective and sustainable than local water supplies*.

Historic Importing

Historically, federal water development was financially supported through direct and indirect subsidies and by long-term repayment contracts backstopped by the federal government and ultimately the American taxpayer. Imported water is subject to many constraints that locally developed water is not — primarily disrupted infrastructure and supply related issues.

Snowpack Variability

Issues associated with predictability of water supplied by seasonal snowpack has been impacted by increased variability in local and regional hydrology. Climate scientists in government and academia have invested considerable research and analytical assessment in determining that western water supplies will likely diminish and become more variable in the future (Conover ed. 2009).

Earthquakes

A significant challenge, especially in California, is the potential destabilization of the imported water canals due to seismic activity. Both the State Water Project and the Central Valley Project canals cross multiple fault lines as they traverse the state. Other western states also face potential disruption of water distribution systems including Idaho, Colorado, New Mexico, Nevada, and Arizona (EPA 2018).

Myth # 3. *Groundwater can replace surface water.*

Groundwater Limitations

Groundwater has for decades been the alternative water supply if surface water is diminished. The result in many areas has been that extraction of groundwater has led to: subsidence of land; reduction in non-agriculture well production; and diminishment of overall water quality.

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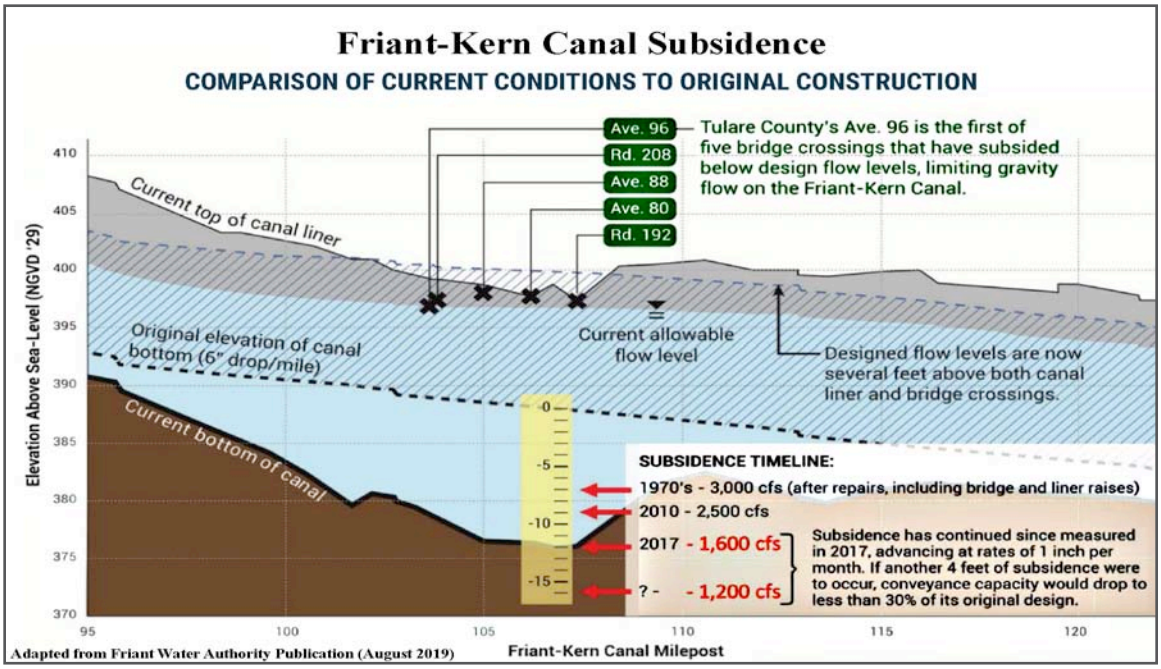
Reduced Pumping

Subsidence

In 2014, the State of California passed the Sustainable Groundwater Management Act (SGMA – *see TWR*s #128 (Moon), #163, #170, #181), which is making efforts through local groundwater basin plans, to reduce pumping and move towards sustainable groundwater supplies. The reduction in groundwater pumping will likely lead to changing agricultural crops and practices and shifting economic impacts (Farm Progress 2020).

Water distribution in California is already being impacted by excessive groundwater withdrawal. In the Central Valley of California, the Friant-Kern Canal has had its capacity substantially reduced due to subsidence, resulting in a 60 percent reduction in deliveries to water districts. The subsidence occurred from 2012 to 2016 and coincided with the increased groundwater pumping after Reclamation reduced surface water deliveries (Farm Progress 2018).

The SGMA, along with the 1980 Arizona Groundwater Act (*see* Staudenmaire, *TWR* #33*;* Megdahl, *TWR* #104*;* Moon *TWR* #125) and actions taken by other western states recognizes the importance of managing and protecting freshwater resources both above and in the ground.



Summary

There are multiple ways to create new, usable, "wet" water supplies for the growing West's urban needs. Calculating the cost of water development includes: the capital required to build a facility; the associated **o**peration and **m**aintenance (O&M) costs over the facility lifetime; replacement costs; the discount rate; expected lifetime; water production capacity; and water yield.

Development Costs

Quicker Access

An additional element in assessing potential water development options is the length of time it will take for getting access to water. Local, smaller-scale projects typically, once authorization and funding are in place, can move through the permitting and construction phase quickly. Small-scale projects typically take from two years to five years to be completed and producing useable water supply. Larger water developments (dams, large canals, pumping plants, etc.) can take anywhere from five to 20 years (or longer) to be completed. This is largely due to: the need to get multiple annual appropriations; acquiring multiple permits; significant time for development of reports; construction surprises; and the acquisition of rights of way for both access and construction. For large projects useable water supplies are typically not available until the full project is completed and approved for use.

Costs/Benefits Analysis

When assessing the economic viability of a water supply project, it is important to understand the difference between economic costs and benefits and financial accounting of costs and benefits (NRC, 2008b). Financial costs involve how much the utility must pay to construct and operate the water project, including interest costs. Economic costs account for all the costs to whomever they may accrue, including the costs to build and operate the project plus the costs that may be placed on the public associated with disruption, environmental costs, and other social costs. Benefits associated with a reliable water supply can be considerable.

Better Options

Forward looking decision-makers, both locally and regionally, see that future support for local populations and economies requires developing alternative water supplies. They realize that the historic approach of constructing dams and reservoirs is limited due to: lack of suitable locations; subsidized federal funding not being available; and regulatory restrictions to protect publicly valued rivers. Compounding the issue today is the increasing variability of available surface water supplies associated with climate change and drought (Cooley et al 2019).

Title XVI

Viable Options

Reuse & Recycling Factors

Water reuse and recycling *is a viable option* for developing resilient, sustainable, and secure local water portfolios. It is not a replacement for the traditional water supplies. If used in combination with other options, it will improve local water resiliency and water security. It is meant to provide water security, local water control, and an option for those instances when imported surface or groundwater is limited or not available.

Conclusions

The following conclusions are based on information collected and analyzed in your author's review of water reuse and recycling programs. They form a basis from which a dialogue can be started with water managers and the public to determine what suite of options best fits their needs and the expectations of their stakeholders.

- Water reuse and recycling is not intended to be a complete replacement for imported or locally available water supply sources. The intent is to: augment traditional water supplies; drought proof local water users; expand the water portfolio; and increase the resilience of water supplies.
- Water reuse and recycling assists in the drought proofing of a local area's water supply. It is intended to provide for a percentage of a local water suppliers total portfolio of available supply. The objective is to increase dependable water supplies.
- Financial costs of water reuse are variable due to the influence of site-specific factors. In general, the cost per acre-foot of *non-potable* reuse and recycled water is comparable to the cost of developing new surface water supplies. The cost per acre-foot for *potable* reuse and recycled water is dependent upon the size of the project — ranging from 20% to 60% more than traditional surface water supplies.
- In general, surface water projects take from five to 20 years for full project build-out and the delivery of wet water to a distribution system. In comparison, Title XVI projects can provide wet water to distribution systems within 12 to 24 months. The value in having access to a dependable water supply in a timely manner is important for many communities.
- Distribution system costs (separate "purple pipe" distribution) can be the most significant component of costs for *nonpotable* reuse systems.
- Recycling and water reuse projects tend to be more expensive that water conservation options and less expensive than developing new surface water supplies and seawater desalination.
- To determine the best economic and socially feasible alternative for local water users, water managers and planners should include assessing non-monetized costs and benefits of reuse projects in comparison to other water supply alternatives.
- Dependable water supplies should include a mix of different water sources in order to create a sustainable local water supply.
- Costs for new water supplies will be more expensive as compared to the traditional federal and state subsidized water.
- Alternative approaches to financing and supporting infrastructure is necessary. Using water pricing to allocate water among municipal, industrial, agricultural, and environmental users of water will become a tool to manage water scarcity and a way to minimize the potential for water shortages.

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David Wegner is retired from a senior staff position on water, energy, and transportation committees in the US House of Representatives. In that position he worked on legislation that directly affected administration policy and federal agency actions related to the US Army Corps of Engineers, the US Department of the Interior (DOI), the US Environmental Protection Agency, the Bonneville Power Administration, the Tennessee Valley Authority, and the US Department of Energy. Prior to serving in Washington, DC, he worked for over 20 years for DOI managing water and science programs in the Colorado River basin and the Grand Canyon. During his tenure at DOI he was instrumental in formulating the Adaptive Management approach for other river systems impacted by dams and river operations. From 1997 through 2008 he built a private international environmental company that focused on global water and climate issues. Currently he works as a senior scientist for strategic planning for Woolpert Engineering and provides input and strategic counsel to NASA/JPL, academic institutions, members of Congress and staff, and international organizations focused on water, energy, coastal, reservoir management, and climate issues. Mr. Wegner is a frequent lecturer on the use of science in natural resource management and on the history of western water. He is on the boards of the National Academy of Sciences, Glen Canyon Institute, the Sonoran Institute and mentors several post-docs in the US, Europe, and Asia through the International Association of Hydrologic Research.

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