Nonpotable Water Use by California Community Associations

FOUNDATION FOR COMMUNITY ASSOCIATION research

H2O:

The Smart Water Project

SMART WATER PROJECT REPORT

Nonpotable Water Use by California Community Associations

Published by the
Foundation for Community Association Research
Falls Church, Virginia

The Foundation for Community Association Research (FCAR) is a nonprofit affiliate of Community Associations Institute, the professional organization representing those who manage, govern, advise, and live in nearly 350,000 common interest communities throughout the United States. The Foundation's mission is to provide authoritative and reliable research and reports on the operations of the common interest community industry and its community associations.

This document is intended to provide reliable information regarding the subject matter covered. It is provided with the understanding that the publisher is not engaged in rendering legal, accounting, risk management, or other professional services. Readers should consult qualified professionals for appropriate advice on relevant matters.

Table of Contents

INTRODUCTION

Water may be the most valued and sought-after natural resource of the 21st century. Every day, our coastal areas discharge 12 billion gallons of wastewater into estuaries and oceans—equivalent to six percent of the country's total daily water use. Reusing this water would directly impact the nation's water supply and promote better conservation practices.

Climate change, drought, and population growth are creating stress in areas previously considered water-rich. People are starting to rethink how and where they live, work, and play based on availability and scarcity of water. There is no question that Americans waste water or that we need to be more attentive to conserving this vital natural resource. One place where we can make a difference is in the management of residential communities with large green space, golf courses, trails, and water features.

The *Community Association Fact Book* confirms that common interest ownership communities account for at least 22 percent of the American residential housing inventory, making them significant users (or abusers) of our water resources and prime candidates to lead the way in water reuse. California, in particular, has experienced severe drought and water use restriction in recent years, causing its communities to find alternative ways to handle irrigation, landscaping, and water feature management.

To help the 45,500 community associations in California, which represent 9 million homeowners, the Foundation for Community Association Research (FCAR) commissioned a research project to look into water use and reuse in California. This activity became known as the "Smart Water Project," and we are proud to present the results of our investigation on this important topic.

The rationale for the Foundation Smart Water Project was to assist community associations in California and neighboring states in finding effective methods to maintain their common infrastructure in the face of drought and regional water use restrictions. Because California is a bell weather site for new trends and ideas, we believe this project will benefit community association leaders in all regions as the nation addresses new environmental, resource, and housing challenges.

I would like to thank the members of the Smart Water Task Force—Skip Daum, Clifford Treese, Tyler Berding, Marvin Nodiff, and Margey Meyer—for sharing their time, talents, and networks to lead this project. We were incredibly blessed to have Leslie Valencia as our project manager. Leslie received the Foundation's Byron Hanke Fellowship during her master's program studies at the University of California-Berkeley, and she continues to work with us on innovative research projects.

We also recognize the generous and loyal donors whose contributions make this and other research projects possible. Two major donors whose support has enabled the Foundation to significantly ramp up our research agenda are the Foundation Think Tank and the Foundation for California Community Association Education (FCCAE). We are grateful for their confidence in our work.

We hope readers find this report informative, useful, and slightly provocative. We welcome your feedback and comments as we plan for continuing "Smart Water" research activity.

Christine Danielson
Research Committee Chair, 2016-2018
Foundation for Community Association Research

EXECUTIVE SUMMARY

The *Smart Water Project*'s goal was to investigate current community association usage of nonpotable (recycled) water (NPW) for irrigation and water feature maintenance and to identify potential incentives, barriers, and challenges to more communities adopting these practices.

To conduct this research, the Foundation for Community Association Research established a task force whose members have significant expertise in community association operations, management, law, and regulation. The Foundation engaged a professional researcher, along with a California firm with expertise in land use and regulation. See Appendix A for the task force members and project participants.

Smart Water research activity was conducted from 2016–2018 and focused on these areas of investigation:

- Literature search and review of common practices and policies for outdoor water use management in California communities, including site visits to several communities
- Survey of California community association leaders regarding interest in adopting nonpotable water usage
- Identification of case studies of nonpotable water use in community associations
- Review of recent actions by the California Legislature and State Water Resources Control Board to impose regulations on recycled water use in existing and new communities
- Review of statutory and regulatory activity regarding nonpotable water use in California and adjacent states
- Database compilation that includes essential information and electronic citations of laws and regulations that impede or encourage recycled or grey water use for residential conservation
- Investigate new technology and research on systems that promote water conservation and grey water use in residential communities in the USA and elsewhere
- Literature review of nonpotable water usage by communities in states other than California that encourage use of recycled water for water facility maintenance and irrigation
- Review findings of reputable scientific research on health and safety issues related to use of greywater for both indoor and outdoor use
- Identification of existing and emerging technologies that encourage greater use of recycled water in communities impacted by water restrictions and drought
- Identification of equipment vendors and installation providers in Western states

- Compilation of database of equipment, consultants, and vendors with expertise in nonpotable water irrigation systems to assist communities in implementing a recycled water use program

The research activity format included all of the following:

1. Face-to-face meetings and telephone interviews with CAI and other experts
2. Site visits to community associations in northern California currently using nonpotable water
3. Literature review and analysis of nonpotable water activity by the project manager
4. Original research to identify emerging best practices and issues of concern
5. Questionnaires and surveys sent to targeted audiences to determine the current level of activity and establish parameters of nonpotable water usage in California. Recipients of these surveys included:
   A. Executive directors of Community Association Institute's (CAI) eight California chapters, which represent more than 45,500 community associations and 6,100 individuals working in and for California community associations
   B. Community association managers and management company executives working in California and Western states impacted by drought condition and water use restrictions
   C. Vendors of large-scale irrigation and water management systems that service the community associations industry in Western states

Key Findings of the Smart Water Project Phase I:

1. Few community associations in California are using nonpotable water systems for irrigation and community resource management, and not much information is available about operations of the associations that are using it.
2. Primary barriers to nonpotable water adoption are: cost; available technology; problems with retrofitting/rebuilding common infrastructure; concerns about health/safety; value/return on investment; lack of information/education/technical expertise.
3. Primary incentives to nonpotable water usage are: recent water use restrictions; predictions about climate change and water availability; homeowner interest in "green" communities and conservation; state/local grants, rebates and tax relief programs.
4. Good models for community implementation of nonpotable water systems exist in California and states with historical track record of usage, including Florida, Texas, Nevada, Colorado. Local regulation in California plays a major role in the implementation of nonpotable water reuse systems.
5. Smart water usage is likely to become a rising trend in large-scale community association operations in the coming decade.

Impact and Utilization

By identifying and analyzing current practices, issues of concern, and practical case studies, this report aims to help community association leaders conduct thoughtful evaluation and make informed decisions about adding or expanding nonpotable water reuse to community operations.

While California has a long history of controlled water use management, this report has value for any community considering how to improve conservation and environmental activity in the face of changing climate conditions.

BACKGROUND

Research Plan and Goals
The State of California has experienced severe water shortages over the past decade, and in April 2016, official "drought" was declared with severe water usage restrictions in commercial and residential properties. Even though the severe drought water restrictions had been lifted at time of publication of this report, water use management and conservation remain critical issues for Californians. Gov. Jerry Brown recently said, "This drought emergency is over, but the next drought could be around the corner, and conservation must remain a way of life."

This research project was implemented to assess the costs, benefits, and feasibility of using nonpotable, recycled water for large-scale irrigation, landscaping, and water feature management in California community associations. The goal was to collect information on water reuse practices, review scientific and technical literature, and address barriers and incentives to continued water reuse. By collecting basic information, tracking nonpotable water use in California, and providing relevant case studies and expert professional contacts, we can help community associations manage resources, protect reserves, and promote conservation practices.

The Smart Water Project began in fall 2016, and Phase I was concluded in February 2018. The Foundation Smart Water task force and a professional researcher who served as project manager conducted most of the research activity. See Appendix A for names and credentials of this group.

Anticipated Outcomes:

- Collect baseline data on nonpotable water usage in California community associations
- Survey community associations to measure their interest in water reuse systems
- Identify barriers and incentives for more community water reuse
- Monitor California regulatory activity impacting recycled or gray water use
- Identify existing and emerging technologies for nonpotable water reuse
- Visit communities using nonpotable water to determine costs and benefits
- Compile list of qualified nonpotable water vendors and consultants
- Review relevant scientific and technical literature
- Compile database on relevant state statutes and regulations
- Compile case studies of community implementation of nonpotable water systems

METHODOLOGY

The research methods used for this study include personal interviews, surveys, site visits, questionnaires, literature reviews, and factual research.

Literature Review and Investigational Research
The project manager, an experienced and credentialed professional researcher with expertise in community association operations and management, conducted most of the research activity, including technical, engineering, and health/safety literature review, compilations of key contacts and information databases, interviews and survey management, and compilation and analysis of findings.

The Foundation engaged a Northern California land use firm to conduct the statutory and regulatory review based on its familiarity with and expertise in these matters.

California Chapter Executive Director (CED) Survey
A questionnaire was sent to all eight CAI California chapter executive directors, who represent more than 6,100 CAI members who are involved in community association activity. The questionnaire asked for general information about member interest and involvement in nonpotable water use, recommendations regarding potential site visits and case studies, and identification of reputable vendors, consultants, and service providers working in the irrigation and water management fields. The response rate was low, but we did receive some useful leads that lead to the Vendor Survey.

CAI Vendor Survey
A new survey was developed for vendors that design, install, or maintain nonpotable water systems in communities. Some contacts were obtained from the CAI Vendor Directory (Appendix B) and from San Francisco's nonpotable water systems vendors list (see sfwater.org/Modules/ShowDocument.aspx?documentID=9673).

Survey Results
These surveys yielded 154 vendor contacts that can assist California communities to implement a recycled water use program, but the response was too low to be statistically valid, and the quality of information provided was minimal. We hope to conduct another vendor survey.

Table 1 below shows a summary of the Smart Water survey results.

Company Name	CA NPW projects completed (last 5 yrs)	How many were CA Associations?	CA Community Association Inquiries	Alternative water collection systems used in CA Community Associations	CA Community Associations top 3 reasons not to use NPW systems
Water Systems Maintenance, Inc. 856 N. Elm Street, #K, Orange, CA 92867 www.watersystemsmaintenance.com 714-997-2770	10+	10+	Fountains, waterfalls and decorative water features, community-maintained lakes, ponds, and/or canals	Rainwater collection systems: gutters, water boxes, detention pond, etc., Pumping water from man-made water features for community irrigation	Cost to implement and maintain, concerns about health and safety issues, lack of public (governmental) incentives to do so
Allied Landscape 1647 Willow Pass Rd, Concord, CA 94520 www.contactallied.com 925-280-0160	10+	10+	Outdoor irrigation of open spaces or parks, community water conservation plan or program	Greywater collection and piping systems, laundry distribution to landscaping, pumping water from man-made water features for community irrigation	Lack of public (governmental) incentives to do so, no knowledge or awareness of how NPW works, lack of demand from users (homeowners and businesses)
Ecovie Environmental LLC 6000 Collins Avenue #512, Miami Beach, FL 33140 www.ecovierain.com 404-824-9266	5–10	1–5	Outdoor irrigation of open spaces or parks; outdoor irrigation for golf courses, walking/bike trails, and other recreational areas; fountains, waterfalls, and decorative water features; building heat and/or cooling applications; indoor plumbing use such as toilets, clothes washers, dishwashers, etc.	Rainwater collection systems: gutters, water boxes, detention pond, etc.; greywater collection and piping systems	Cost to implement and maintain, lack of public (governmental) incentives to do so, no knowledge or awareness of how NPW works
Rainwater Management Solutions 1260 W Riverside Dr, Salem, VA 24153 www.rainwatermanagement.com 540-375-6750	10+	1–5	Outdoor irrigation of open spaces or parks; outdoor irrigation for golf courses, walking/bike trails, and other recreational areas; building heat and/or cooling applications; indoor plumbing use such as toilets, clothes washers, dishwashers, etc., Community water conservation plan or program	Rainwater collection systems: gutters, water boxes, detention pond, etc.; greywater collection and piping systems; pumping water from man-made water features for community irrigation	Cost to implement and maintain, concerns about health and safety issues, lack of public (governmental) incentives to do so

Table 1. California Community Association Nonpotable Water Vendors (Survey Responses), created by Leslie Valencia, 2017

DEFINITIONS

Community Association – Community associations (also known as common interest ownership communities) are residential communities governed by certain legal declarations, or covenants, in which residents have common ownership of and responsibility for shared facilities and amenities, and all residents are members of a self-governing body (the association) that is responsible for maintenance and management of the commonly owned infrastructure. Community associations often are identified as homeowners associations (HOA), property owners associations (POA), or condominium associations (CA), depending on the type of entity and community they represent (CAI, 2018).

Community Association Management – the entity or person(s) responsible for operation of a community association, including common facility and area maintenance and management (CAI, 2018).

Water use terminology used in this report:

Dual distribution system – use of two separate water piping systems to distribute water to customers—one carrying potable water and the other conveying lesser-quality water (WRF, 2013)

Nonpotable water (NPW) – water that has not been examined, properly treated, or approved by appropriate authorities as being safe for human consumption. This is water that is not of drinking quality but may be used for many other purposes, depending on its quality.

Nonpotable reuse – all water reuse applications that do not involve potable reuse (EPA, 2012)

Direct potable reuse (DPR) – introduction of reclaimed water, with or without retention in an engineered storage buffer, directly into a drinking water treatment plant, either collocated or remote from the advanced wastewater treatment system (EPA, 2012)

Indirect potable reuse (IPR) – augmentation of a drinking water source (surface or groundwater) with reclaimed water followed by environmental buffer that precedes drinking water treatment (EPA, 2012)

Potable water – drinking water that meets or exceeds state and federal drinking water standards (watereuse.org, 2017)

Potable reuse – planned augmentation of a drinking water supply with reclaimed water (EPA, 2012)

Gray water (grey water) – water from the kitchen, bath, and/or laundry that generally does not contain significant concentrations of excreta (WHO, 2016)

Runoff – how groundwater from rainfall or snow melt can be captured and possibly reused for commercial and residential purposes. For the purposes of this report, the term includes water from rooftops, as well as ground sources (WE&RF, 2017; CAI, 2018).

Recycled water/reclaimed water – "recycled water," "reclaimed water," or "treated sewage effluent water" means treated or recycled waste water of a quality that's suitable for nonpotable use such as landscape irrigation and water features. This water is not intended for human consumption (23 CCR § 491).

Stormwater – precipitation runoff from rain or snowmelt events that flows over land and/or impervious surfaces (e.g., streets, parking lots, and rooftops). Runoff from roofs with frequent public access is defined herein as stormwater (WE&RF, 2017).

Wastewater – liquid waste discharged from homes, commercial premises, and similar sources to individual disposal systems or municipal sewer systems and that contains mainly human excreta and used water. When produced by household and commercial activities, this is called domestic or municipal wastewater or domestic sewage. In this context, domestic sewage does not contain industrial effluents at levels that could pose threats to sewerage systems, treatment plants, public health, or the environment (WHO, 2016).

Water rights – legal permission to use a reasonable amount of water for a beneficial purpose such as swimming, fishing, farming, or industry (CA Water Board, 2017)

- **Appropriative water rights** – When someone uses water on non-riparian land or uses water that would not be there under natural conditions on riparian land, he or she appropriates water. Water right permits and licenses issued by the State Water Board and its predecessors are appropriative water rights. An appropriative water right that was acquired before 1914 is called a pre-1914 appropriative water right. If a user has a pre-1914 right, that person doesn't need a water right permit unless he or she has increased water use since 1914. If the amount of water used has increased since 1914, the user must get a water right permit for the new amount, unless it can be proven that the user had a plan in place before 1914 to use the additional water after 1914. Once the user loses an appropriative water right, he or she must apply for and receive a new water right permit from the state before resuming use of the water (CA Water Board, 2017).

- **Riparian water rights** – A riparian water right is a right to use the natural flow of water on riparian land. Riparian land is land that touches a lake, river, stream, or creek. Riparian rights usually come with owning a parcel of land that is adjacent to a source of water, and the rights remain with the parcel when it changes hands. However, a riparian right can be lost even if land is not cut off from the water source. This can happen when the owner of the riparian land sells or transfers the land to someone but explicitly separates the riparian right from the parcel. Once it is lost, a riparian right can almost never be restored. Riparian water rights cannot be sold or transferred other than with the riparian land (CA Water Board, 2017).

Reclaimed Water – used water that has been treated to be fit-for-purpose for reusing or recycling (watereuse.org, 2017).

Reused Water – water used more than once that has been treated to a level that allows reuse for a beneficial purpose (watereuse.org, 2017).

STATUTORY & REGULATORY ENVIRONMENT

The Foundation engaged professional staff from PCC Land Consultants to review and analyze existing laws and regulations in California and adjoining states that affect residential community use of recycled water for irrigation purposes. That research was conducted in May 2017 and the complete report, *Overview of Laws and Regulations Governing Water Reuse in California, Arizona, Nevada and Texas*, is included in the Appendix B.

Note the following conditions underlying this report: Unless nonpotable water reuse guidelines are specifically incorporated into a law or regulation, they are not enforceable and serve only as useful information. While there are no comprehensive federal regulations on water reuse, established water rights law (appropriative and riparian) provide[s] “legal right for an entity to divert, capture, and use water within the boundaries of each individual state.” Because these water rights laws are uniquely implemented in each state, it is difficult to establish a model for nonpotable water use that can be replicated nationally. Federal regulations do address related topics such as water pollution, stormwater management, and plumbing.

Below is a list of the relevant federal guidelines and regulations with a brief summary of each:

Federal Water Pollution Control Act (Title 33)	addresses water pollution prevention and control
Title 40, Code of Federal Regulations	includes federal water quality standards and state specific standards for certain waters of Arizona and California, namely the San Francisco Bay/Sacramento-San Joaquin Delta Estuary
U.S Environmental Protection Agency (EPA)	established guidelines to encourage states to develop their own regulations
EPA 2012 Guidelines for Water Reuse	issued in 1980 and updated in 1992, 2004, and 2012
The 2015 International Residential Code, International Plumbing Code, Uniform Plumbing Code, and International Green Construction Code	require that water reuse systems used for residential toilet/urinal flushing comply with the NSF/ANSI 350: Onsite Residential and Commercial Water Reuse Treatment

Table 2. Federal regulation related to nonpotable water reuse, created by Leslie Valencia, 2017

California, Arizona, Texas, Florida, and Nevada have established water reuse programs, and more states recently have adopted laws and regulations regarding water reuse. As seen in Figure 1 below, other than these five states, most states do not have specific laws or regulations on water reuse. Some East Coast states have adopted minimal regulations, and most other states have non-enforceable guidelines.

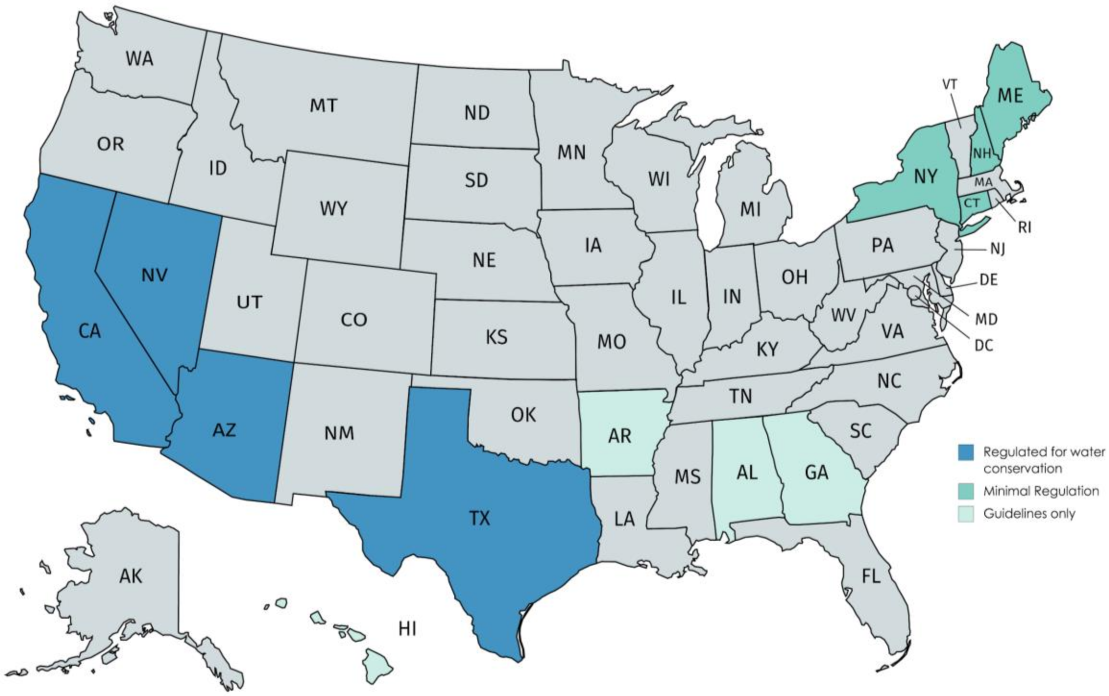


Figure 1. United States Water Reuse Guidelines and Regulations, created by Leslie Valencia, 2017

It is difficult to compare the various state policies and regulations because there are no uniformly accepted definitions for this subject matter. Bluefield Research, an independent firm, analyzed 607 water reuse projects in the pipeline in Florida, California, Texas, and Colorado (which adopted its first statewide water regulation in 2015). These projects account for 95 percent of planned water reuse projects at this time. According to Bluefield, Florida and California have the most installed water reuse capacity, followed by Texas and Arizona. See Figure 2 below:

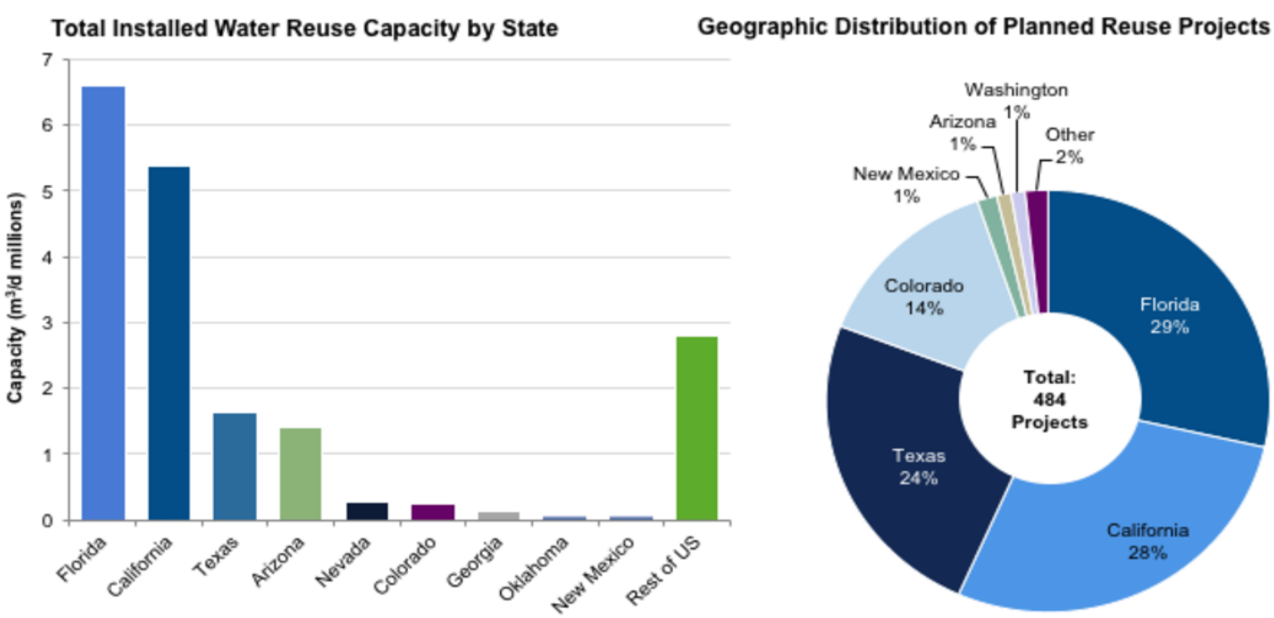


Figure 2. Water Reuse Capacity by State and Geographic Distribution of Reuse Projects, Bluefield Research, 2016

NONPOTABLE WATER USE IN CALIFORNIA

According to the California State Water Resources Control Board (SWRCB) and the Department of Water Resources (DWR), farmers began using wastewater for landscape irrigation and to grow crops in the 1800s in California. By the 1950s, there were 100 communities and entities using this technique. In 1970, the first survey on recycled water use in California was conducted. The 1990 survey estimated 175,000 acre-feet of municipal wastewater was recycled, with two-thirds used for agriculture.

According to the most recent survey, conducted in 2015, the State reuses around 706,247 acre-feet of municipal water per year. Recycled water represents about 14 percent of the 5 million-acre feet of municipal water produced annually in California. (SWRCB and DWR, 2012).

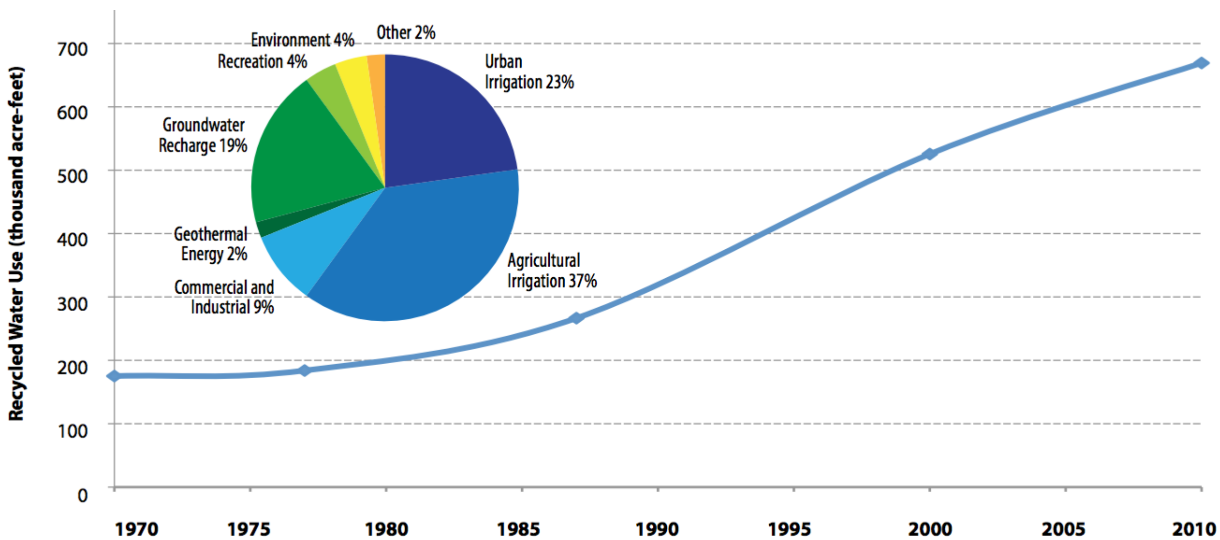


Figure 3. Recycled Water Trends in California 1970–2009, SWRCB and DWR, 2012

*Urban irrigation includes the use of recycled water for irrigating large landscapes and golf courses. Groundwater recharge includes the use of recycled water for that purpose and as a seawater intrusion barrier.

As seen in Figure 3, more than half the reuse water is for agriculture and urban irrigation. However, there are other uses, such as groundwater recharge, that address energy and water conservation. This chart also shows a growing trend of recycled water reuse over time due to several state-level initiatives including the 1972 Clean Water Act and the Water Reuse Law of 1974, which declared that the "primary interest of the people of the state in the conservation of all available water resources requires maximum reuse of reclaimed water in the satisfaction of requirements for beneficial uses of water." Assembly Bill 331 (2001) created the Recycled Water Task Force, a group of water recycling experts from public and private sectors who work with governmental and environmental organizations. The task force has developed recommendations that can be found in the report *Water Recycling 2030: Recommendations of California's Recycled Water Task Force* (see www.water.ca.gov/pubs/use/water_recycling_2030/recycled_water_tf_report_2003.pdf).

The Water Recycling in Landscaping Act and Water Recycling Policy (see www.waterboards.ca.gov/water_issues/programs/water_recycling_policy/) further reinforced the importance of water conservation and recycled water reuse in California. Resolution No. 2016-0061 (2016) (see www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2016/rs2016_0061.pdf) requires the California Water Recycling Policy to be updated. This update is expected in December of 2018.

The California Water Code allows public agencies to allow or require recycled water reuse for irrigation or residential landscaping as long as:

1. The recycled water doesn't cause any loss or diminution of any existing water.
2. The public agencies comply with Section 13550, which states: *"Use of potable domestic water for irrigation of residential landscaping is a waste or unreasonable use of water within the meaning of Section 2, Article X, of the California Constitution if recycled water, for this use, is available to the residents and meets requirements set forth in Section 13550 …"* (see leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=WAT&sectionNum=13550).
3. The irrigation systems comply with Chapter 3 (Section 6030) of Division 4 of Title 22 (see govt.westlaw.com/calregs/Browse/Home/California/CaliforniaCodeofRegulations) Under this regulation, the following levels (Table 3 below) of treated municipal wastewater are allowed/defined as:

Disinfected Secondary	*May be used to irrigate crops not for human consumption or where the edible portion of the crop does not come into contact with the recycled water*
Disinfected Secondary-23	*May be used for freeway landscaping, restricted access golf courses, or landscape irrigation where there is controlled access to the irrigated areas*
Disinfected Secondary-2.2	*Certain food crops where the edible portion does not come in contact with the recycled water*
Tertiary Disinfected	*May be used for landscape irrigation where public contact may occur such as parks and playground; commercial uses, such as area wash-down and vehicle washing; or industrial uses, such as cooling towers*
Advanced Treatment	*May be used for groundwater replenishment and as a domestic water supply. Disinfected recycled water is the predominant recycled water quality used; it accounted for 66 percent, or 465,000 acre-feet per year, of use in 2015. A total of 56 percent of the tertiary recycled water is used for landscape, agricultural, and golf course irrigation.*

Table 3. Chapter 3, Division 4 of Title 22 California Code of Regulations

The California Water Code, Division 6, Part 2.6, Section 10610-10610.4, also requires urban water management plans from urban water suppliers "providing water for municipal purposes either directly or indirectly to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually." These plans are centered around long-term water conservation methods while addressing the public health concerns of recycled water and other water management strategies. Nearly 420 urban water suppliers submitted data that's available at wuedata.water.ca.gov.

For specific construction and design guidelines, builders refer to Title 24, Part 5, of the California Plumbing Code (2016), which is currently being updated. As shown in Figure 4, amendments from the 2016 Intervening Code adoption cycle will become effective July 1, 2018. See www.iapmo.org/Documents/Codes/2016%20CPC%20Supplement.pdf

California's buildings codes are published every three years. However, there are Intervening Code Adoption Cycles every 18 months. Relevant agencies, including the Department of Housing and Community Development, Division of the State Architect-Access Compliance, Division of the State Architect-Structural Safety, Office of the State Fire Marshall, Office of Statewide Health Planning and Development, and the Department of Public Health may propose changes to the California Plumbing Code. They then propose changes to the California Building Standards Commission. The California Building Standards Commission Code Advisory Committee reviews proposals and makes recommendations to the state agencies after hosting a series of public meetings.

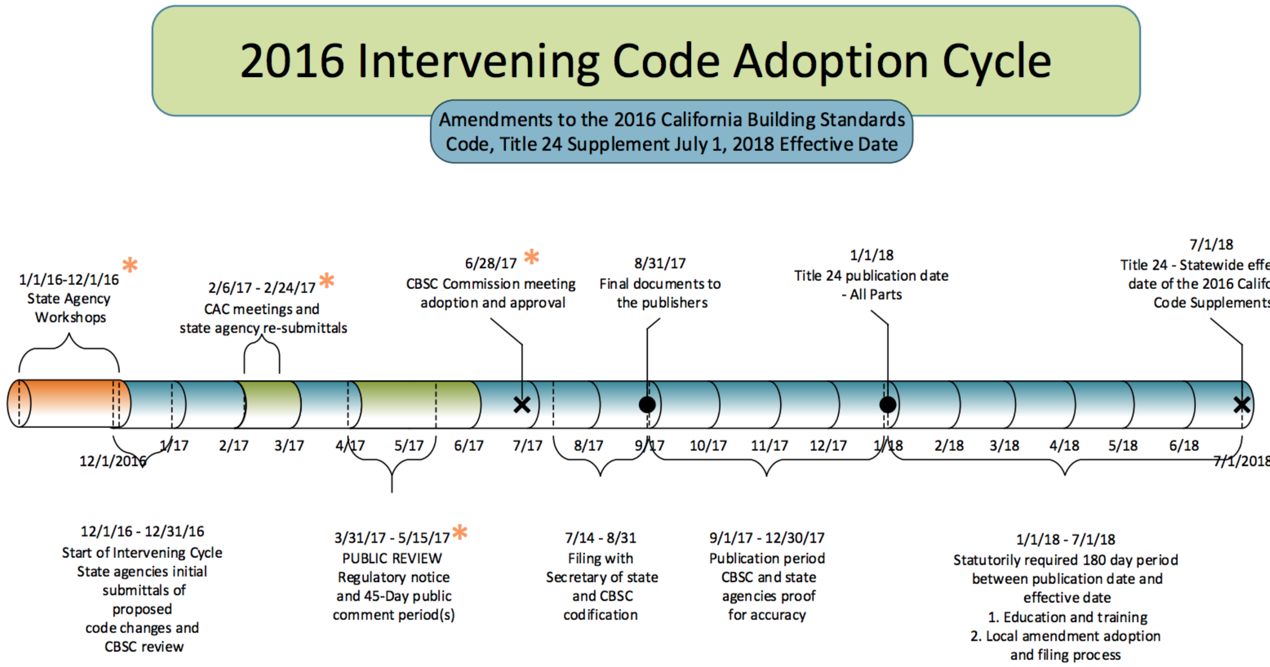


Figure 4. 2016 Intervening Code Adoption Cycle to the 2016 California Building Standards Code, Title 24

The proposed changes to Chapter 15 of the California Plumbing Code, titled Alternate Water Sources for Nonpotable Applications, will:

1. Conserve potable water by facilitating greater reuse of laundry, shower, lavatory, and similar sources of discharge or, by use of alternative water sources, where available, for irrigation and/or indoor use

2. Reduce the number of non-compliant gray water systems by making compliance easily achievable

3. Provide guidance to avoid potentially unhealthful conditions

4. Provide alternatives to relieve stress on private sewage disposal systems by diverting the graywater

The California Code of Regulations Title 23, Division 2, Chapter 2.7. Model Water Efficient Landscape Ordinance (see water.ca.gov/LegacyFiles/wateruseefficiency/docs/MWELO09-10-09.pdf) provides guidelines for water efficiency and water conservation in outdoor irrigation.

California Homeowner Associations and Water Reuse

Community associations in California became more interested in water reuse as the state became heavily impacted by drought conditions in 2006 and subsequent water use restrictions were imposed. When the governor officially declared a drought emergency in 2014, several bills were passed that amended the California Civil Code to establish fines for community associations that did not adopt water conservation methods recommended by the state.

As seen in Figure 5, most of the regulations applicable to homeowners associations address aesthetics more than operational practices. In part, this relates to the fact that aesthetics and “curb appeal” are a significant factor for residents who choose to live in a community association, and restrictions on the aesthetics, amenities, and appearance can affect decisions about changing water management practices.

This report seeks to identify the primary benefits and challenges for California community associations that are considering adoption of new water conservation and management practices and, specifically, to integrate nonpotable water reuse into community irrigation practices.

Relevant resources include:

- www.theacorn.com/articles/homeowners-hoa-clash-over-landscape-rules
- www.desertsun.com/story/news/environment/2016/02/04/hoas-could-face-fines-under-california-drought-rules/79818412
- www.ocregister.com/2017/07/26/rancho-santa-margarita-resident-hoa-at-odds-over-drought-tolerant-front-lawn
- www.latimes.com/business/la-fi-associations-drought-landscaping-20161130-story.html
- www.latimes.com/business/la-fi-associations-20151004-story.html

State Laws Governing HOAs and Landscaping

Assembly Bill 1881 (2006)

This bill established that the architectural guidelines of a common interest development shall not prohibit or include conditions that have the effect of prohibiting the use of low water-using plants as a group.

Assembly Bill 1061 (2009)

Precludes HOAs from prohibiting or restricting residents' compliance with local water-efficient landscape ordinances and local water use restrictions.

Assembly Bill 2100 (effective 7/21/14)

Prohibits HOAs from imposing a fine or assessment on property owners for reducing or eliminating watering of plants and lawns if the governor or local government has declared a drought emergency.

Senate Bill No. 992 (effective 9/18/14)

Prohibits HOAs from requiring power washing of exterior surfaces during a governor or local government declared drought and clarifies that a common interest development cannot penalize property owners for reducing or eliminating watering of plants and lawns during a drought emergency unless the development uses recycled water for landscape irrigation.

Assembly Bill No. 2104 (effective 1/1/15)

Bars a common interest development from prohibiting the replacement of existing turf with low water-using plants. This measure preserves the authority of a common interest development to impose design and quality standards.

Resolution 2016-0007 To Adopt an Emergency Regulation

(e)(1) To prevent the waste and unreasonable use of water and to promote water conservation, any homeowners' association or community service organization or similar entity is prohibited from:

(A) Taking or threatening to take any action to enforce any provision of the governing documents or architectural or landscaping guidelines or policies of a common interest development where that provision is void or unenforceable under section 4735, subdivision (a) of the Civil Code; or

(B) Imposing or threatening to impose a fine, assessment, or other monetary penalty against any owner of a separate interest for reducing or eliminating the watering of vegetation or lawns during a declared drought emergency, as described in section 4735, subdivision (c) of the Civil Code.

(2) As used in this subdivision:

(A) "Architectural or landscaping guidelines or policies" includes any formal or informal rules other than the governing documents of a common interest development.

(B) "Homeowners' association" means an "association" as defined in section 4080 of the Civil Code.

(C) "Common interest development" has the same meaning as in section 4100 of the Civil Code.

(D) "Community service organization or similar entity" has the same meaning as in section 4110 of the Civil Code.

(E) "Governing documents" has the same meaning as in section 4150 of the Civil Code.

(F) "Separate interest" has the same meaning as in section 4185 of the Civil Code.

(3) If a disciplinary proceeding or other proceeding to enforce a rule in violation of subdivision (e)(1) is initiated, each day the proceeding remains pending shall constitute a separate violation of this regulation. Authority: Section 1058.5, Water Code.

Figure 5. Water Conservation Laws for Homeowner Associations, East Bay Municipal Utility District

NONPOTABLE WATER USE IN KEY STATES

Florida

Although Florida received significant annual rainfall, which occurs mostly during a four-month period creating periodic droughts throughout the rest of the year. Florida has limited sources of potable groundwater other than from rainfall and freshwater lakes and rivers. As seen in Table 4, Florida has a long history of using reclaimed water for irrigation, starting with farm and crop irrigation since 1966 and major golf course maintenance since 1973.

Year	City/Region	Event
1966	Tallahassee	Spray irrigation: crops
1973	Fiesta Village	Irrigation: golf courses
1976	Vero Beach	Industrial: power plant cooling tower
1977	St. Petersburg	Dual water distribution begins: landscape irrigation
1977	Gainesville	Ground water recharge: wastewater injected into Floridian aquifer
1978	Loxahatchee River Environmental Control District	Reuse program begins
1980	Tallahassee	Opens Southeast farm
1986	Orlando–Orange county	Water Conserv II starts: Irrigation of citrus groves and ground water recharge thru rapid infiltration basins
1987	Orlando	Wetlands begins: 1640 acres in public park and nature preserve
1991	Altamonte Springs	Project APRICOT begins: landscape irrigation
1992	Cape Coral	World's largest residential irrigation program
1998	West Palm Beach	Permit issued for indirect potable water reuse
2001	Hillsborough County NW	Testing of a reclaimed water ASR well

Table 4. History of Reclaimed Water Use in Florida (modified from FDEP 2003), University of Florida, 2009

Water Conserv II, a water reclamation and reuse program formed through a partnership between the City of Orlando and Orange County, started operations in 1986. Water Conserv II provides an "annual average of up to 35 million gallons per day (mgd) of reclaimed water for agricultural and residential irrigation and aquifer recharge (WSP USA, 2017)." In comparison, the State of Florida reuses about 738 million gallons of reclaimed water per day (SFWMD, 2017). This is the largest project of its kind in the world and often is described as a form of "cooperative water reuse." It was the first project to meet the Florida Department of Environmental Protection's (FDEP) public access reuse standards and become permitted for regular activity. Reclaimed water has been used for citrus farm irrigation for more than 20 years, providing water for 4,300 acres of crops. It also is used to irrigate two Orange County golf courses, 12 nurseries, and several residential neighborhoods. (Parsons, 2007). See Figure 6.

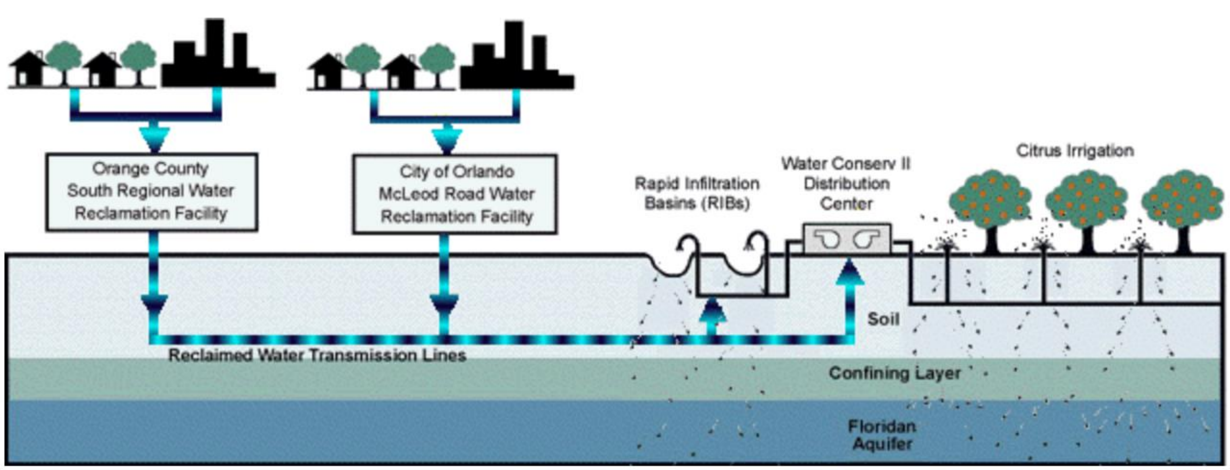
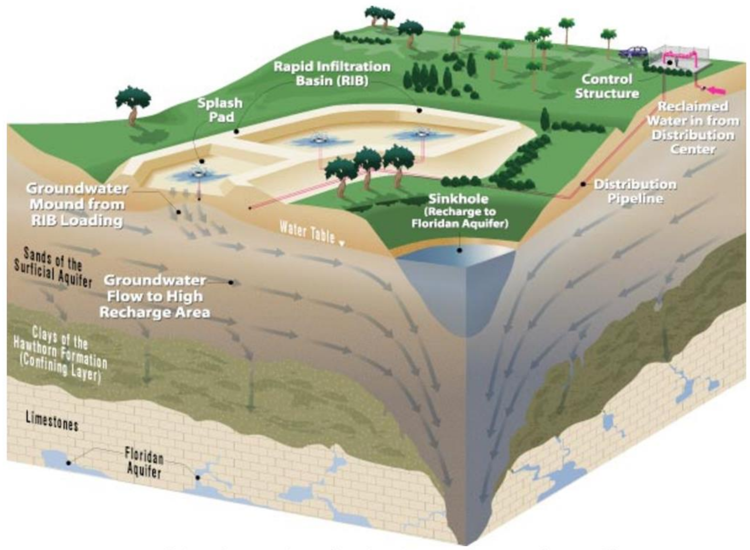


Figure 6. Water Conserv II, Project Website, 2017

Water Conserv II is an innovative water reuse project that combines agricultural irrigation with use of rapid infiltration basins (RIBs). The RIBs are made up of several cells of about 150 feet wide and 350 feet long. As seen in Figure 7, below, the water trickles through 30 to 200 feet of natural sand. It then goes through a layer of Hawthorn formation, a dense concentration of semi-permeable clays. Finally, it ends up in the Floridan Aquifer, replenishes the drinking water supply, and meets "most state and federal primary and secondary drinking water standards." (Project Website, 2017)



Reclaimed Water is Refined as it Travels From the Rapid Infiltration Basin to the Floridan Aquifer Below

Figure 7. Water Conserv II Rapid Infiltration Basin System, project website 2017

In 2005, Florida enacted the Water Protection and Sustainability Program (WPSP) to encourage cooperation among counties, municipalities, and the state's five water management districts. This legislation also established a state funding source for alternative water resource projects.

According to FDEP, in 2016, reclaimed water for Florida public access areas provided irrigation for 362,737 residences, 537 golf courses, 1,022 parks, and 369 schools. As seen in Figure 8, 58 percent of reclaimed water use activity takes place in public access areas. In addition, although precise figures are not available, many private residential communities in Florida are using reclaimed water to irrigate common areas and golf courses and to maintain water features.

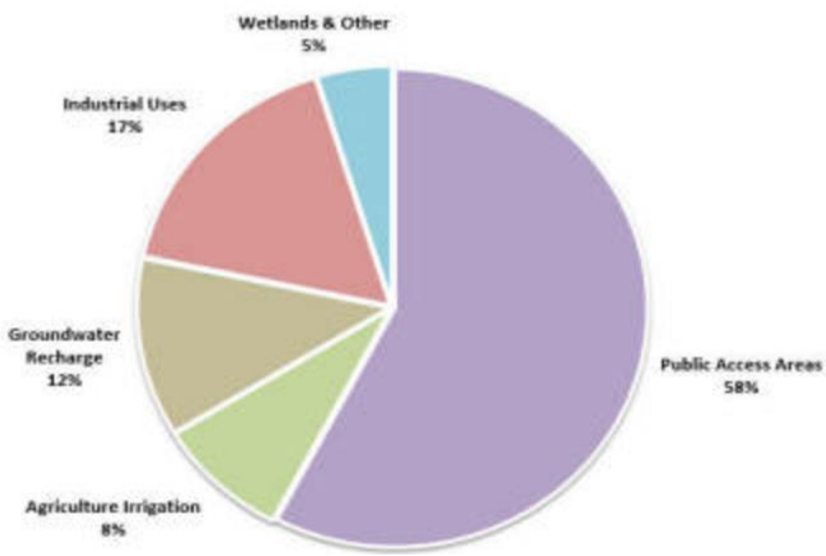


Figure 8. Reuse Activities in Florida, FDEP, 2016

As demand for irrigation and maintenance of public and private areas in Florida continues to rise, the State expects to continue supporting alternate water source projects. Florida publishes an interactive map where users can search various locations and find the nearest water reuse facility operating in the area. This map can be found at www.sfwmd.gov/our-work/alternative-water-supply/reuse.

FDEP provided this list of current public water reuse projects:

- St. Petersburg Dual Distribution System
  Use: landscape irrigation of 9,992 residences, 61 schools, 111 parks, six golf courses, cooling towers

- *Project APRICOT*
  Use: landscape irrigation, commercial car wash, street sweeping equipment, fire control

- *Orlando Wetlands*
  Use: manage 1,640 acres of wetlands ecosystem

- *Tallahassee Spray Irrigation System*
  Use: irrigate more than 2,200 acres of agricultural crops

- *Gainesville*
  Use: irrigate residential lawns, golf courses, botanical garden, and recharge groundwater

- *Reedy Creek Utilities*
  Use: landscape irrigation of five golf courses, five hotels, numerous highway medians, water park, Disney World Resort horticultural area, various Disney operations, and groundwater recharge

Arizona

Arizona is believed to be the first state to develop a dual distribution system. This wastewater treatment plant in Grand Canyon Village, completed in 1926, was the first to separate nonpotable from potable water, allowing the former to be used for flushing toilets, powering steam locomotives, and as boiler feed (ADEQ, 2014). However, regulations on nonpotable water use were not adopted until 1972. Arizona statutes require permits for certain discharges associated with manmade bodies of water, and under Arizona Administrative Code, Title 18, Chapter 11, there are provisions regarding quality standards for reclaimed water. Arizona uses five quality standards for reclaimed water, ranging from A+ to C (see Table 5). According to the Arizona Department of Environmental Quality (ADEQ), about 70 percent of permits issued are for Class A+ and A, and 80–90 percent of all municipal water is reclaimed and reused.

Type of Direct Use	Min. Class
Irrigation of food crops; recreational impoundments; residential landscape irrigation; school ground landscape irrigation; open-access landscape irrigation; toilet and urinal flushing; fire protection systems; spray irrigation of orchard or vineyard; commercial closed-loop air conditioning systems; vehicle and equipment washing (does not include self-service vehicle washes); snowmaking	A+, A *Open Access uses* Pathogen-free turbidity <2 NTU -denitrified (A+)
Surface irrigation of an orchard or vineyard; golf course irrigation; restricted access landscape irrigation; landscape impoundment; dust control; soil compaction and similar construction activities; pasture for milking animals; livestock watering (dairy animals); concrete and cement mixing; materials washing and sieving; street cleaning	B+, B *Restricted Access uses* fecal coliform organisms < 200/100 ml denitrified (B+)
Pasture for non-dairy animals; Livestock watering (non-dairy animals); Irrigation of sod farms; Irrigation of fiber, seed, forage, and similar crops; Silviculture	C+, C *Very Limited uses* fecal coliform <10mg/l for C+ & <1000/m for C

Table 5. Minimum Reclaimed Water Quality Requirements for Direct Reuse

Arizona's four main sources of water are the Gila River, the Colorado River, groundwater, and reclaimed water. Arizona continues to support reclaimed water reuse projects with public and private funds to encourage sustainability. As seen in Figure 9, municipalities and for-profit entities are the largest suppliers of reclaimed water in the state. For-profit entities sell reclaimed water at significantly lower rates than drinking water or wastewater. While the median charge is 8.7 cents per 1,000 gallons, "some utilities even offer effluent free of charge from company standpipes or sell at 'market rate,' which is whatever price the customer is willing to pay for the water, (EFC and UNC, 2017)." The median charge for municipalities is $1.78 per 1,000 gallons. However, overall, reclaimed water bills in Arizona are still "considerably lower than bills for commercial water use, with median bill amounts approximately four times less expensive than potable water (EFC and UNC, 2017)."

Figure 9. Reclaimed Water Rate Structures by Utility Type (n=51), EFC and UNC, 2017

Nevada
Although the Colorado River is also Nevada's primary source of water, only a certain amount of the water is allocated to the state, which addresses restrictive water use through direct and indirect reuse policies. Nevada's definitions for these terms are listed below, as published by the Southern Nevada Water Authority (SNWA):

- **Direct reuse** involves capturing, treating, and reusing wastewater flows for uses such as golf courses or park irrigation.
- **Indirect reuse** consists of recycling water through the wastewater treatment facilities and releasing it back into Lake Mead for return flow credits.

According to the SNWA 2017 Water Resource Plan, "approximately 22,000 AFY of water is directly reused in Southern Nevada for golf course irrigation, power plant cooling, sand and gravel operations, and municipally operated common area landscape irrigation."

Return flow credit (Figure 10 below) means that the state is allowed to use one gallon more water than what is allocated for every gallon they return back into the Colorado River. Due to this incentive, SNWA says that 90 percent of recycled water is for indirect reuse (Figure 11).

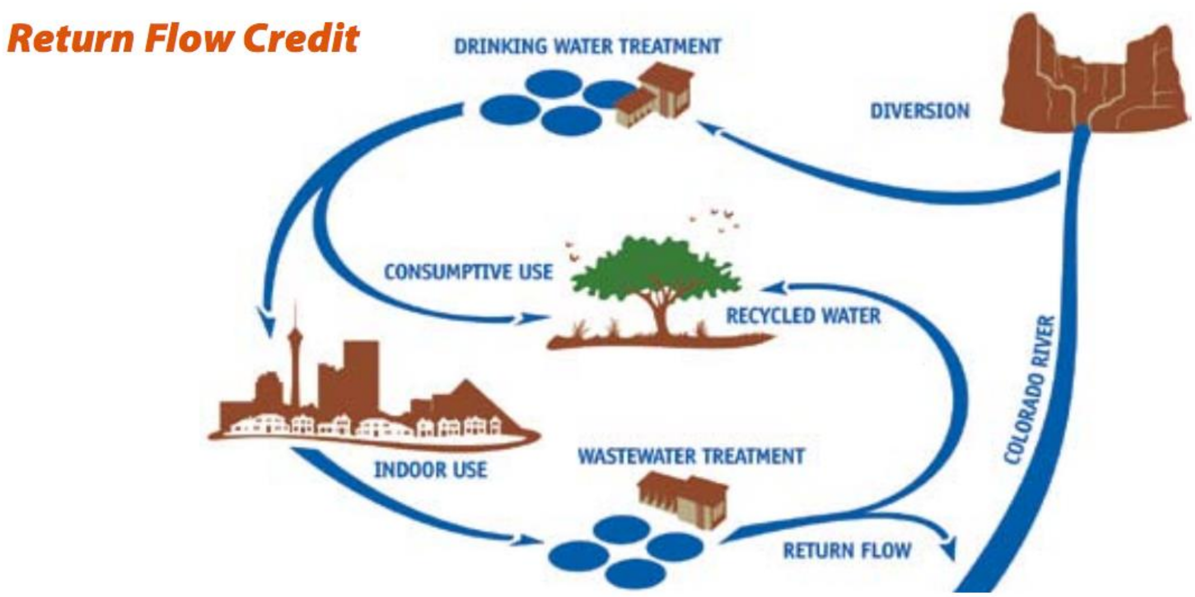


Figure 10. Return Flow Credit, SNWA, 2009

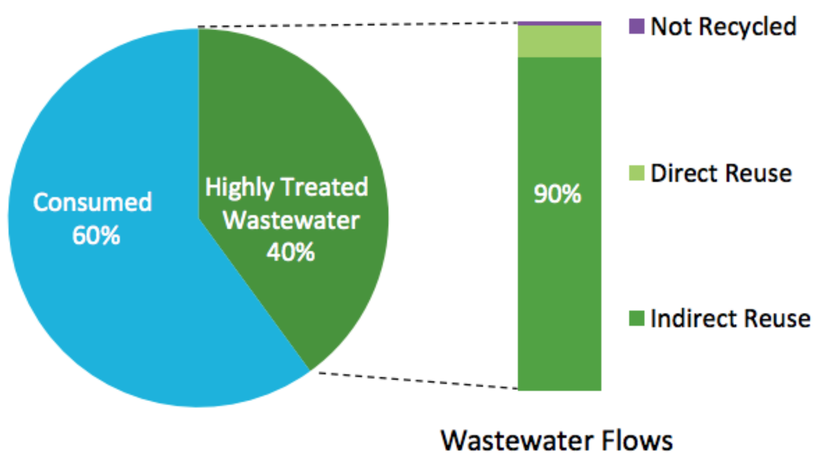


Figure 11. SNWA Water Use and Recycling, SNWA, 2017

Overall, about 40 percent of Nevada's water is recycled (Figure 11). Nevada Title 48 Water Law, Chapter 540 (under Planning and Development of Water Resources), requires all water suppliers to adopt a water conservation plan that must be updated every five years. As seen in Figure 12, this has motivated Nevada businesses and commercial users to recycle water for outdoor irrigation.

Nevada Water Reuse (SNWA, 2009):

- Approximate annual volume of indirect water recycling – 186,000 acre-feet
- Approximate annual volume of direct water recycling – 27,000 acre-feet
- Golf courses irrigated with recycled water – 30 golf courses
- Power plants using recycled water for cooling – two power plants

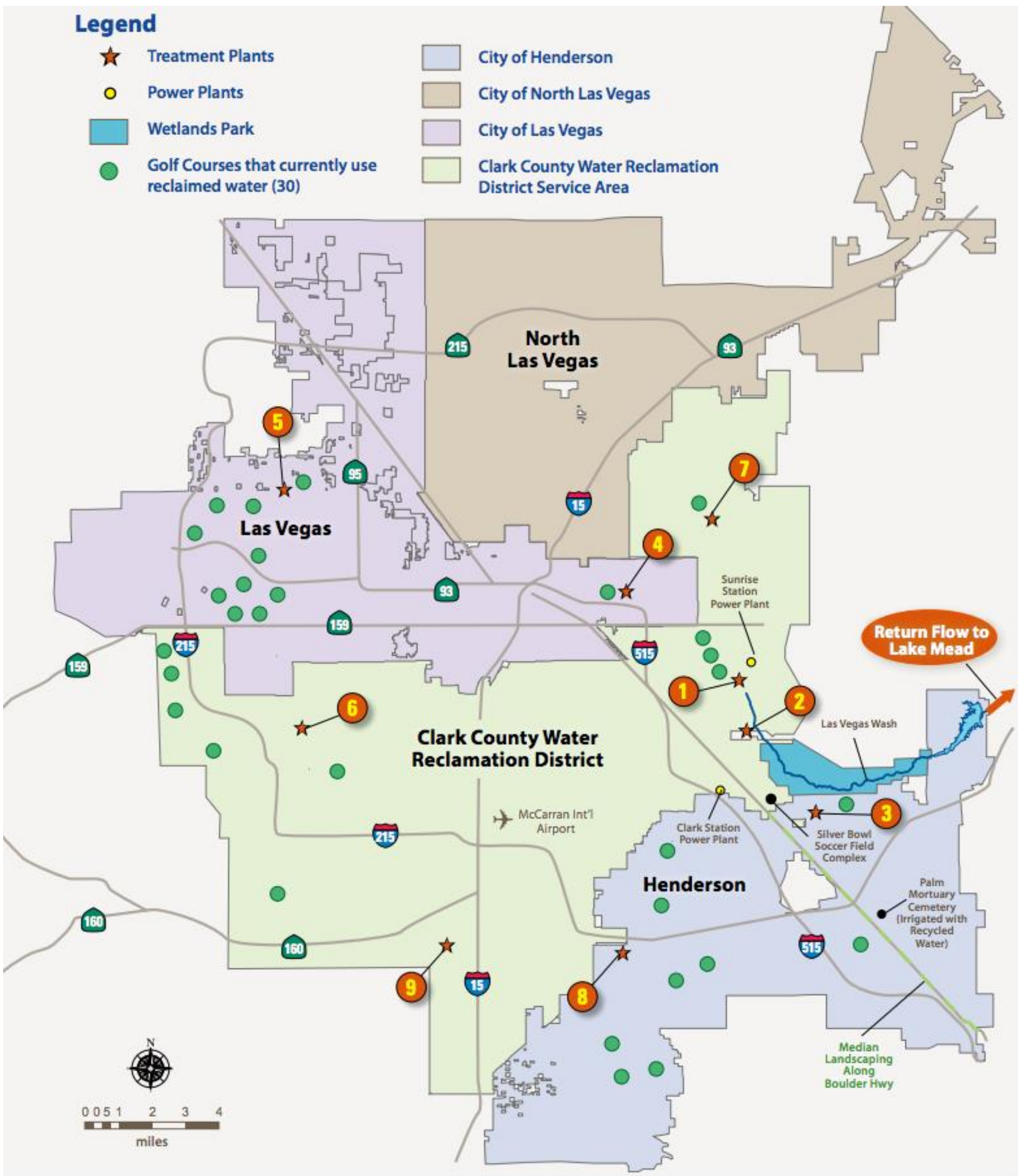


Figure 12. Las Vegas Valley Treatment Plants and Recycling Sites, SNWA, 2009

Texas

As seen in Figure 13, Texas has a long history of using reclaimed water dating back to the 1800s. Like Florida and Arizona, initial usage was for agriculture irrigation. However, with a growing population and the development of large residential communities, Texas continues to revise regulations and adopt new water management reuse guidelines.

The Texas Water Development Board (TWDB) uses these definitions:

Direct Reuse – The use of reclaimed water that is piped directly from the wastewater treatment plant to the place where it is used.

- Direct nonpotable reuse – The use of reclaimed water, for nonpotable purposes, that is piped directly to a site for beneficial uses not requiring drinking water quality.
- Direct potable reuse – The use of reclaimed water, for potable purposes, that is piped directly from the wastewater treatment plant to a drinking water treatment and distribution system.

Indirect Reuse – The use of reclaimed water by discharging to a water supply source, such as surface water or groundwater, where it blends with the water supply and may be further purified before being removed for nonpotable or potable uses.

- Nonpotable Reuse – The use of reclaimed water for nonpotable purposes by discharging to a water supply source, such as surface water or groundwater. The reclaimed water is subsequently diverted from the water body and used for beneficial purposes that do not require drinking water quality.
- Indirect Potable Reuse – The use of reclaimed water for potable purposes by discharging to a water supply source, such as a surface water or groundwater. The water supply source serves to dilute the reclaimed water and provides additional treatment through natural processes. The mixed reclaimed and natural water then receive additional treatment before entering the drinking water distribution system.

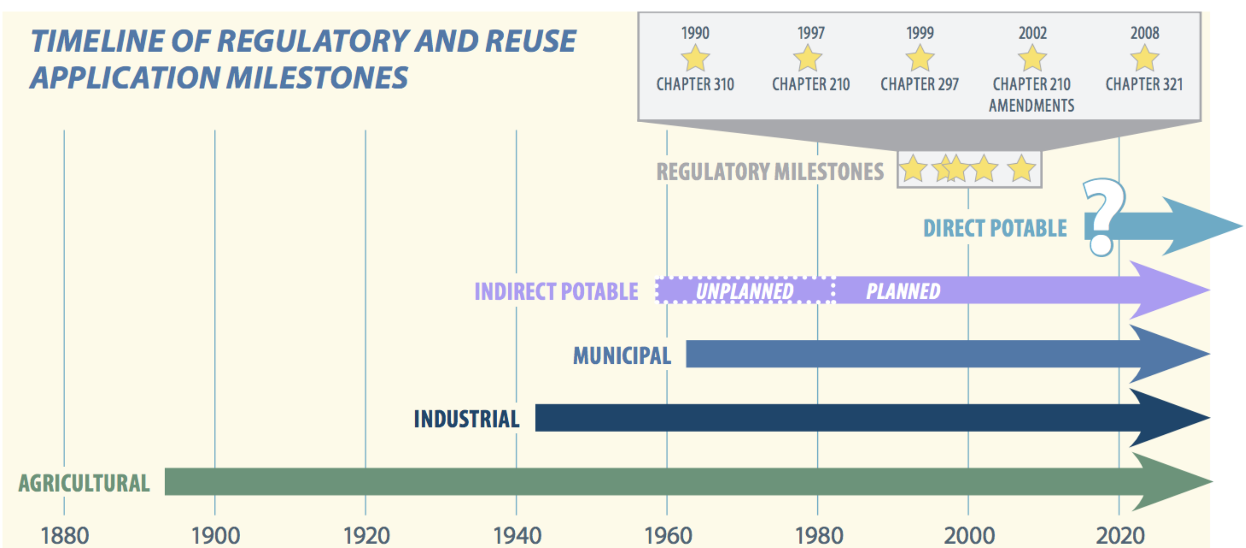


Figure 13. TImeline of Regulatory and Reuse Application Milestones, TWDB, 2011

As seen in Figure 14, the Texas Commission on Environmental Quality (TCEQ) first adopted regulations on nonpotable water reuse in 1990 through the Texas Administrative Code, which defines two classes of water quality standards. Type I is reclaimed water that may involve human contact, such as for landscape irrigation. Type II is reclaimed water that is unlikely to come in contact with humans, such as for cooling tower application and irrigating fenced areas that are restricted from public access.

REGULATORY MILESTONES	
1990	Adoption of Texas Administrative Code Chapter 310 – The first state regulations specifically addressing the use of reclaimed water
1997	Adoption of Texas Administrative Code Chapter 210 – Establishes rules and the authorization process for direct nonpotable water reuse projects. Replaces Chapter 310.
1999	Adoption of Administrative Code Chapter 297.49 – Grants the right to reuse treated wastewater as long as the water is not discharged to waters belonging to the State of Texas.
2002	Adoption of amendments to Texas Administrative Code Chapter 210 to include rules for use of industrial reclaimed water.
2008	Adoption of Texas Administrative Code Chapter 321, Subchapter P – Reclaimed Water Production Facilities – establishes streamlined permitting requirements for reclaimed water treatment (production) facilities at remote sites.

Figure 14. Texas Water Reuse Regulatory Milestones, TWDB, 2011

Colorado

Like the states highlighted above, Colorado faces challenges from population growth and increasing demand for water. Colorado began using reclaimed water around 1977, although it was unregulated at that time. Guidelines were adopted around 1980, and discharge permits became available in 1982. In 2000, the Colorado Department of Public Health and Environment (CDPHE) Water Quality Control Commission (WQCC) implemented Regulation 84 Reclaimed Water Control Regulation, which established requirements, standards, and prohibitions for reclaimed water reuse. Allowable uses and categories of water quality are shown in Figure 15.

Although Regulation 84 was intended to protect public health and the environment, a recent incident raised some concerns. The U.S Air Force has been using reclaimed water in Colorado since 1957, prior to any state regulations. Reclaimed water is primarily used for landscape irrigation, but the Denver Post (December 2017) recently cited an incident in El Paso County, where a military air base east of Colorado Springs contaminated ground water with harmful perfluorinated chemicals (PFCs) from a flame retardant used to fight fires. Regulation 84 is likely to be amended in light of this incident.

Colorado continues to contribute to innovative water reuse, including encouragement to expand nonpotable reuse, since it has a separate piping system, identified with the color purple, to separate potable and nonpotable water sources.

In September 2014, three Denver breweries obtained permission to reuse purified potable water to make craft beer. This action demonstrates that states and other regions must address concerns about public health and safety as much as issues of quality, costs, and infrastructure to encourage greater water reuse.

	Category 1	Category 2	Category 3
Minimum Treatment	Secondary Treatment with Disinfection	Secondary Treatment with Filtration and Disinfection	Secondary Treatment with Filtration and Disinfection
***E. coli*/100 mL Limit**	126 mo. Geometric mean and 235 single sample max	126 mo. Geometric mean and 235 single sample max	None in 75% samples and 126 single sample max
Turbidity Limit (NTU)		< 3 mo. Avg. and max 5 in <5% samples in a month	< 3 mo. Avg. and max 5 in <5% samples in a mo.
Total Suspended Solids Limit	30 mg/L daily max		
Allowable Uses	**Industrial** (evaporative, non-discharging construction and road maintenance, and non-evaporative industrial processes) **Landscape irrigation** (restricted) **Commercial** (zoo operations) **Agricultural irrigation** (Non-food crop irrigation and silviculture)	**Industrial** (Category 1 uses, and washwater applications) **Landscape irrigation** (Category 1 uses, and unrestricted) **Commercial** (Category 1 uses, laundries, and automated and manual vehicle washing) **Fire Protection** (Nonresidential) **Agricultural irrigation** (Category 1 uses)	**Industrial** (Category 2 uses) **Landscape irrigation** (Category 2 uses, and resident controlled) **Commercial** (Category 2 uses) **Fire Protection** (Category 2 uses and residential fire protection) **Agricultural irrigation** (Category 1 uses)

Figure 15. Current Colorado Regulation 84 Reclaimed Water Categories

HEALTH AND SAFETY ISSUES

Terms and Definitions Related to Health and Safety

Decentralized Nonpotable Water (DNW) System – a system in which water from local sources is collected, treated, and used for nonpotable uses at the building-to district/neighborhood-scale, generally at a location near the point of generation. Currently, San Francisco, Santa Monica, and Los Angeles are the only cities in California that have Decentralized Nonpotable Water (DNW) systems in place (WE&RF, 2017).

Quantitative Microbial Risk Assessment (QMRA) – a scientific approach used to estimate the potential risks to human health resulting from exposures to microbial hazards (i.e., human pathogenic viruses, bacteria, and protozoa). The four steps of the harmonized QMRA framework are: (1) problem formulation; (2) exposure assessment; (3) health effects assessment; and (4) risk characterization (WHO, 2016).

Log10 Reduction Target (LRT) – the log10 reduction target for the specified pathogen group (i.e., viruses, bacteria, or protozoa) to achieve the agreed level of risk to individuals (e.g., 10–4 infection per year) (WE&RF, 2017).

Log10 Reduction Value (LRV) – the observed log10 pathogen reduction performance for a unit process operated under controlled and defined conditions. The LRV is equal to the difference in concentration of an added or indigenous pathogen or surrogate (reported in log10 units) between paired samples of influent and effluent (WE&RF, 2017).

Validated Log10 Reduction Value (VLRV) – the log10 reduction value for a unit process determined through validation testing over the range of anticipated operational conditions and taken to be representative of the lower bound of performance (typically, lower 5 or 10 percent value) (WE&RF, 2017).

Health and Safety Overview

At this time, there are no national standards on the use of recycled and nonpotable water for either indoor or outdoor purposes. This causes some people to question the health and safety aspects of communities that use nonpotable water. The primary concern seems to be existence of pathogens, defined as "a variety of microorganisms can cause disease. Pathogenic organisms are of five main types: viruses, bacteria, fungi, protozoa, and worms (Garland Science, 2001)." Other concerns include the safety of children, pets, and persons with chronic health conditions. Some municipalities also have raised concerns about the long-term environmental impacts of nonpotable water reuse.

Some academic and public entities have attempted to address these concerns with factual research on issues related to nonpotable water use in residential surroundings, however, very few practical guidelines are available for implementation.

In California, the San Francisco Public Utilities Commission (SFPUC) partnered with several entities to develop recycled water use guidelines. One such partnership is with the U.S. Water Alliance and the National Blue Ribbon Commission for Onsite Nonpotable Water Systems: uswateralliance.org/initiatives/commission. As described on their site, their goal is to "advance best management practices that support the use of onsite nonpotable water systems at the local scale (sfwater.org, 2018)." The Commission recently published model state regulation, local ordinance and program rules for Onsite Nonpotable Water Systems (ONWS): sfwater.org. The SFPUC also collaborated with the National Water Research Institute to publish a report in March 2017 titled *Risk-Based Framework for the Development of Public Health Guidance for Decentralized Nonpotable Water Systems* (see sfwater.org/Modules/ShowDocument.aspx?documentID=10493). This report establishes guidance to "help state and local health departments develop oversight and management programs for onsite nonpotable water systems that are adequately protective of public health (WE&RF, 2017)." Lastly, the World Health Organization (WHO) also has developed *Quantitative Microbial Risk Assessment: Application for Water Safety Management*, a document that presents a framework for risk evaluation and provides guidance on the interpretation of QMRA and scientific data for water safety management (see apps.who.int/iris/bitstream/10665/246195/1/9789241565370-eng.pdf?ua=1).

Health and Safety Concerns – Outdoor Use
Nonpotable water can be used for landscaping and agricultural irrigation, dust suppression systems, fire control, and to create and maintain wetlands, recreational lakes, ponds, and canals.

A laundry-to-landscape system that relies on gravity can directly discharge water for landscape irrigation. Water from showers and/or lavatory sinks also can be used in the same way. Water from these systems also can be stored in a holding tank prior to being mechanically pumped for landscape irrigation on an as-needed basis.

Questions arise regarding how the water is treated before being sprayed outdoors and about potential hazards (bacteria, pH levels, algae blooms) in the storage tanks. Consumers ask how the recycled water will impact the grass, trees, plants, water bodies, and wildlife that inhabit affected areas. Elevated saline levels create problems for vegetation and can cause defoliation, stunted growth, and other damage (PCC Land Consultant, 2017). The ingestion of sprays from aerosol exposure in landscape irrigation and the direct exposure that comes from ingesting crops retaining large amounts of water (lettuce for example) are also concerns. Furthermore, pet owners ask if their animals are at risk for disease or infection when the water is not properly disinfected before being sprayed on grassy areas and walking paths.

Fortunately, these concerns can be addressed through education and upon the understanding of scientific data and the risk management strategies available for water safety management (discussed in subsequent chapters of this report). It is also important to acknowledge the fact that the California Department of Health Services has high treatment standards appropriate for landscaping, turf, gardens, and edible crops. Also, as referenced in many FAQs, according to Stanley Deresinski, Ph.D., clinical professor at the Stanford School of Medicine, one would have to "drink at least 12 gallons of reclaimed water in a single sitting in order to ingest an infectious dose of coliform bacteria (raindancenow.com; purplepipeco.com; cityofpaloalto.org, 2018)."

Salmonella is a common foodborne pathogen that places people and pets at risk. Salmonella is bacteria that is easily quantified and has low resistance to disinfection (WHO 2016). Additionally, utilities do not normally recommend that nonpotable water be used where it may contaminate driveways and sidewalks through runoff (i.e., washing cars) or where pets or humans come into direct contact and accidentally ingest large amounts of the water (i.e., swimmable pools and ponds). Either way, it would generally be a lot safer than accidentally ingesting water from a street puddle or natural pond.

Health and Safety Concerns – Indoor *Use*
Indoor uses of nonpotable water include flushing toilets and laundry, as well as shower-to-toilet systems. While there is less aerosol exposure for these uses, it remains a minor concern. Other than that, the only concern pertains to accidentally ingesting the water by not being able to read the required signage differentiating potable from nonpotable water. If not properly labeled/regulated, accidental ingestion of the nonpotable water through cross connections and dual distribution systems create a

human health concern. Households with infants, elderly people, and persons with chronic health conditions frequently raise concerns over potential health impact of using nonpotable water indoors.

However, Chapter 6 of the California Plumbing Code clearly requires alternate water source systems to have a purple background (Pantone color No. 512, 522C, or equivalent) with uppercase lettering with the words "CAUTION: NONPOTABLE WATER, DO NOT DRINK" in black letters. Similar signage is required for gray water systems, reclaimed/recycled water systems, on-site treated water systems, and rainwater catchment systems (CA Plumbing Code § 601.3.2-601.3.5). Section 601.3.2 also requires the direction of normal flow to be identified, as well as an international symbol of a glass in a circle with a slash through it, as seen in Figure 16, to be displayed for all nonpotable water systems.

Figure 16. International Symbol

As seen in Figure 17, Chapter 15 of the California Plumbing Code also recommends source testing, inspection, and maintenance frequency, including cross-connection inspection and tests.

DESCRIPTION	MINIMUM FREQUENCY
Inspect and clean filters and screens, and replace (where necessary).	*In accordance with manufacturer's instructions, and/or the Authority Having Jurisdiction, or every 3 months.*
Inspect and verify that disinfection, filters and water quality treatment devices and systems are operational and maintaining minimum water quality requirements as determined by the Authority Having Jurisdiction.	In accordance with manufacturer's instructions, and the Authority Having Jurisdiction.
Inspect pumps and verify operation.	*In accordance with manufacturer's instructions, and/or the Authority Having Jurisdiction, or after installation and every 12 months thereafter.*
Inspect valves and verify operation.	*In accordance with manufacturer's instructions, and/or Authority Having Jurisdiction, or after installation and every 12 months thereafter.*
Inspect pressure tanks and verify operation.	*In accordance with manufacturer's instructions, and/or the Authority Having Jurisdiction, or after installation and every 12 months thereafter.*
Clear debris from and inspect storage tanks, locking devices, and verify operation.	*In accordance with manufacturer's instructions, and/or the Authority Having Jurisdiction, or after installation and every 12 months thereafter.*
Inspect caution labels and marking.	*In accordance with manufacturer's instructions, and/or the Authority Having Jurisdiction, or after installation and every 12 months thereafter.*
Inspect and maintain mulch basins for gray water irrigation systems.	As needed to maintain mulch depth and prevent ponding and runoff.
Cross-connection inspection and test*	*In accordance with this chapter, and/or the Authority Having Jurisdiction, or after installation and every 12 months thereafter.*

* The cross-connection test shall be performed in the presence of the Authority Having Jurisdiction in accordance with the requirements of this chapter, *unless site conditions do not require it. Alternate testing requirements shall be permitted by the Authority Having Jurisdiction.*

Figure 17. Recommended Minimum Alternative Water Source Testing, Inspection, and Maintenance Frequency

Chapter 15 also requires the following additional signage in residential common areas: (TO CONSERVE WATER, THIS BUILDING USES ON-SITE TREATED NONPOTABLE GRAYWATER TO FLUSH TOILETS AND URINALS); in equipment rooms: (CAUTION: ON-SITE TREATED NONPOTABLE GRAYWATER, DO NOT DRINK. DO NOT CONNECT TO DRINKING WATER SYSTEM. NOTICE: CONTACT BUILDING MANAGEMENT BEFORE PERFORMING ANY WORK ON THIS WATER SYSTEM); and in restrooms (CAUTION: NONPOTABLE RECYCLED WATER – DO NOT DRINK) in order to prevent any accidental consumption during a repair or an emergency. There are guidelines for signage material, text size and colors, and placement to ensure that these messages remain visible.

As seen in Figure 18 below, there are both intended and unintended uses that derive from the treatment, storage, and distribution systems for both indoor and outdoor us nonpotable water uses.

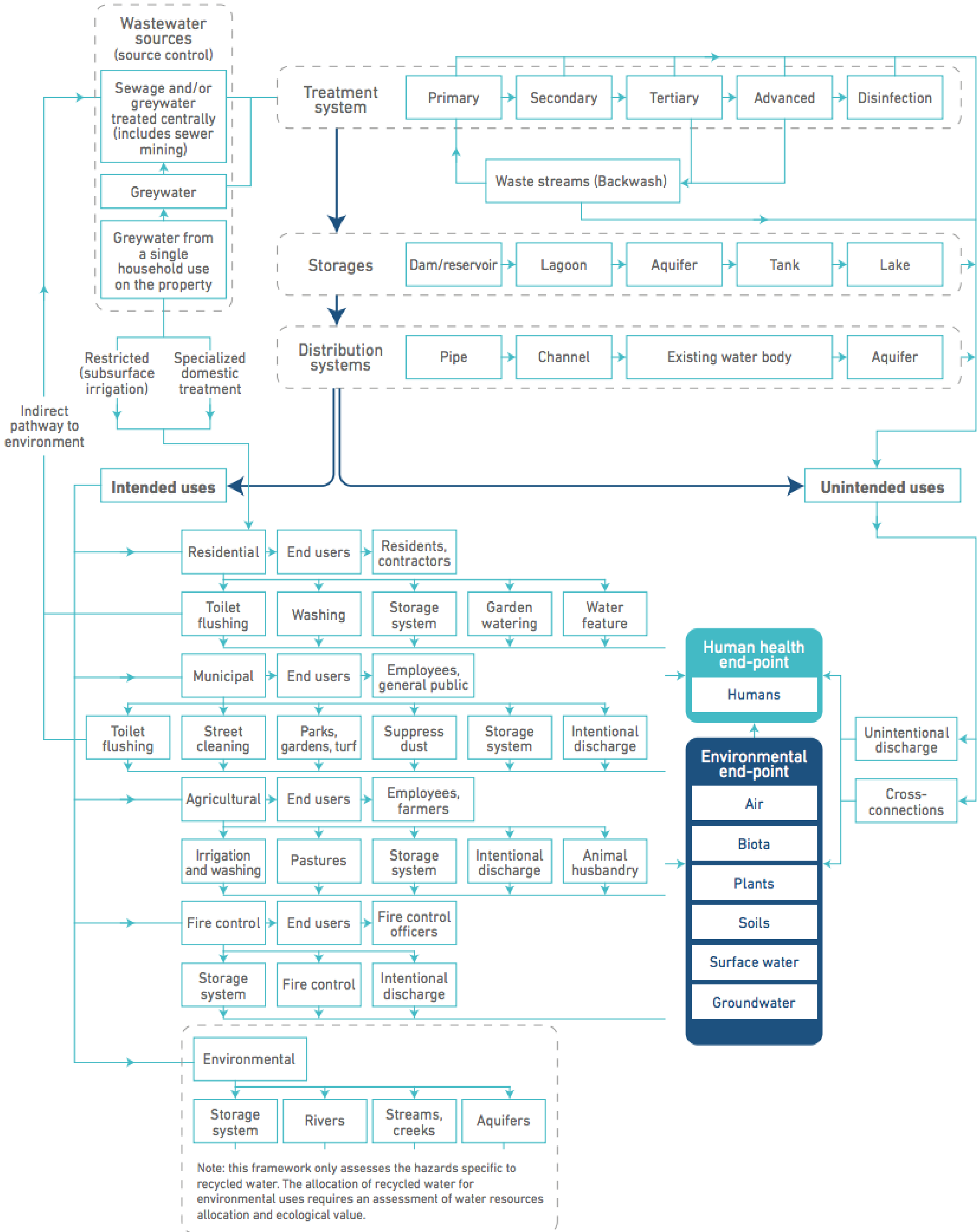


Figure 18. Schematic illustration of water uses (including intended and unintended exposures) considered in the guidelines (adapted from NWQMS, 2006), WHO 2016

The SFPUC and NWRI proposed framework for implementing a decentralized nonpotable water system, as seen in Figure 19, is organized into six steps: Design, Management Plan, Permit Application, Construction & Commissioning, Operational Monitoring, and Reporting.

The first step is centered around water treatment. The second and third steps specify roles and responsibilities of the Responsible Management Entity (RME) and the operations and maintenance (O&M) plan. The RME can be the homeowners association (HOA), however, the report mentions that some of these entities may struggle to provide the required leadership and oversight, as well as appropriate technical expertise. Financial (budgetary) challenges also can impact a homeowners association's ability to manage the water treatment program.

The report suggests that a more "appropriate means to overcome much of the performance risk is through a long-term contract with a larger, specialized private entity that can absorb all O&M responsibility and provide the required technical, managerial, and financial capabilities (NWRI 2017)." Private entities usually have significant financial and operational resources, and they are usually licensed and bonded for additional security.

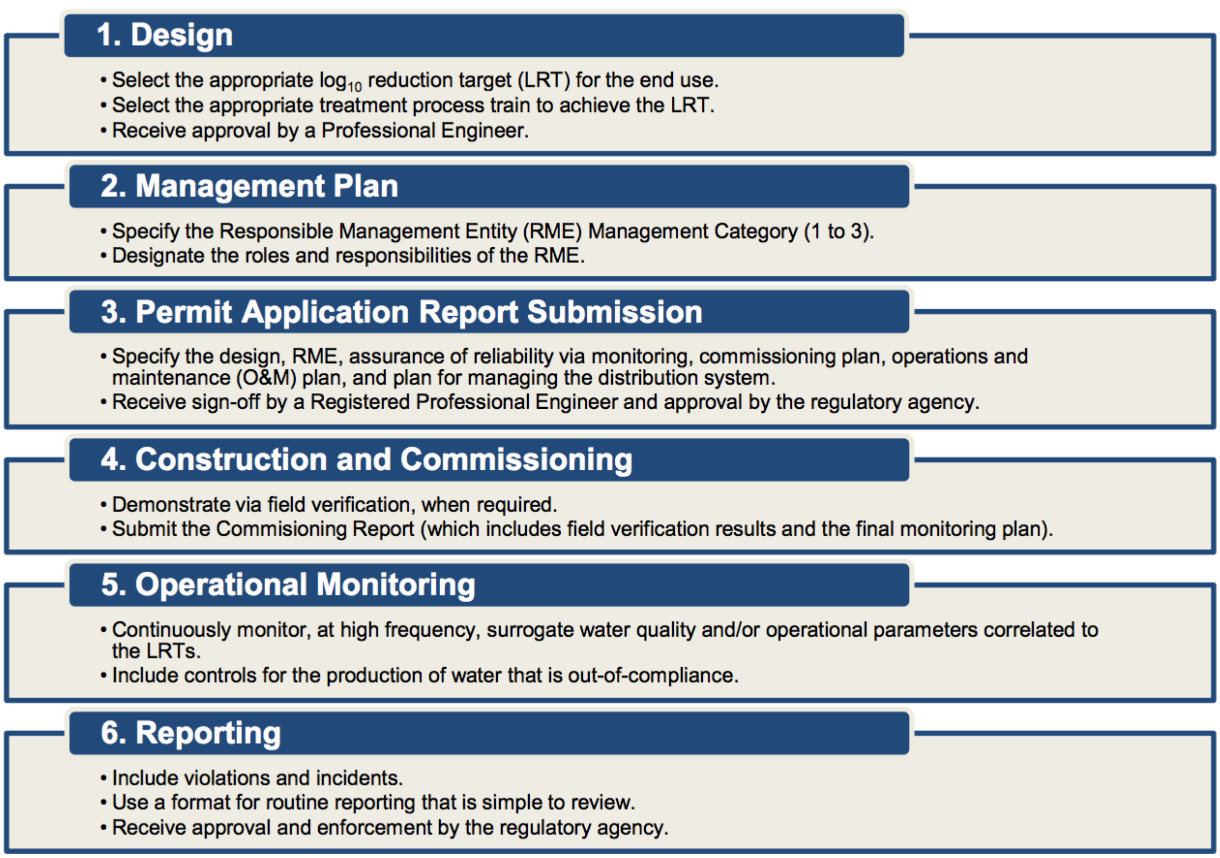


Figure 19. Proposed Framework for Implementing Decentralized Nonpotable Water Systems, NWRI, 2017

The SFPUC and NWRI report suggests three management categories, as seen in Figure 20. In most cases, the homeowners association would fall under Category 1, with very little operational monitoring and reporting required. However, the homeowners association, as property owner, is ultimately liable for the system's performance, so it must provide diligent and thorough oversight of the management activity and make sure it has adequate financial reserves to deal with emergencies, repairs, upgrades, or replacements.

Management Category	Definition of Category
1	• Lowest user population. • Non-potable water sources with the lowest concentrations of pathogens. • Non-potable water uses with the lowest human exposure. • Treatment mechanisms that are simple to operate and maintain.
2	• Some increase in the number of persons exposed, but strong mitigating factors achieved through combinations of small user populations. • Non-potable water sources with the lowest concentrations of pathogens. • Non-potable water uses with low human exposure. • Treatment mechanisms that are simple to operate and maintain.
3	• More exposure risk due to the combinations of increased user populations. • Non-potable water sources with higher concentrations of pathogens. • Non-potable water uses with increased likelihoods of exposure. • More complex treatment mechanisms that require rigorous operation and maintenance.

Figure 20. Risk-Based Management Categories for Decentralized Nonpotable Water Systems, NWRI, 2017

The following sections are intended to give readers a better understanding of the various options available for the treatment, storage, and distribution of nonpotable water that can be used to address any safety concerns their constituency may have.

Treatment of Nonpotable Water

There are natural and biological ways to treat nonpotable water, including effective filtration and disinfection processes. Prior to any treatment, the potential pathogens must be identified with appropriate pathogen reduction targets. As seen in Figure 21, the report identified enteric viruses, parasitic protozoa, and enteric bacteria as the three main pathogens found in domestic wastewater, blackwater, graywater, stormwater, and roof runoff water. The targets chosen are based on existing density and occurrence of these pathogens in various recycled water sources.

Unrestricted irrigation is defined as “ornamental plant (non-food) irrigation and dust suppression,” while indoor uses are defined as “toilet flushing, clothes washing, and rare accidental cross connection with drinking water or direct ingestion of treated nonpotable wastewater (NWRI 2017).” The pathogens and benchmarks chosen are based on the World Health Organization’s recommendations. The type of test chosen is significant and is based on US-EPA or National Sanitation Foundation (NSF) testing.

Water Use Scenario	Log_{10} Reduction Targets for 10^{-4} (10^{-2}) Per Person Per Year Benchmarks[b,i]		
	Enteric Viruses[c]	Parasitic Protozoa[d]	Enteric Bacteria[e]
Domestic Wastewater or Blackwater			
Unrestricted irrigation	8.0 (6.0)	7.0 (5.0)	6.0 (4.0)
Indoor use[f]	8.5 (6.5)	7.0 (5.0)	6.0 (4.0)
Graywater			
Unrestricted irrigation	5.5 (3.5)	4.5 (2.5)	3.5 (1.5)
Indoor use[g]	6.0 (4.0)	4.5 (2.5)	3.5 (1.5)
Stormwater (10^{-1} Dilution)			
Unrestricted irrigation	5.0 (3.0)	4.5 (2.5)	4.0 (2.0)
Indoor use	5.5 (3.5)	5.5 (3.5)	5.0 (3.0)
Stormwater (10^{-3} Dilution)			
Unrestricted irrigation	3.0 (1.0)	2.5 (0.5)	2.0 (0.0)
Indoor use	3.5 (1.5)	3.5 (1.5)	3.0 (1.0)
Roof Runoff Water[h]			
Unrestricted irrigation	Not applicable	No data	3.5 (1.5)
Indoor use	Not applicable	No data	3.5 (1.5)

Figure 21. Ninety-Fifth Percentile Log_{10} Pathogen Reductions Targets (LRT95) to Meet 10-4 (infection) or 10-2 (infection) ppy Benchmarks for Healthy Adults, NWRI, 2017

As shown in Figure 22, the natural and biological processes depend mostly on retention time and/or effectiveness of the filtering material used. Natural and biological methods include use of a primary settling/septic tank, upflow anaerobic sludge blanket or anaerobic filter, a packed bed filter, a trickling filter, suspended growth reactor/activated sludge, a pond/lagoon, treatment wetland, slow sand filter, and storage pond/reflection pool/water feature in which solar ultraviolet light is used.

Barrier	**Example Log_{10} Reduction Values**[a]			**Key Factors that Impact Log_{10} Reduction Values**
	Virus	**Protozoa**	**Bacteria**	
Primary settling/septic tank	0.8 (0.5 – 1)	0.5 (0.2 – 1)	0.5 (0.1 – 0.6)	Retention time
Upflow anaerobic sludge blanket/anaerobic filter	0.8 (0.5 – 1)	0.5 (0.2 – 1)	0.5 (0.1 – 0.6)	Retention time
Packed bed filter	1 (1 – 2)	2 (1 – 4)	1 (1 – 1.3)	Hydraulic application rate, dosing frequency, filter bed surface area
Trickling filter	0.5 (0.3 – 1)	0.6 (0.4 – 1)	0.5 (0.2 – 1)	Hydraulic loading rate, filter surface area
Suspended growth reactor/ activated sludge	0.5 (0.5 – 2)	0.5 (0.2 – 1)	1 (1 – 1.7)	Biomass conc., retention time
Pond/lagoon	0.8 (0.5 – 1)	1 (0.7 – 2)	0.5 (0.1 – 0.6)	Retention time, pH
Treatment wetland	0.5 (0.2 – 1)	1.2 (1 – 2)	0.8 (0.5 – 1)	Retention time, packing material
Slow sand filter	2 (2 – 3)	4 (3.9 – 7.1)	2 (0.6 – 5)	Sand effective size, filter ripening, filter-to-waste cycles
Storage pond/reflection pool/water feature	1 (1 – 4)	1 (1 – 3.5)	1 (1 – 3.5)	Retention time, exposure to solar ultraviolet light

[a] Adapted from Petterson et al. (2016); EPHC (2008); Mara and Horan (2003); Harrington et al. (2001).

Figure 22. Observed Values for Pathogen Reduction with Natural and Biological Treatment Processes, NWRI, 2017

As seen in Figure 22, alternative filtration systems include slow sand filter, dual media filter with coagulant, cartridge/bag filter, diatomaceous earth, microfilter, ultrafilter, nanofilter, and reverse osmosis. Most of these methods depend on the grade, pore size, and age of the filter.

These types of treatment differ from disinfection processes, which include free chlorine, chloramine, peracetic acid, ozone, ultraviolet radiation, advanced oxidation, and pasteurization (60°C). Each of these methods can be studied further if used and are often integrated into water treatment systems.

Barrier	Example Log10 Reduction Values[a]			Key Factors Impacting Log10 Reduction Values
	Virus	Protozoa	Bacteria	
Slow sand filter	2 (2 – 3)	4 (3.9 – 7.1)	2 (0.6 – 5)	Sand effective size, filter bed depth
Dual media filter with coagulant	1 (0.5 – 3)	2 (1.5 – 2.5)	1 (0.25 – 1)	Coagulant dose, filter design
Cartridge/bag filter (5 to 10 microns)	0	0	0	Absolute pore size, hydraulic shock
Cartridge/bag filter (3 microns or less)	0	3 (2.5 – >4)	0	Absolute pore size, hydraulic shock
Cartridge/bag filter (1-micron absolute)	0	4 (2.5 – >4)	0	Absolute pore size, hydraulic shock
Diatomaceous earth (DE)	1 (0.4 – 3)	4 (3.5 – 7.7)	2 (0.1 – 3.3)	DE grade
Microfilter	1 (0 – >2)	>6 (4 – >6)	6 (3.5 – >6)	Membrane age, pressure decay testing, integrity testing, integrity testing
Ultrafilter	>6 (4 – >6)	>6	>6	Membrane age, pressure decay testing, integrity testing
Nanofilter	>6	>6	>6	Membrane age, pressure decay testing
Reverse osmosis	>6	>6	>6	Membrane age, seal integrity

[a] Adapted from EPHC (2008); U.S. EPA (2005); Harrington et al. (2001).

Figure 23. Observed Values for Pathogen Reduction Using Alternative Filtration Processes, NWRI, 2017

As seen in Figure 24, the three types of treatment processes can be combined into a multiple barrier system to ensure the quality and safety of the nonpotable water. It is important to monitor the system through sensors that can take the treatment train offline automatically in the event of process malfunction (NWRI 2017).

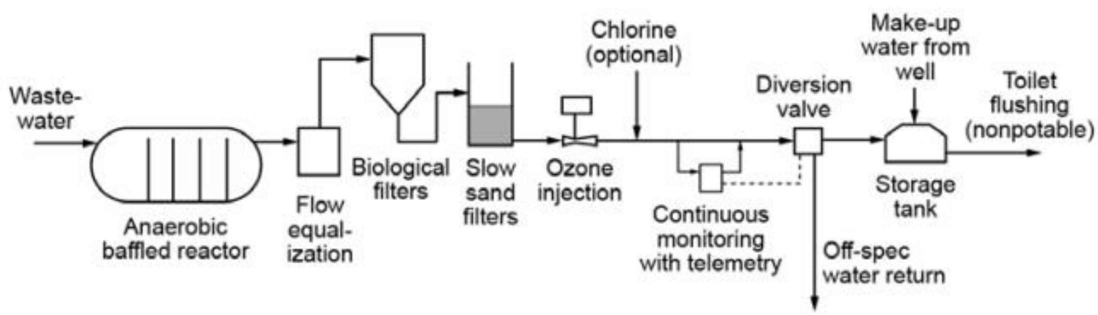


Figure 24. Example of Multiple Barrier Treatment Train for a Blackwater Source Used for Toilet Flushing, NWRI, 2017

Nonpotable Water Storage & Distribution

As if water treatment is not complicated enough, storage and distribution of nonpotable water is an equally important factor in managing the system and ensuring its safety and health impact. Supply and demand may not correlate with each other. For example, while production may be high in the winter, highest demand is likely to be in the summer.

Homeowners associations can adapt to seasonal usage patterns by utilizing ponds and similar retention facilities to hold reclaimed water until it's needed. Many golf course communities manage their seasonal irrigation needs by constructing ponds, canals, and water features to hold reclaimed water until needed (Nelson, 2010) (WRF, 2013). However, the nutrients in stored nonpotable water can result in algae growth, and "opportunistic pathogens like Legionella (Beer et al., 2015) could grow in the distribution system, sewage could contaminate treated water (Besner et al., 2013), or lead and copper (which cause toxicity) could leach from piping (U.S. EPA, 1991)." For this reason, nonpotable water storage systems often require special maintenance including reservoir cleaning, corrosion of control valves due to corrosion, cross-connection control, and reporting of leaks or spills to the health agency. Also, a water reuse program requires vigilance and effective community outreach (WRF, 2013).

As seen in Figure 25, the NWRI provides many different recommendations to mitigate the risk of microbial growth in storage and distribution systems. Temperature control, flushing the distribution system, cleaning the storage tank frequently, and using nonreactive and biologically stable materials in the construction are all safety techniques for ensuring the system's water quality. Post-treatment disinfection and regulating the water's nutritional content also are important in mitigating the risk of microbial growth throughout the distribution system.

Approach	Description
Producing non-potable water low in carbonaceous material and nutrient content	The primary energy source for pathogen regrowth is organic carbon measured as assimilable organic carbon, biodegradable dissolved organic carbon, total organic carbon, and other essential nutrients, including nitrogen (N), phosphorous (P), and iron (Fe); therefore, the primary means to reduce the regrowth potential of pathogens is to provide highly treated water. Reducing the potential for regrowth is more important in large-scale buildings or neighborhood/district-scale projects where there will be more residence time (creating more opportunities for regrowth) in distribution systems that supply non-potable water.
Producing highly disinfected non-potable water	Low concentrations of microbes resulting from filtration and advanced means of disinfection have a reduced potential for regrowth if organic carbon levels are low. Otherwise, there may be a need for a residual disinfectant to manage growth in larger community systems that produce aerosols. Post-treatment disinfection with ultraviolet (UV) radiation is a recommended means of disinfection that does not increase levels of assimilable organic carbon or biodegradable dissolved organic carbon.
Using non-reactive, biologically stable materials of construction	Avoid the use of corrosive materials or organic materials that tend to protect microorganisms from disinfection and enhance the regrowth environment by the adsorption of organic compounds (LeChevallier et al., 1990).
Maintaining a residual disinfectant	Different disinfectants offer advantages and disadvantages to overall water quality and system management. In general, a higher disinfectant residual provides lower regrowth. Many design and operation considerations are available for each specific system. The Panel recommends that a free chlorine residual of 0.2 milligram per liter (mg/L) (Cervero-Arago et al., 2015) or monochloramine residual of 2 to 3 mg/L (Marchesi et al., 2013) be maintained at or near the point of use to control microbial growth. Using disinfectant booster stations within the distribution system is one way to ensure adequate disinfectant residuals for systems with long detention times. Chloramine provides a better residual duration as compared to chlorine. Various combinations of UV, chlorine, chloramine, ozone, and hydrogen peroxide are beneficial for specific disinfection goals. Periodic shock treatments with disinfectants and continuous disinfection looping of reservoirs help reduce the potential for regrowth and manage issues with biofilms (LeChevallier, 2003). Stagnation resulting from dead zones or prolonged periods of zero-flow or low flow that create long residence times and allow disinfectants to dissipate and sediments to deposit result in improved conditions for regrowth and should be avoided.
Cleaning storage tanks	The required frequency of storage tank cleaning varies depending upon the quality of water stored, detention time in storage, temperature of the water, and nature of the tank. Tanks that are open to the atmosphere require more frequent cleaning.
Flushing the distribution system	The required frequency of distribution system flushing varies depending upon the quality of water transmitted, detention time in the distribution system, temperature of the water, and nature of the distribution system components. Periodic flushing is a good means of both removing sediments and scouring pipe walls. System design must include means for easily flushing pipes as part of routine maintenance.
Controlling temperature	Avoid the storage and distribution of non-potable water within 20 to 45°C (Health and Safety Executive, 2013d) to reduce the potential for pathogen regrowth. Otherwise, consider a disinfection residual or point-of-use system, particularly if aerosols are generated. Heat recovery from warm waters, particularly graywater and wastewater, can offer the benefit of reducing the temperature at which these waters are stored.

Figure 25. Recommended Approaches for Controlling Microbial Growth in Distribution Systems, NWRI, 2017

GOVERNMENTAL INCENTIVES

As seen in Figure 26, The California Department of Water Resources has identified the factors needed to ensure a successful community water recycling project. Based on the restrictions that remain in effect even after the official drought emergency was lifted, we can assume these criteria continue to set the standard for a successful project.

Successful water recycling projects require:

- User acceptance and commitment
- Public support and acceptance
- Addressing institutional constraints
- Inclusion in local and regional water plans
- Environmental benefits
- Economic feasibility

Figure 26. Water Facts Short Report 2004, The State of California Department of Water Resources
The vendor survey and this secondary research were both used in order to identify and address the following challenges regarding community associations and nonpotable water reuse.

Use of existing and emerging technologies that address safety and health concerns can unfortunately be costly. This has motivated many cities and counties in California to offer regulatory incentives that help communities justify the cost of a new nonpotable water program.

Similarly, Chapter 7 of the EPA 2012 Guidelines for Water Reuse also recognizes the fact that aside from public acceptance/participation, technical expertise and management, funding for water reuse systems is also crucial to its feasibility and sustainability. For homeowners, it is also important to measure the cost effectiveness of these systems as the "the total life-cycle costs of the system [exceeding] the total life-cycle savings from reduced potable water purchases (AWE, 2017)." Oftentimes, there are also service fees and impact fees to consider and while fixed monthly fees may be appropriate for residential communities, volumetric rates may be more accessible to communities that also have golf courses or that will utilize the water for agriculture irrigation.

Some federal and state funding sources that may be available to large community association developments are:

1. USDA Rural Development Water and Environmental Programs (see www.rd.usda.gov/programs-services/all-programs/water-environmental-programs)
2. Clean Water State Revolving Fund (CWSRF) (see www.epa.gov/cwsrf/learn-about-clean-water-state-revolving-fund-cwsrf)
3. Water Recycling Funding Program (WRFP) (see www.waterboards.ca.gov/water_issues/programs/grants_loans/water_recycling/proposition1_funding.shtm)

Upcoming grants and loans managed by California Department of Water Resources can be found at water.ca.gov/Work-With-Us/Grants-And-Loans.

Some examples of local governmental incentives are best showcased through San Francisco's Nonpotable Grant Program and The City of Santa Barbara Smart Landscape Rebate Program.

San Francisco's Nonpotable Grant Program

The City and County of San Francisco adopted the Onsite Water Reuse for Commercial, Multi-family, and Mixed-Use Development Ordinance in September 2012. Article 12C was then added to the San Francisco Health Code "allowing the collection, treatment, and use of alternate water sources for nonpotable applications (SFPUC, 2015)." The Nonpotabe Water Ordinance was amended in 2013 to include district scale systems and again in 2015 to actually require new developments (projects of 250,000 sf or more of gross floor area) to install onsite water treatment systems for toilet, urinal flushing, and irrigation.

San Francisco's grant program is designed to encourage projects to voluntarily install onsite water systems even when these systems aren't required. Projects that can replace at least 1,250,000 gallons of potable water annually for eight years or more are eligible to receive $250,000 in funding, and projects that are able to replace at least 3,750,000 gallons of potable water annually for eight years or more are eligible to receive $500,000. Funds are disbursed as invoices are submitted for work previously specified in the budget. Eligible budget items include "materials, supplies, salaries and fringe benefits, and payments on construction contracts (SFPUC grant application)."

San Francisco published the *Non-potable Water Program Guidebook: A Guide for Implementing Onsite Nonpotable Water Systems in San Francisco* (see sfwater.org/Modules/ShowDocument.aspx?documentID=11629). Although the specifics of the grant application have changed slightly, the guidebook provides great visuals (Figure 27 and Figure 28) explaining the basics of nonpotable water reuse systems as well as the step-by-step process for implementing such a system.

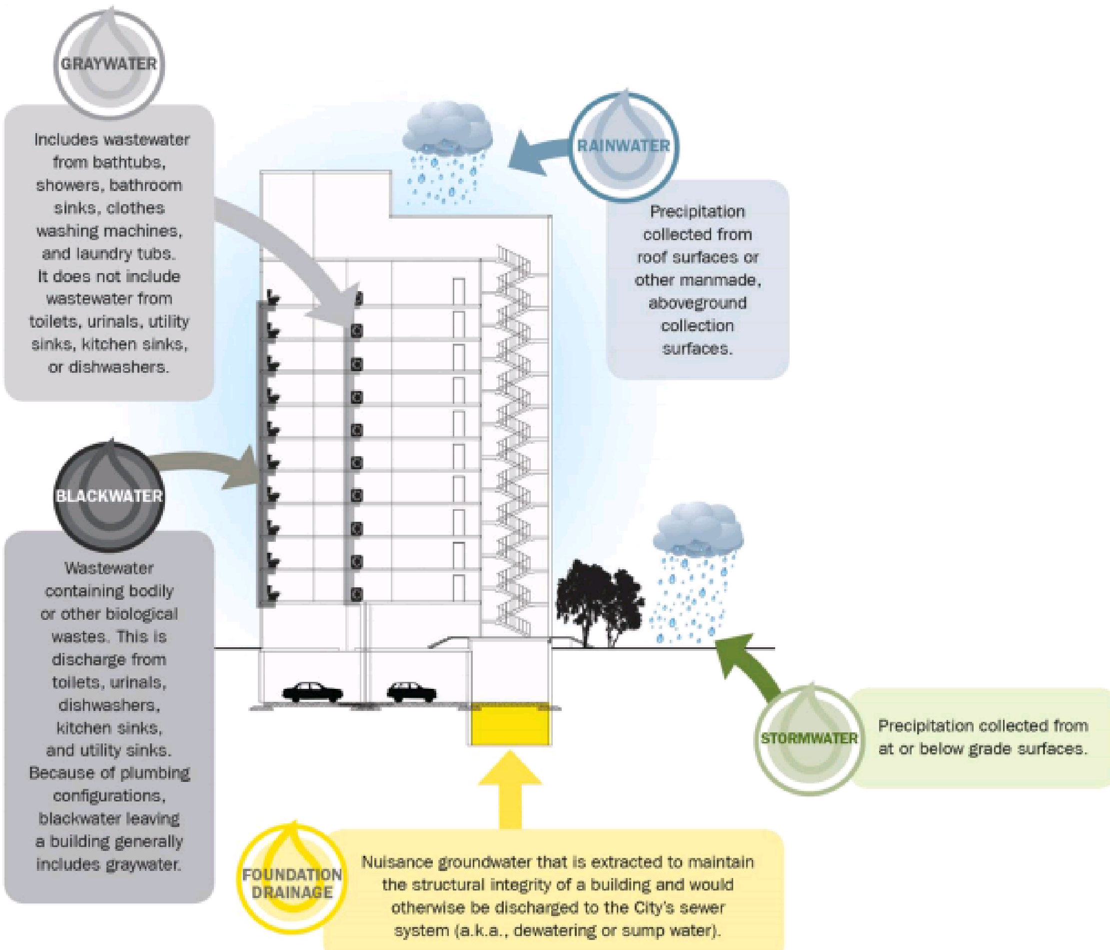


Figure 27. Alternate Water Sources and End Uses, SFPUC, 2015

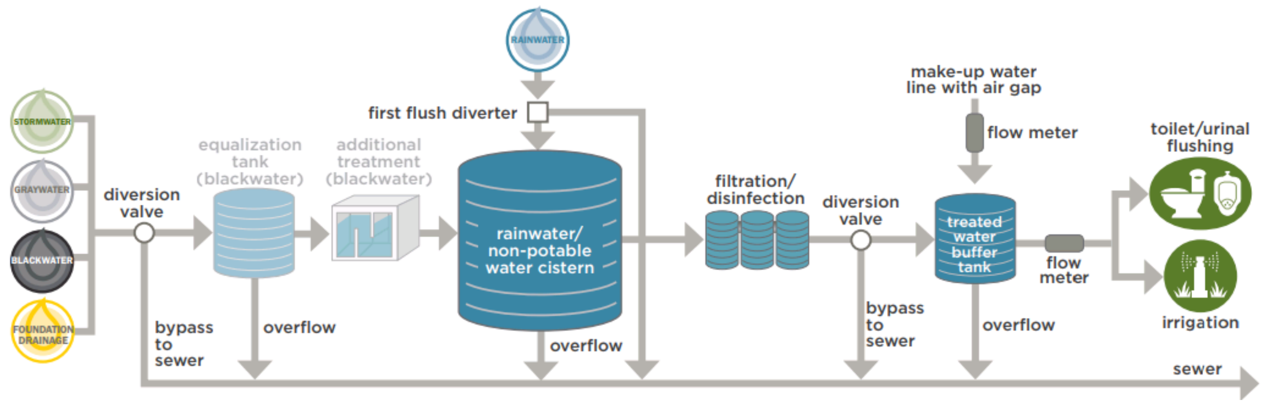


Figure 28. Onsite Non-Potable Water System Design Basics, SFPUC, 2015

The City of Santa Barbara Smart Landscape Rebate Program

The City of Santa Barbara Smart Landscape Rebate Program offers rebates for 50 percent of the cost of water conservation methods such as the use of drip irrigation systems, sprinkler system efficiency retrofits, rotating sprinkler nozzles, rain shut-off devices, irrigation submeters, equipment for a laundry to landscape graywater system, mulch, permeable surfaces (artificial grass, gravel, flagstone with spacing, etc.), synthetic turf (actual turf material only), and smart irrigation controllers. The program allows for single-family homes that use any combination of irrigation equipment and planting costs to obtain a rebate of up to $1,000. It also allows commercial, multi-family, and homeowners associations to receive up to $2,000–$4,000.

A number of other small graywater rebate programs also support—mostly—laundry-to-landscape systems in The City of San Diego (www.sandiego.gov/water/conservation/graywater), The Santa Clara Valley District (www.valleywater.org/graywater-rebate-program), The City of Contra Costa Water District (www.ccwater.com/868/Laundry-to-Landscape-Greywater-Rebate), The City of Pasadena (ww5.cityofpasadena.net/water-and-power/greywatersystems/), The Soquel Creek Water District (www.soquelcreekwater.org/conserving-water/rebates/graywater-landscape), and City of Santa Rosa (srcity.org/834/Rebates-Free-Services). The East Bay Municipal Utility District also has a program specifically for homeowners associations (see www.ebmud.com/water-and-drought/conservation-and-rebates/residential/homeowners-associations-hoas/).

SMART WATER PROJECT
FINDINGS AND RECOMMENDATIONS

Findings

1. Not many community associations in California currently are using nonpotable water systems for irrigation and community resource management.

2. Hardly any California community associations reported plans to implement this type of water management program in the next 3 to 5 years.

3. Primary barriers to nonpotable water adoption are cost, available technology, problems with retrofitting/rebuilding common infrastructure, concerns about health/safety, value/return on investment, and lack of information.

4. Primary incentives to nonpotable water use are recent water use restrictions, predictions about climate change and water availability, homeowner interest in “green” communities and conservation, and state/local grants and tax relief programs.

5. There is no reputable resource to find qualified consultants and contractors with expertise in creating nonpotable water systems in a managed community. The Foundation and CAI could provide valuable services in this area.

6. Good models for community implementation of nonpotable water systems exist in California and in states with historical usage track records, including Florida, Texas, Nevada, and Colorado.

7. Developers of new planned communities in California should become informed about regulations taking effect in 2018 and plan to incorporate some aspects of nonpotable water usage in community operations.

8. Likewise, developers of existing communities could install nonpotable water systems as value-added features to attract home buyers, especially those who are environmentally motivated.

9. Smart water usage is likely to become a rising trend in large-scale community associations operations in the coming decade.

Recommendations for Future Activity

1. This report has identified existing and emerging technologies that could encourage communities to adopt use of recycled water for irrigation and outdoor facility management. Additional research should be conducted to show community association managers and leaders:
    a. how using recycled water can be more attractive and affordable
    b. to increase community support by addressing health and safety concerns
    c. to demonstrate how recycled water use contributes to positive environmental action

2. Community association leaders should work to educate residents and homeowners and increase their awareness about the value of nonpotable water use. Some effective education methods:
    a. resident meetings
    b. articles in community newsletters and webpages
    c. guest speakers
    d. site visits to "model" projects in other communities
    e. demonstrating proper signage
    f. hosting "Ask the Experts" forum

3. The Foundation and CAI should offer managerial education courses focused on conservation, environmental action, and modernization of community systems.

4. The Foundation and CAI should create and promote a directory of experts who are qualified in the use of nonpotable water systems in community association management.

5. Training resources should be available to association directors and other homeowner leaders so they can plan and implement an effective nonpotable water management program. Training would cover:
    - Convene a working group to guide the development of the program.
    - Identify options for the type of program and choose one or two top choices for further study.
    - Identify desired goals and outcomes for their program.
    - Determine desirable water-quality standards for sources and end use.
    - Consult municipal government to make sure plan meets local codes and standards.
    - Request proposals from reputable contractors/consultants.
    - Meet with community residents to explain proposed projects and solicit input.
    - Establish budget and desired implementation schedule.
    - Choose a contractor and begin implementation.
    - Determine project management and oversight process (in house vs contract).
    - Test all system operations and make needed corrections and changes
    - Conduct inspections and share the report with residents.
    - Operate the system and conduct regular monitoring and reporting.
    - Publicize positive impact to residents and the community.
    - Create reserve fund for repairs, maintenance, and emergencies.
    - Plan for future growth of the program.

Some valuable resources for association leader training include *Blueprint for Onsite Water Systems: A Step-by-Step Guide for Developing a Local Program to Manage Onsite Water Systems* (see sfwater.org/modules/showdocument.aspx?documentid=6057) and *Nonpotable Water Program Guidebook: A Guide for Implementing Onsite Nonpotable Water Systems in San Francisco* (see sfwater.org/Modules/ShowDocument.aspx?documentID=11629).

APPENDIX

A. Smart Water Project Sponsors and Participants

Foundation for Community Association Research (FCAR) – The Foundation for Community Association Research is a nonprofit 501(c)(3) organization devoted to research, information collection, and scholarship focused on the common interest ownership industry and the people and associations they comprise. Established in 1975, the Foundation commissions and conducts research about the community association industry and publishes key data and reports on rising trends, best practices, and critical issues impacting the industry. The Foundation publishes the annual *Community Association Fact Book*, the premiere resource for statistical information about community associations, and a series of *Best Practice Reports* on community association operation and management. See foundation.caionline.org.

Community Associations Institute (CAI) – CAI is an international membership organization dedicated to building better communities and better community leaders. With nearly 40,000 members representing all aspects of the community association industry. CAI supports its members and partners in 64 chapters throughout the Unites States and in other countries, providing information, education and resources for those who live in, manage and govern common interest ownership communities. See www.caionline.org.

Smart Water Task Force

Skip Daum – Legislative expert and and lobbyist, Daum is the retired owner/principal of Capitol Communications Group, which advocates in California for the community association industry. He is a member of the Foundation's board of directors and Research Committee.

Tyler Berding – Attorney and founding partner of Berding & Weil LLP, Berding has represented commercial and residential real estate clients since 1974. The firm has resolved more than 700 complex construction-defect claims in California, Florida, Arizona, and Hawaii. A former Foundation board member, Berding currently serves on the Foundation's Research Committee.

Marvin Nodiff – An attorney representing condominiums and homeowner association, Nodiff is also a law professor and author of several novels, including *Special Assessment, The Condo Kerfuffle*, and *No Spitting on the Floor*. Nodiff is a CAI member and national service volunteer.

Clifford J. Treese – Nationally recognized leader in common interest community underwriting, risk management, and insurance, Treese has substantial experience in all phases of community association activity. He is owner/principal of Association Data Inc., which provides data and documentation services for community association clients. Treese, who is also a past president of both CAI and the Foundation, currently serves as editor of the *Community Association Fact Book*.

Margey Meyer, CMCA, PCAM – Educator, mediator, speaker, and president/founder of CADRExperts (Community Association Dispute Resolution Experts), Meyer is a past president the Foundation and former CAI trustee.

Christine Danielson Isham – Foundation Research Committee chair for 2016-2018, Danielson is a past president of the Foundation. Owner of residential and commercial development businesses in Western Pennsylvania, she is a well-known author, trend-watcher, and marketing consultant.

Leslie Valencia – Project manager and principal researcher for the Smart Water Project, Valencia earned a master's degree in community planning from University of California – Berkeley in 2016 and was awarded the Foundation's 2015–2016 Byron Hanke Fellowship. She is author of *The Sharing Equity*

Project: Bridging Community Associations and Affordable Housing Organizations Together (see foundation.caionline.org/wp-content/uploads/2017/06/valencia_final_paper.pdf).

Funding
The Smart Water Project was funded in part by donations from:

- The **Foundation for California Community Association Education** (FCCAE), created to provide resources that support homeowner and manager education and to promote positive action by community associations in California and throughout the United States.

- The **FCAR Think Tank**, a group of generous and influential experts in community association activity, operations, management, and oversight.

B. Reports and Database

Report: Overview of Laws and Regulations Governing Water Reuse in California, Arizona, Nevada, and Texas, PPC Land Consultants LLC, May 2017
• foundation.caionline.org/wp-content/uploads/2018/07/smart_water_project_ppc_laws.pdf
Database of Nonpotable Water Equipment Vendors, Consultants, and Service Providers in California and Adjacent States
• foundation.caionline.org/wp-content/uploads/2018/07/smart_water_report_vendors.xlsx

Report: Task Force Site Visit to Serrano Community, 2017

The Smart Water Task Force conducted a site visit to the Serrano Community Association in El Dorado Hills, Calif., in July 2017. Participants included Task Force leader Skip Daum, the lead attorney for the California State Water Resources Control Board, which is involved in water conservation programs, and the Serrano Association Maintenance Manager.

The Serrano community is in a desirable area of Northern California about 15 miles east of Sacramento near Folsom Lake and the American River. This community has 3,900 homes, a prestigious golf course, and large open areas and trails throughout the 3,500-acre property.

This community was identified as an early innovator of nonpotable water use, making it an ideal starting point for the Foundation research project. A post on the Serrano HOA website states: “In 1999, Serrano expanded its use of recycled water from the golf course, parks, and greenbelts to residents’ front and back yards in order to conserve this most precious resource.” The recycled water is delivered through a series of purple-colored pipes that are separate from drinking water pipelines in a number of villages. This system puts Serrano at the forefront of the trend toward environmentally-sensitive development and greatly improves the community’s ability to support potable water conversation measures.

The Serrano community received the following awards for its water use program:
2005 – Recycled Water Innovation (Special Judges’ Award), National Water Reuse Association
1998 – Recycled Water Project of the Year, Water Reuse Association of California

Smart Water Task Force participants toured the entire community and observed both potable and nonpotable water pipe systems, common area irrigation, and a large storage tank for potable water. The Serrano manager provided data on water usage during the tour.

High-level observations from this tour included:

1. This community was developed “smartly” decades ago with a contract for nearby stream water rights and strategic plans for water use management and conservation.
2. Most of the homes were built in the last 20 years, but new homes are under construction in an adjacent large phase.
3. Awareness of water use planning is higher today than when the community was started.
4. All common areas are irrigated using nonpotable water.
5. Most residents do not realize that nonpotable water is sprayed in common areas. This suggests the importance of visible reminders (signage and postings) to increase resident awareness and approval of conservation practices. This type of activity can have positive impact on marketing and sales.
6. Retrofitting home sites for outside use of nonpotable is expensive.
7. The association obtains potable and nonpotable water from the El Dorado Irrigation District (EID), which has facilities about two miles downhill from the Serrano community. Both types of water are purified at this site using ultraviolet light. Chlorinated water is not distributed, as it is expensive and explosive.
8. Discussions with the EID facility manager focused on these questions:
    - What are the costs to provide both types of water to large users?
    - In considering storage options, what size storage tanks are needed, and where should they be located?

- Is it difficult to find qualified and trained personnel to manage a nonpotable water system? Is technical training available for this skill? Are community colleges and vocational programs promoting job training for this?
- Have other community associations expressed interest in adopting nonpotable water use?

C. California Case Studies and Information Resources

Each of the following case studies are located in the State of California.

1. Carlsbad Water Recycling Facility

"The City of Carlsbad has approximately 79 miles of recycled distribution pipeline. This distribution system currently supplies more than 700 recycled points of connection. The sites served by recycled water include: La Costa Golf Course, Park Hyatt Resort and Golf Course; The Crossings @ Carlsbad Golf Course; LEGOLAND California; Grand Pacific Palisades Hotel; Karl Strauss Brewery; Flower Fields. Recycled water also is supplied to many of the City of Carlsbad parks, median strips, shopping areas, freeway landscaping, and 'common areas of many homeowner associations."

See more at www.carlsbadca.gov/services/depts/pw/utils/water/reclaimed.asp.

2. Coachella Valley

"The Coachella Valley Water District recycles more than 2 billion gallons of wastewater each year, subjecting it to an advanced multi-step process that filters out solids, organic materials, chemicals, and germs. At three of the district's six wastewater reclamation plants, the treated water is clean enough for human contact (though not consumption), groundwater replenishment or outdoor irrigation. The Coachella Valley is home to more than 120 golf courses. Unfortunately, the amount of wastewater available that is recycled can't meet the year-round irrigation needs of the courses. To increase the available nonpotable water supply for golf courses to reduce their demand on the aquifer, CVWD in 2009 completed the Mid-Valley Pipeline Project to bring Colorado River water to the Water District's largest wastewater reclamation plant in Palm Desert."

See more at www.cvwd.org/164/Recycled-Nonpotable-Water.

3. Dublin San Ramon Services District (DSRSD)

"Recycled water comprises 20 percent of the water used in the DSRSD service area and is available for irrigation in Dublin and Dougherty Valley."

See more at: www.dsrsd.com/do-business-with-us/recycled-water-use.

4. Eastern Municipal Water District (EMWD)

"EMWD has been treating wastewater (sewer water) within its service area since the 1960s. EMWD's Recycled Water System currently receives 45–50 million of treated wastewater gallons a day from its four operating regional treatment plants. This treated water is distributed throughout the Recycled Water Distribution System. Today, EMWD serves more than 200+ active accounts and Hemet/San Jacinto Constructed Wetlands—a joint program with the U.S. Bureau of Reclamation. EMWD's multipurpose, constructed wetlands in San Jacinto has evolved as a world-renowned wastewater treatment research center, while creating beneficial wildlife habitat."

See more at www.emwd.org/services/recycled-water-service/about-recycled-water.

5. East Bay Municipal Utilities District (EBMUD)

"EBMUD has built infrastructure with the capability to provide more than 9 million gallons per day (mgd) of recycled water. [Its] 2040 goal is to recycle 20 mgd of water or nearly 7.3 billion gallons annually. That amount could save enough water to supply the indoor and outdoor water needs of more than 220,000 EBMUD residents per day."

See more at www.ebmud.com/wastewater/recycled-water/ and www.ebmud.com/water-and-drought/conservation-and-rebates/residential/homeowners-associations-hoas.

6. Elsinore Valley Municipal Water District (EVMWD)
"The Elsinore Valley Municipal Water District provides an additional level of treatment, called 'tertiary' treatment, which uses a state-of-the-art ultraviolet system to remove 99.9 percent of pathogens. 'Tertiary' treated water is so highly cleaned that it is safe for human contact, and more than 27,000 acre-feet of recycled water are used throughout Riverside County each year. An acre-foot is approximately 326,000 gallons of water, enough water for two average families for one year. Recycled water uses include irrigating crops, golf courses, fishing lakes, landscape irrigation, and wetlands enhancement."

See more at: www.evmwd.com/about/departments/water_efficiency/recycled.asp.

7. Inland Empire Utilities Agency (IEUA)
"Water recycling is a critical component of the water resources management strategy for IEUA and the Chino Basin. The State of California has determined that the reuse of highly treated recycled water is the only new major source of water available to meet Southern California's growing water demand.
IEUA currently receives more than 50 million gallons per day of wastewater from its regional treatment plants. This water is treated to Title 22 regulations set forth by the State Division of Drinking Water and distributed throughout the service area. IEUA delivers the recycled water to be used for agriculture, municipal irrigation, industrial uses, and for groundwater replenishment."

See more at: www.ieua.org/water-sources/recycled-water.

8. Irvine Ranch Water District (IRWD)
"IRWD meets roughly 28 percent of its service area's water demands with recycled water. IRWD is a national leader in recycled water. Its long history of recycled water achievements began in 1963 when its forward-thinking board of directors implemented its vision to integrate water recycling into the overall design of our community. Today, IRWD's nationally recognized recycled water program encompasses a wide variety of uses such as landscape irrigation, industrial processes, and toilet flushing in commercial buildings."

See more at www.irwd.com/services/recycled-water.

9. Inland Empire Utilities Agency (IEUA)
See more at www.ieua.org.

10. Long Beach Water Department (LBWD)
"The Recycled Water System Expansion Program is primarily intended to connect the recycled water system to new customers, as well as increase the reliability of the distribution system through the completion of looped transmission corridors. The primary elements of the program include the construction of a recycled water pipeline, new pump stations, augmentation of water system storage, and the completion of new service connections."

See more at www.lbwater.org/recycled-water.

11. Los Angeles County – Los Angeles Department of Water and Power
"The County Sanitation Districts of Los Angeles County (Sanitation Districts) are helping to conserve California's precious water supplies for future generations by supplying high-quality treated recycled water that is suitable for a variety of nonpotable uses.

The Districts' 1,400 miles of main trunk sewers and 11 wastewater treatment plants convey and treat about 400 million gallons per day (mgd) of wastewater; approximately 140 mgd are available for reuse in the dry Southern California climate."

See more at www.lacsd.org/waterreuse/AboutRecycledWater.asp and www.lacsd.org/waterreuse.

12. Los Angeles-Glendale Water Reclamation Plant
"Los Angeles-Glendale Water Reclamation Plant is strategically located to serve east San Fernando Valley communities that are both within and outside of the Los Angeles city limits. The plant's highly treated wastewater meets and exceeds the water quality standards for recycled water for irrigation and industrial processes. This water reuse conserves more than one billion gallons of potable water per year. The plant is highly automated, and staff can control processes from the onsite control room or at remote locations."

See more at www.lacitysan.org/san/faces/home/portal/s-lsh-wwd/s-lsh-wwd-cw/s-lsh-wwd-cw-p/s-lsh-wwd-cw-p-lagwrp.

13. Monterey County Water Recycling Projects (MCWRP)
See more at www.co.monterey.ca.us/government/government-links/water-resources-agency/projects-facilities/salinas-valley-water-project-svwp#wra and www.co.monterey.ca.us/government/departments-a-h/health/environmental-health/environmental-health-review/graywater-recycled-water.

14. Orange County
"OCWD's mission of providing a reliable water supply in a cost-effective manner is brought to life through its water reuse projects:

- The Groundwater Replenishment System (GWRS) is the world's largest system for indirect potable reuse. The system takes highly treated wastewater that would have previously been discharged into the Pacific Ocean and purifies it using a three-step advanced treatment process.

- OCWD's Green Acres Project (GAP) is a water reuse effort that provides recycled water for landscape irrigation at parks, schools, and golf courses; industrial uses, such as carpet dying; toilet flushing; and power generation cooling.

- Water Factory 21, the predecessor to GWRS, recycled treated wastewater from the Orange County Sanitation District, blended it with imported water, and injected it into 23 wells in Fountain Valley and Huntington Beach to combat seawater intrusion."

See more at: www.ocwd.com/what-we-do/water-reuse.

15. Rancho California
"Rancho California Water District (RCWD) is continuing to develop more uses for recycled water. Water recycling, which produces highly treated wastewater, is used to irrigate most golf courses, large landscaped areas, schools, parks, and greenbelts. Southern California is using more and more recycled

water in order to save its precious well water and import water for drinking and household use. Use the *On-Site Recycled Water Irrigation Manual* for proper usage and handling of recycled water, along with requirements for installing or modifying your irrigation system. Managers and supervisors of recycled water systems also can reference the *RCWD Recycled Water Site Supervisor Training Program Guide*.

The District's recycled water meets the strict standards of the State Water Resources Control Board, and using recycled water conserves the region's supply of drinking water. Recycled water is wastewater that has been purified through a series of treatment processes. According to these standards, tertiary-treated recycled water is safe for all human contact except drinking."

See more at www.ranchowater.com/206/Recycled-Water.

16. Sacramento

"The Sacramento County Water Agency (SCWA), in partnership with the Sacramento Regional County Sanitation District (Regional San), has developed a recycled water system that treats and delivers up to 5 mgd of recycled water that is used for irrigation purposes, thereby conserving and extending the life of our precious drinking water resources.

In May 2003, the recycled water system officially went online and is currently delivering recycled water to the communities of Laguna West, Lakeside, and Stonelake in the Elk Grove and Laguna areas. Specifically, recycled water is used to irrigate street medians, commercial landscaping, parks and school sites."

See more at www.waterresources.saccounty.net/scwa/Pages/RecycledWater.aspx.

17. San Diego

"To meet future water demands while reducing dependence on imported water, the City of San Diego built the North City Water Reclamation Plant and the South Bay Water Reclamation Plant. These plants treat wastewater to a level that is approved for irrigation, manufacturing, and other non-drinking or nonpotable purposes. Recycled water gives San Diego a dependable, year-round, and locally controlled water resource."

See more at www.sandiego.gov/water/recycled.

18. San Francisco

Case Studies: San Francisco's 2017 Non-potable Water System Projects (see http://sfwater.org/Modules/ShowDocument.aspx?documentID=7089) and 2014 Non-potable Water System Projects (see http://sfwater.org/modules/showdocument.aspx?documentid=6133).

San Francisco's Department of Public Health has a program and permit for Alternate Water Source Systems in Residential Buildings that is not only for residential buildings containing three or more dwelling units, but also for mixed-use and non-residential buildings. The rules and regulations allow for the collection, treatment, and reuse of rainwater, stormwater, graywater, foundation drainage, and blackwater. The allowable uses indoors are toilet and urinal flushing, priming drain traps, and washing clothes. The allowable uses outdoors include subsurface irrigation, drip or other surface non-spray irrigation, spray irrigation, decorative fountains and impoundments, cooling applications, and dust control/street cleaning. The San Francisco Health Code Article 12C even provides permit exceptions if graywater, foundation drainage, and stormwater systems are solely used for subsurface irrigation. There is also a permit exception if rainwater systems have a "first flush diverter and a 100 µm filter, which are used solely for subsurface irrigation or for surface non-spray irrigation (SFDPH, 2017)." For projects that otherwise need to be permitted, SFDPH provides rules and regulations for system design, water quality, monitoring, sampling, and reporting requirements. The R&Rs also provide guidelines for variance and permit modifications, appeals and permit transfer, and information on violations and administrative penalties. The SFDPH also provides Alternative Compliance for District-Scale Nonpotable Water Systems (see http://sfwater.org/Modules/ShowDocument.aspx?documentID=10568).

19. San Ramon

"Water plays an essential role in sustaining the quality of life and economic strength in our communities. Realizing the need for a reliable water supply in the San Ramon Valley, particularly in dry years, the Dublin San Ramon Services District (DSRSD) and the East Bay Municipal Utility District (EBMUD) created the San Ramon Valley Recycled Water Program (SRVRWP) in 1995. The partnership provides an eco-friendly supply of irrigation water while conserving limited drinking water. Recycled water deliveries began in early 2006 when construction of the program's first phase was completed."

See more at www.srvrwp.org.

20. Santa Barbara

After several dry years in the late 1970s and continued population growth in the city, analysis of the Santa Barbara's water supply showed that additional water sources were needed. Recycled water was identified as a potential substitute for potable water for irrigation and other uses. The city's Recycled Water Project was developed in two phases: Phase I was completed in July 1989, and Phase II was completed in May 1991. The total cost of the project was $15,200,000. To fund the project, the city received $7 million in low-interest loans from the California State Water Resources Control Board. In October 2015, the city began distributing recycled water from the newly constructed tertiary treatment facility, which uses ultrafiltration technology to produce high-quality recycled water. A grant was obtained through the Department of Water Resources Integrated Regional Water Management Drought Grant program in the amount of $1,045,222 to offset project costs.

See more at www.santabarbaraca.gov/gov/depts/pw/resources/system/recwater/default.asp.

21. Santa Cruz

"Santa Cruz has offered Soquel Creek 1.4 mgd of treated water at a cost of $500,000 a year. Any water supplied to Soquel Creek from Santa Cruz is water saved and banked in the aquifer. Soquel Creek has a "preferred" solution: A recycled water plant. The plant will cost $70 million. When completed in 2022, the plant will produce 1.5 mgd. Soquel Creek needs to accelerate the water plan to accept Santa Cruz water."

See more at waterforsantacruz.com.

22. Santa Monica

"Stormwater/urban runoff is considered the number one source of pollution to Santa Monica Bay. At the end of the 1990s, many cities across the country were looking for creative ways to treat their stormwater. Santa Monica's Urban Runoff Recycling Facility, otherwise known as the 'SMURRF,' is one of the finest examples of the future of dealing with polluted stormwater/urban runoff to the maximum extent possible to protect our coastal waters for future generations. The project is a joint effort of the City of Los Angeles and the City of Santa Monica."

See more at www.smgov.net/Departments/PublicWorks/ContentCivEng.aspx?id=7796.

23. Santa Rosa
"Santa Rosa Regional Water Reuse System is composed of the Laguna Treatment Plant and Water Reuse Operations and Biosolids Distribution System and serves approximately 230,000 residents in Santa Rosa, Rohnert Park, Cotati, Sebastopol, and unincorporated portions of Sonoma County.

The hub of the Water Reuse System is the Laguna Treatment Plant, which cleans sewage from homes and businesses throughout the region so that it can be reused safely with beneficial outcomes. The plant recycles approximately 7 billion gallons of wastewater each year. During dry-to-normal water years, nearly 100 percent of the tertiary treated recycled water is reused beneficially.

Our state-accredited environmental laboratory, located at the plant, analyzes drinking water, sewage, and industrial waste to ensure compliance with applicable federal, state and local regulations, public health, and protection of the Laguna de Santa Rosa watershed."

See more at srcity.org/1061/Recycled-Water and srcity.org/1052/Water-Reuse.

24. Silicon Valley
"When adequately treated and thoroughly disinfected, treatment plant effluents can be reused for many purposes such as landscape and agricultural irrigation and industrial applications. Recycled water is becoming a key part of California's overall water supply.

SVCW has been a leader in studying the feasibility of carrying out recycled water projects. It is a policy of SVCW to provide technical and institutional leadership for the community it serves on all subjects related to water recycling. SVCW is prepared to coordinate public and private participation among the entities within the SVCW service area to assist in the development of local recycled water programs."

See more at www.svcw.org/facilities/sitePages/recycled%20water.aspx and www.svcw.org/_layouts/15/start.aspx#/SitePages/Home.aspx.

25. Ventura
"The Ventura Water Reclamation Facility includes pump stations and pipelines for water reclamation, with an average of more than 700,000 gallons (approximately 3 percent of total wastewater flow) reclaimed daily. Our reclaimed water system provides water for irrigating nearby golf courses, parks, and similar landscape areas. This reuse is an integral part of the water efficiency program and represents a reduction in demand on the drinking water supply each year of approximately 300 million gallons."

See more at www.cityofventura.ca.gove/1107/Recycled-Water.

26. West Basin
"West Basin is diversifying the water supply portfolio designed to shift our future water supplies to more locally controlled and reliable sources of water. Nothing is more reliable and sustainable for the planet than recycled water. West Basin's state-of-the-art water recycling program produces five types of 'designer' waters to specifically meet our customers' needs."

See more at www.westbasin.org/water-supplies/recycled-water.

BIBLIOGRAPHY

Literature Review conducted by Leslie Valencia, Project Manager, 2017-2018

Baum-Haley, Melissa et al. (2014, March). Landscape Irrigation Best Management Practices. Fall Church, VA: Irrigation Association and American Society of Irrigation Consultants. Retrieved from www.nciclb.org/wp-content/uploads/2017/08/Best-Management-Practices.pdf.

Bill Gauley, P.Eng., Principal, Gauley Associates Ltd. (2017, February). Water Savings and Financial Benefits Associated with SingleFamily Package Graywater Systems. Chicago, IL: Alliance for Water Efficiency. Retrieved from www.allianceforwaterefficiency.org/graywater-reuse-systems-report.aspx.

Crook, James. (2004). Innovative Applications in Water Reuse: Ten Case Studies. Boston, MA: WaterReuse Association. Retrieved from watereuse.org/wp-content/uploads/2015/10/WRA-101.pdf.

Crook, James. (2007). Innovative Applications in Water Reuse and Desalination Case Studies 2. Alenxandria, VA: WaterReuse Association (WRA). Retrieved from watereuse.org/wp-content/uploads/2015/10/WRA-103.pdf.

Environmental Working Group (EWG) & Northeastern University Social Science Environmental Health Research Institute (SSEHRI). (2017, June). Mapping a Contamination Crisis: Toxic fluorinated chemicals in tap water and at industrial or military sites. Retrieved from www.ewg.org/interactive-maps/2017_pfa/index.php.

Feinstein, Laura et al. (2017). Drought and Equity in California. Oakland, CA: Pacific Institute. Retrieved from pacinst.org/wp-content/uploads/2017/01/PI_DroughtAndEquityInCA_Jan_2017.pdf.

Janeway CA Jr, Travers P, Walport M, et al. (2001). Immunobiology: The Immune System in Health and Disease. 5th edition. New York: Garland Science. Retrieved from www.ncbi.nlm.nih.gov/books/NBK27114.

National Academies Press (NAP). (2012). Water Reuse: Potential for Expanding the Nation's Water Supply Through Reuse of Municipal Wastewater. Washington D.C: The National Academy of Sciences. Retrieved from www.nap.edu/read/13303/chapter/5.

National Research Council. (2012). Understanding Water Reuse: Potential for Expanding the Nation's Water Supply Through Reuse of Municipal Wastewater. Washington, DC: The National Academies Press. doi.org/10.17226/13514.

San Francisco Public Utilities Commission (SFPUC). (n.d.). Innovation in Urban Water Systems. Retrieved from sfwater.org/index.aspx?page=836.

State Water Resources Control Board (SWRCB) and Department of Water Resources (DWR). (2015). Water Recycling Funding Program (WRFP): Munilcipal Wastewater Recycling Survey. Retrieved from www.waterboards.ca.gov/water_issues/programs/grants_loans/water_recycling/munirec.shtml.

United States Environmental Protection Agecy (US-EPA). (n.d.). Water Recyclying and Reuse: The Envrionmental Benefits. Retrieved from www3.epa.gov/region9/water/recycling.

Nonpotable Water Use in California

Assembly Bill 2100 Introduced by Assembly Member Campos. (2014, February). Amending the Davis-Stirling Common Interest Development Act. Retrieved from www.leginfo.ca.gov/pub/13-14/bill/asm/ab_2051-2100/ab_2100_bill_20140220_introduced.html.

California Department of Water Resources: Urban Water Use Efficiency (n.d.). Model Water Efficiency Landscape Ordinance (MWELO). Retrieved from www.water.ca.gov/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency.

City and County of San Francisco Department of Public Health. (2017, August). Director's Rules and Regulations Regarding the Operation of Alternate Water Source Systems. Retrieved from www.sfdph.org/dph/files/EHSdocs/ehsWaterdocs/NonPotable/SFHC_12C_Rules.pdf.

Grigg, Neil S. et al. (2013). Dual Water Systems: Characterization and Performance for Distribution of Reclaimed Water. Washington D.C.: Water Research Foundation (WRF), Unites States Environmental Protection Agency (EPA) and Water Environment Research Foundation. Retrieved from www.waterrf.org/PublicReportLibrary/4333.pdf.

Innovations in Urban Water Systems. (2014, May). Alternate Water Source Overview by Agency. Retrieved from sfwater.org/modules/showdocument.aspx?documentid=6449.

Office of the City Clerk City of Los Angeles. (2017, December). Potential Regulation Analysis Commercial Cannabis License Capacity. Retrieved from clkrep.lacity.org/onlinedocs/2014/14-0366-S5_misc_12-05-2017.pdf.

San Francisco Public Utilities Commission (SFPUC). (n.d.). Non-potable Water System Vendors sfwater.org/Modules/ShowDocument.aspx?documentID=9673.

San Francisco Public Utilities Commission (SFPUC): San Francisco Water Power Sewer. (n.d.). Non-Potable Water Program. Retrieved from sfwater.org/index.aspx?page=686.

San Francisco Planning Department. (2015). 1598 Bay Street Conditional Use. Retrieved from commissions.sfplanning.org/cpcpackets/2014-003157CUA.pdf.

Senate Bill 992 Introduced by Senator Neilsen. (2014, September). Amending the Davis-Stirling Common Interest Development Act. Retrieved from www.leginfo.ca.gov/pub/13-14/bill/sen/sb_0951-1000/sb_992_bill_20140918_chaptered.html.

United States Environmental Protection Agency (EPA). (2012, September). Washington, D.C.: EPA, USAID and CDM Smith. Retrieved from watereuse.org/wp-content/uploads/2015/04/epa-2012-guidelines-for-water-reuse.pdf.

Nonpotable Water Use in Florida

Christopher J. Martinez and Mark W. Clark. (2015). Reclaimed Water and Florida's Water Reuse Program. University of Florida. Retrieved from edis.ifas.ufl.edu/pdffiles/AE/AE44800.pdf.

Florida Deparment of Environmental Protection (DEP). (n.d.). Reuse Inventory Database and Annual Report. Retrieved from floridadep.gov/water/domestic-wastewater/content/reuse-inventory-database-and-annual-report.

Gurpal S. Toor and Donald P. Rainey. (n.d.). History and Current Status of Reclaimed Water Use in Florida. University of Florida. Retrieved from edis.ifas.ufl.edu/pdffiles/SS/SS52000.pdf.

Parsons, Dr. Larry. (2007, May). Reclaiming a Resource. University of Florida. Retrieved from www.crec.ifas.ufl.edu/academics/faculty/parsons/PDF/MayParsons.pdf.

Water Conserv II: Beneficial Water Reuse. (n.d.). Original and New Citrus Grower Agreement. Retrieved from www.waterconservii.com/agreements/.

Nonpotable Water Use in Arizona

Arizona Department of Environmental Quality (ADEQ). (n.d.). Water Quality Division: Permits: Reclaimed Water. Retrieved from legacy.azdeq.gov/environ/water/permits/reclaimed.html.

Carpenter, Guy W. (2016). Reusing Water for 90 Years. Water Reuse and Municipal Water Leader. Retrieved from watereuse.org/wp-content/uploads/2015/01/MuniWaterLeaderArticle_Feb2016-Carpenter-p32-34.pdf.

Central Arizona Project. (2014, April). Arizona: A National Leader in Water Reuse. Retrieved from www.cap-az.com/public/blog/75-arizona-a-national-leader-in-wate-reuse.

Department of Environmental Quality: Water Quality Division. The Arizona Administrative Code: Title 18. Environmental Quality. Chapter 11. (2016). Phoenix, AZ: Arizona Department of State: Office of the Secretary of State, Public Services Division. Retrieved from apps.azsos.gov/public_services/Title_18/18-11.pdf.

Environmental Finance Center (EFC) at the University of North Carolina, Chappel Hill and Water Infrastructure Finance Authority of Arizona (WIFA). (2017). 2017 Arizona Water & Wastewater Rates Report. Environmental Finance Center at the University of North Carolina. Retrieved from efc.sog.unc.edu/sites/www.efc.sog.unc.edu/files/2017/2017%20Arizona%20Water%20%26%20Wastewater%20Rates%20Report_0.pdf.

Fulton, Michael A. (2014, October). Arizona's Legacy and Leadership in Wastewater Reuse. Scottsdale, AZ: Arizona Department of Environmental Quality (ADEQ). Retrieved from legacy.azdeq.gov/environ/water/apec/download/101014_fulton_wwreuse.pdf.

Middel, Ariane et. al. (2013, October). Water Reuse in Central Arizona: A Technical Report by Decidion Center for a Desert City. Tempe, AZ: Arizona State University. Retrieved from d3dqsm2futmewz.cloudfront.net/docs/dcdc/website/documents/DCDC_WaterReuse_Final.pdf.

Nonpotable Water Use in Nevada

Southern Nevada Water Authority (SNWA). (2009, March). Southern Nevada Regional Water Recycling Study. Southern Nevada Water Authority (SNWA) and Clean Water Coalition. Retrieved from www.snwa.com/assets/pdf/wq_lvvwac_recycling_study.pdf.

Southern Nevada Water Authority (SNWA). (2017). Water Resources Plan 2017. Retrieved from www.snwa.com/assets/pdf/wr_plan.pdf.

Southern Nevada Water Authority (SNWA). (n.d.). Water Recycling Through Reuse. Retrieved from www.snwa.com/ws/recycled.html.

Nonpotable Water Use in Texas

Texas Water Development Board (TWCB). (2011, February). History of Water Reuse in Texas. Retrieved from www.twdb.texas.gov/innovativewater/reuse/projects/reuseadvance/doc/component_a_final.pdf?d=37941260.76500001.

Texas Water Development Board (TWCB). (n.d.). Frequently Asked Questions. Retrieved from www.twdb.texas.gov/innovativewater/reuse/faq.asp.

Nonpotable Water Use in Colorado

Colorado Department Of Public Health And Environment Water Quality Control Commission (CWQCA). (2013). Regulation No. 84 Reclaimed Water Control Regulation. Retrieved from www.colorado.gov/pacific/sites/default/files/84_2013%2807%29hdr.pdf.

Denver Post Editorial Board. (2017, September). El Paso County water contamination shows need for statewide limits. Retrieved from www.denverpost.com/2017/09/28/el-paso-county-water-contamination-shows-need-for-statewide-limits/.

Denver Water and Stantec. (2017, July). Regulation 84 – Proposed Reclaimed Water Uses Workshop Livestock Washdown and Watering Stakeholder Workbook. Retrieved from www.colorado.gov/pacific/sites/default/files/WQ_Reg84-Agricultural-Washdown-Workbook.pdf.

Industrial Water World. (2017, September). Denver Breweries On Tap To Brew Colorado's First Beer From Recycled Water. Retrieved from www.waterworld.com/articles/iww/2017/09/denver-breweries-on-tap-to-brew-colorado-s-first-beer-from-recycled-water.html.

Lorenz, Wayne P.E. (2013, September). A History of Water Reuse in Colorado. Wright Water Engineers. Retrieved from www.wrightwater.com/assets/a-history-of-water-reuse-in-colorado-9-15-13.pdf.

ABOUT THE FOUNDATION FOR COMMUNITY ASSOCIATION RESEARCH

Our mission—with your support—is to provide research-based information for homeowners, association board members, community managers, developers, and other stakeholders. Since the Foundation's inception in 1975, we've built a solid reputation for producing accurate, insightful, and timely information, and we continue to build on that legacy. Visit foundation.caionline.org

ABOUT COMMUNITY ASSOCIATIONS INSTITUTE

Since 1973, Community Associations Institute (CAI) has been the leading provider of resources and information for homeowners, volunteer board leaders, professional managers, and business professionals in 342,000 community associations, condominiums, and co-ops in the United States and millions of communities worldwide. With nearly 40,000 members, CAI works in partnership with 36 legislative action committees and 63 affiliated chapters within the U.S., Canada, United Arab Emirates, and South Africa, as well as with housing leaders in several other countries including Australia, Spain, Saudi Arabia, and the United Kingdom.

A global nonprofit 501(c)(6) organization, CAI is the foremost authority in community association management, governance, education, and advocacy. Our mission is to inspire professionalism, effective leadership, and responsible citizenship—ideals reflected in community associations that are preferred places to call home. Visit us at www.caionline.org and follow us on Twitter and Facebook @CAISocial.

caisocial

Community Associations Institute

@caisocial and @caiadvocacy

6402 Arlington Blvd., Suite 500 | Falls Church, VA 22042 | www.caionline.org