Municipal Recycled Water

A Resource Management Strategy of the California Water Plan

California Department of Water Resources

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Acronyms and Abbreviations

af	acre-feet
af/yr.	acre-feet per year
CAT	Climate Action Team
CBSC	California Building Standards Commission
CCR	California Code of Regulations
CDPH	California Department of Public Health
CII	commercial, industrial, and institutional
CPUC	California Public Utilities Commission
CWC	California Water Code
CWP	California Water Plan
DWR	California Department of Water Resources
GHG	greenhouse gas
HCD	California Department of Housing and Community Development
IRWM	integrated regional water management
IRWMP	integrated regional water management plan
RWQCB	regional water quality control board
RWTF	Recycled Water Task Force
SB	Senate Bill
SWRCB	State Water Resources Control Board
taf	thousand acre-feet
UWMP	urban water management plan

Municipal Recycled Water

California is increasing its integration of municipal recycled water into its water supply portfolio. In some regions of the state, recycled water meets approximately 7 percent of water supply demands. Although the statewide total is an increase since *California Water Plan Update 2009* (Update 2009) was released, it is still far short of previously established goals. Municipal recycled water benefits the state and individual water users by reducing long-distance water conveyance needs, providing local water supplies, and being a drought-resistant resource. This resource management strategy report will describe the current status of recycled water in California, what some of the challenges are to its increasing use, and the resources needed to continue to increase municipal recycled water use.

Introduction

The municipal recycled water resource management strategy addresses the recycling of municipal wastewater treated to a specified quality to enable it to be used again. Within this resource management strategy report, the term "recycled water" refers to water that originates from a municipal treatment plant. Treated wastewater is primarily from domestic (household) sources, but it can include commercial, industrial, and institutional (CII) wastewater discharged to a sanitary sewer. This resource management strategy report does not address other types of water recycling, such as the reuse of:

- Industrial wastewater, either when internally reused or when treated or disposed separately from municipal wastewater.
- Agricultural wastewater.
- Gray water.

These are addressed in other parts of *California Water Plan Update 2013* (Update 2013).

Note that the term "recycled water" is a term indicating a beneficial use after wastewater treatment. It does not indicate a certain level of treatment, such as "tertiary-treatment." Title 22, the regulation overseeing reuse or "recycling" of municipal wastewater, uses level of treatment and bacteriological water quality standards to define what uses are legally allowed, based on the probability of public contact. Title 22 defines uses for water ranging from water that has had secondary wastewater treatment and is not disinfected to water that has undergone tertiary treatment.

Changes in this Strategy Since 2009

The Update 2013 *Municipal Recycled Water* resource management strategy report is extensively changed from the version that appeared in Update 2009. There are new or revised policies (the 2009 Recycled Water Policy adopted by the State Water Resources Control Board [SWRCB]), proposed regulations (the California Department of Public Health's [CDPH's] 2011 draft regulations for groundwater replenishment with recycled water, as part of Senate Bill [SB] 918), and a new statewide survey of recycled water users. In addition, several reports that describe recycled water applications, benefits, and challenges have been prepared. Each of these will be discussed within this resource management strategy report.

Affiliations with other Resource Management Strategies

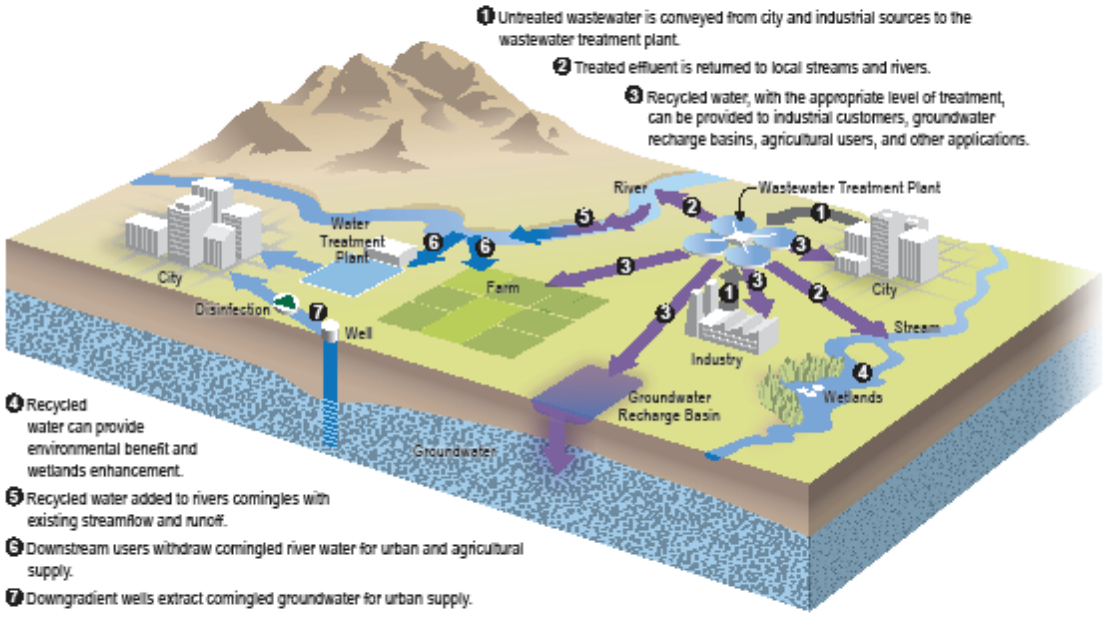
Treating and delivering recycled water, as well as disposing of byproducts that may result from generating recycled water, involve issues that may also be discussed in other resource management strategy reports. The key affiliations of other resource management strategy reports to recycled water are described below.

- *Agricultural Water Use Efficiency* — Depending on the level of treatment, recycled water can be used to irrigate any crop.
- *Urban Water Use Efficiency* — Recycled water can be used for landscape irrigation and commercial or industrial applications. This resource management strategy report describes gray water applications.
- *Conveyance — Regional/Local* — Distribution of recycled water is planned and implemented on local and regional levels with local conveyance systems.
- *Drinking Water Treatment and Distribution* — In the future, recycled water may be distributed via potable water distribution systems.
- *Matching Water Quality to Use* — Recycled water could replace many instances where potable water is currently being used for non-potable applications.
- *Salt and Salinity Management* — Use of recycled water may have an overall impact on salinity of the underlying groundwater basin. As a result, the Recycled Water Policy includes provisions for preparation of salt and nutrient management plans. Recycled water production also may result in brine generation. Discharges of salts and chemicals into sewers from water softeners can increase wastewater salinity and negatively affect municipal recycling.
- *Urban Stormwater Runoff Management* — Stormwater can be used as a water supply mixing source for projects where recycled water is used for groundwater recharge.
- *Ecosystem Restoration* — Recycled water is often a water supply for ecosystem restoration projects.
- *Land Use Planning and Management* — Use of recycled water can be constrained by the availability of sites suitable for recycled water. Successful local planning can encourage locating potential recycled water users where recycled water is available, as well as planning infrastructure needs to support future growth.
- *Economic Incentives — Loans, Grants, and Water Pricing* — Economic incentives are commonly used to facilitate initiation of recycled water projects, enable infrastructure development, or support the use of lower quality water.
- *Outreach and Engagement* — Introduction of recycled water as a local water supply resource requires extensive public outreach and education regarding its uses, as well as addressing local water quality and health effect concerns.

Definition of Municipal Recycled Water

The California Water Code (CWC) provides the following definition for recycled water: "water which, as a result of treatment of waste, is suitable for a direct beneficial use or a controlled use that would not otherwise occur and is therefor [sic] considered a valuable resource" (CWC Section 13050(n)). "Recycled water" and "reclaimed water" have the same meaning and can be used interchangeably. The California Water Plan (CWP) uses the term "recycled water." An illustration of the many paths that municipal recycled water can take for reuse is shown in Figure 1. The recycled water pathways shown in this figure

Figure 1 Municipal Recycled Water Cycle



do not indicate the level of recycled water treatment. Existing California law specifies required treatment levels for designated uses.

Municipal water recycling is a strategy that increases the usefulness of water by reusing a portion of the existing waste stream that would be discharged to the environment as waste and redirecting the water to another local application. Recycling municipal wastewater increases water supply if it reduces discharges into oceans and inland saline waters and enables conserving higher-quality water for appropriate uses. Additionally, as a local water source, municipal recycled water can:

- Be an additional water source, possibly offsetting or delaying obtaining additional freshwater supplies.
- Be a drought-resistant water supply.
- Provide an alternative for treatment and disposal of wastewater.
- Reduce overall energy requirements, especially if it is replacing a higher intensity water source, such as some transferred water.
- Reduce discharge of excess nutrients into surface waters.
- Provide nutrients for crops or landscape plants.
- Support environmental habitats, such as wetlands.
- Be used as the water supply for an injection well barrier to control saltwater intrusion.

Treated municipal wastewater is integrated into California's water supply through both unplanned applications, such as discharge into a stream with a subsequent reuse, or through planned projects. Unplanned reuse occurs when treated wastewater is discharged — usually into a surface water body — and there is no prearranged agreement or intention that the producer would maintain control of the

effluent. Discharged treated wastewater supplements river flow and can be a downstream benefit for wetland or aquatic habitat, or withdrawn by a downstream river water user. In the case of the latter, the wastewater discharge is regulated to protect the public health for the downstream beneficial user (Recycled Water Task Force 2003).

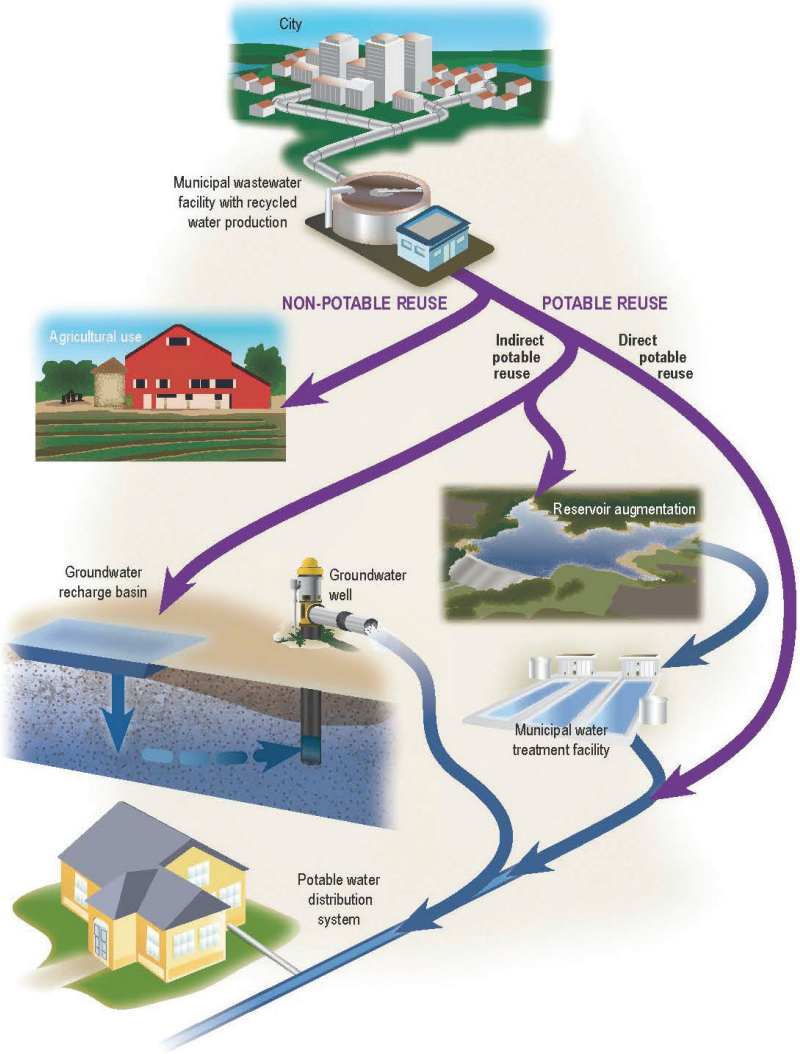
Planned recycled water projects are developed by water and wastewater suppliers for potable and non-potable uses (Figure 2). Non-potable recycling includes any application not involving drinking water for human consumption, such as landscape or agricultural irrigation, commercial applications like car washes or dual-plumbed office buildings, or industrial process such as oil refineries or cooling towers. Potable reuse results in augmentation to drinking water supplies, and it can be either direct or indirect. Direct potable reuse is treated water conveyed directly from the wastewater treatment plant to a raw or treated drinking water supply lines, a practice which is not currently occurring in California. Indirect potable reuse is treated water from the wastewater treatment plant discharged into recharge basins to infiltrate into groundwater aquifers or into surface water reservoirs used for drinking water supply. Because seawater intrusion barriers typically result in groundwater recharge, they are considered a form of indirect potable reuse.

Water discharged from a wastewater facility may still be reused even if it is not a planned action, as shown in Figure 1. Typically, treated wastewater is discharged into rivers and streams as part of permitted disposal practices. Discharged water then commingles with the stream or river that may be a water source for downstream communities or agricultural users. When a downstream entity withdraws water from the stream, a portion of that water is treated wastewater from an upstream discharge that has commingled with the ambient stream flow. Estimates from CWPs prepared in the 1980s indicated that between 86 percent and 100 percent of wastewater discharged in Central Valley hydrologic basins at the time was indirectly reused in this manner. Comingling of recycled water also occurs when it is used to recharge existing groundwater supplies (see Figure 1).

Treated wastewater can also be discharged to the ocean or other saline water bodies. This water usually is considered no longer practically available for reuse and is referred to as “irrecoverable water.” The State recognizes recycling projects that capture municipal wastewater in coastal areas that would otherwise become irrecoverable water as providing “new water” supply. An estimated 0.9 million to 1.4 million acre-feet per year (af/yr.) of “new water” could be realized by 2030 through recycling municipal wastewater that is discharged into the ocean or brackish bays (Recycled Water Task Force 2003). Because discharges to the ocean or brackish water bodies support few, if any, downstream beneficial uses, such discharges are prudent sources of wastewater for future recycling efforts (Recycled Water Task Force 2003). These projects may also support energy-efficient water supply strategies because they more fully utilize the energy already expended to treat the water to disposal levels that would otherwise be discharged to irrecoverable sources.

An additional consequence of increasing direct municipal recycled water use is that the volume of water discharged into streams may be reduced, potentially adversely affecting downstream water rights or instream beneficial uses. Recognizing this, the CWC requires that prior to making any change in the point of discharge, place of use, or purpose of use of treated wastewater, the SWRCB review potential changes to ensure potential impacts on beneficial uses are considered before authorizing a change in the permitted discharge of municipal wastewater (CWC Section 1211).

Figure 2 Potable and Non-Potable Municipal Recycled Water



Recycled Water Use in California

Continued integration and expansion of recycled water into California's water supply options are necessary to support meeting future demands despite uncertain climactic conditions. Language recognizing the importance of recycled water in meeting future water demands is included in State law:

"It is hereby declared that the people of the state have a primary interest in the development of facilities to recycle water containing waste to supplement existing surface and underground water supplies and to assist in meeting the future water requirements of the state" (CWC Section 13510). The state reinforces this declaration by stating in the CWC that under certain conditions the use of potable water for nonpotable purposes is a waste or unreasonable use of water if recycled water is available (CWC Section 13550 et seq.). This has been the basis for the past several decades in California for encouraging recycled water for non-potable uses, especially for industrial and irrigation applications.

Several important actions involving municipal recycled water have occurred (or are in process) since the 2009 update of the CWP. These include:

- Completion of the 2009 Municipal Wastewater Recycling Survey through a joint effort by the SWRCB and the California Department of Water Resources (DWR).
- The SWRCB's adoption of the Recycled Water Policy in 2009.
- CDPH 2011 release of draft regulations for groundwater replenishment with recycled water.
- California Public Utilities Commission (CPUC) release of its Recycled Water Policy Framework for Investor-Owned Utilities.

This section addresses past and current water recycling in the state, as well as each of the important actions involving municipal recycled water.

History of Recycled Water in California

Municipal recycled water has been used beneficially in California for more than 100 years. In the earliest applications, farms located near urban areas in this drought-prone state used effluent from municipal wastewater treatment plants. By 1910, 35 sites were using municipal recycled water for agriculture purposes. From 1932 to 1978, San Francisco's McQueen Treatment Plant, the first documented California treatment facility dedicated to treating recycled water (RMC Water and Environment 2009), supplied recycled water for irrigation in Golden Gate Park.

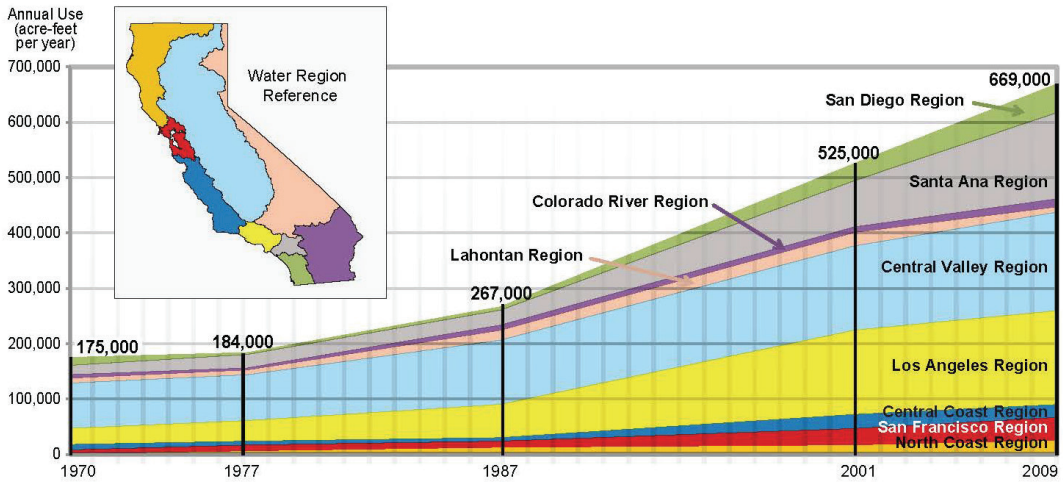
In 1952, 107 California communities were using municipal recycled water for agricultural and landscape irrigation. Following a national initiative to upgrade and improve the level of wastewater treatment in the 1970s, the uses of municipal recycled water applications began to diversify. Beneficial uses of California's recycled water now include landscape, agricultural, and golf course irrigation; commercial and industrial applications; environmental enhancement; groundwater recharge; and lake augmentation.

Current Recycled Water Use in California — The 2009 Survey

Statewide surveys conducted since 1970 quantified annual volumes of municipal recycled water use and have shown a steady increase in the amount and types of uses (Figure 3). These surveys accounted for only planned reuse with recycled water delivered directly to users or to groundwater recharge facilities. For the calendar year 2009, the SWRCB and DWR conducted a survey of agencies involved with the treatment, conveyance, or beneficial reuse of domestic wastewater as recycled water. The survey results identified 669,000 acre-feet (af) of treated municipal wastewater that were beneficially reused in California in 2009, classified according to 11 beneficial uses (State Water Resources Control Board 2012). Beneficial uses in the 2001 and 2009 recycled water surveys, as well as historical uses, are shown in Figure 4. Indirect potable reuse by adding recycled water to reservoir drinking water supplies and direct potable reuse do not currently occur in California. As part of SB 918 (covered later in this resource management strategy report), the California Department of Public Health (CDPH) will investigate the feasibility of developing water recycling criteria for direct potable reuse in California.

Recycling of municipal wastewater occurs throughout California (Figure 5). Only seven of the state's 58 counties do not have identified recycling projects. In general, the highest countywide volumes of recycled water occur in parts of the state where local water resources are strained, population densities are high, or wastewater disposal is problematic (Figure 6).

Figure 3 Municipal Recycled Water Use in California Since 1970



The 2009 Municipal Wastewater Recycling Survey identified 210 recycling systems, directly involving almost 300 agencies in some aspect of recycling municipal wastewater in the state. These projects ranged in size from less than 50 af to more than 86,000 af in 2009, and involved many levels of complexity, from direct agricultural reuse to multiple levels of treatment and agency involvement. These projects were funded by local water suppliers, customers, and state or federal grants and loans obtained through individual or integrated regional water management (IRWM) funding applications.

Potential Recycling in 2020 and 2030

How much water will California be able to recycle in the future? Various future recycled water goals and mandates have been developed by State agencies (Table 1), but to date they have not been met. To establish achievable targets, DWR reviewed recycled water use projections included in 2010 urban water management plans (UWMPs), which are required to be prepared by urban water suppliers providing more than 3,000 af annually or having more than 3,000 service connections. UWMPs are discussed more in the resource management strategy report, *Urban Water Use Efficiency*. The targets established by DWR, as required by SB X7-7 (2009), do not replace the existing Recycled Water Policy goals and mandates, but are intended to provide a basis of expectation of actual new capacity. This is an essential function of the CWP and also provides support of local and regional water supply planning efforts.

Using the data from the 2009 Municipal Wastewater Recycling Survey and the UWMPs, DWR estimates that the 2020 and 2030 targets for statewide municipal water recycling should be established at 1,000,000 and 1,300,000 af. No recommendations are made to modify the existing goals or mandates (California Department of Water Resources 2013b). Achieving these new targets would require identifying new opportunities for reusing California's water resources. California's uses of recycled water have diversified over time (see Figure 4) and are expected to continue increasing as water resources are more constrained and as people become more knowledgeable about water reuse. Local water suppliers are assessing opportunities for indirect and direct potable reuse of highly treated recycled water as a way of augmenting and "drought- proofing" local supplies, as well as expanding existing irrigation and industrial applications.

Figure 4 Changes in California's Recycled Water Beneficial Uses

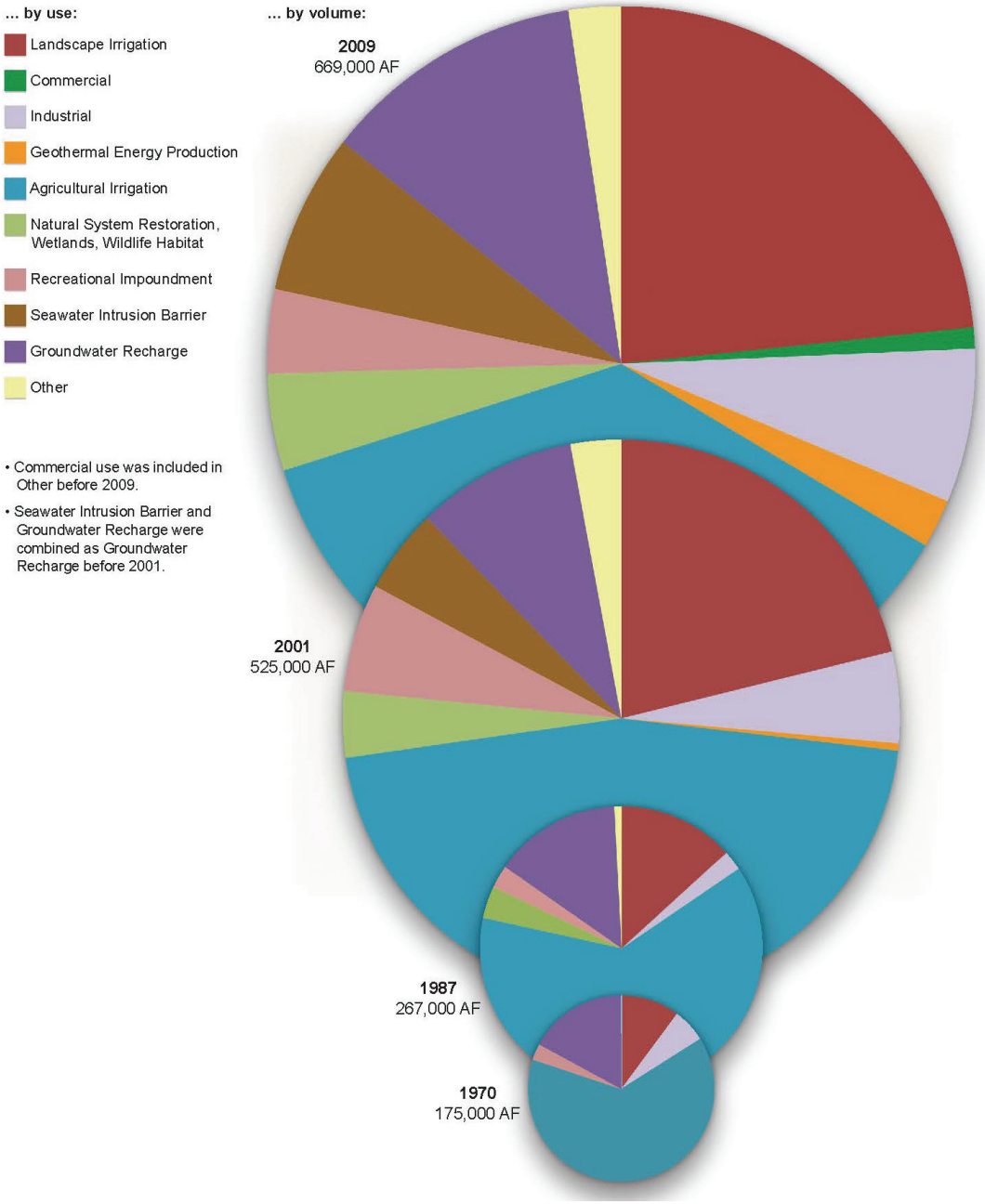
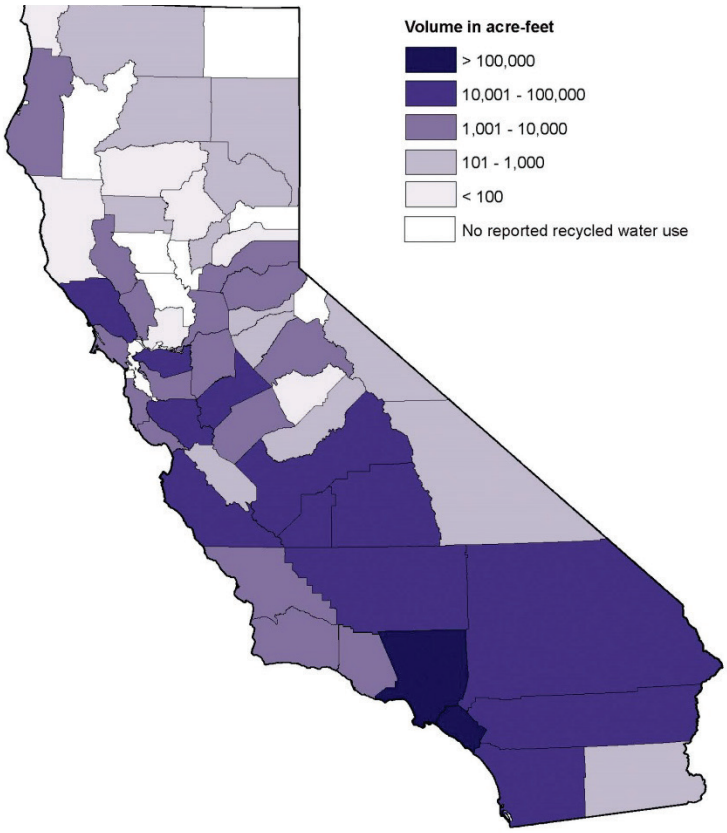


Figure 5 Municipal Recycled Water Use by County in 2009

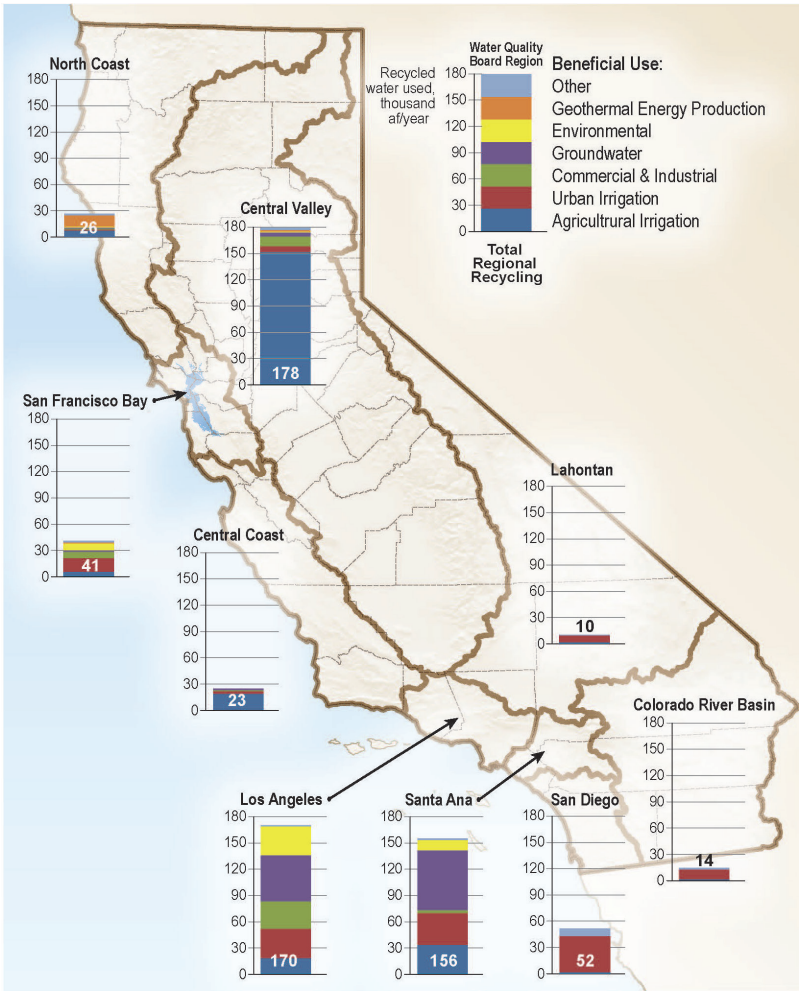


The recycled water community is also placing greater emphasis on matching wastewater treatment levels to water quality requirements for the planned reuse, referred to as "fit for purpose" (U.S. Environmental Protection Agency 2012). This concept is where more rigorous treatment (and more energy-intensive processes) is reserved for uses with higher human or food production contact to minimize pathogen or chemical of emerging concern contact.

Conversely, less-treated wastewater has been safely used for decades in many agricultural reuse applications, which is the largest category of recycled water use in California. Greater reuse of secondary-treated wastewater in agriculture and environmental settings, where additional "natural treatment" can augment wastewater plant treatment, may provide additional opportunities for meeting the newly established 2020 and 2030 recycled water targets. Finally, water suppliers may determine that having available multiple levels of treated wastewater may support increased integration of recycled water use into their water supply portfolio. West Basin Municipal Water District is very successfully providing multiple water quality levels of recycled water to its customers to meet specific needs of its diverse customer base.

Tracking the State's success in increasing use of recycled water and achieving identified goals, targets, and mandates would require conducting future recycled water surveys. Collection of actual recycled water use data in a manner consistent with approaches used in previous recycled water surveys will facilitate monitoring progress. However, completing a voluntary recycled water use survey using the existing methodologies is a labor-intensive effort. Efforts are under way to identify more efficient data collection

Figure 6 Regional Variations in Beneficial Uses of Municipal Recycled Water in 2009



approaches using mandatory, electronic reporting. Because of the complexity of recycled water producers, wholesale and retail agency, and end user relationships, any electronic reporting mechanism will have to be coupled with expert review and compilation of data to avoid missing or duplicating data in surveys.

Recycled Water Use Policies, Regulations, Responsibilities, and Funding

As the treatment level of municipal wastewater increases from primary to secondary, tertiary, or advanced, the permitted uses of recycled water increase. State policies and regulations are in place to increase the use of recycled water in a manner that is protective of human and environmental health. State regulations mandate that producers and users of recycled water comply with treatment and use restrictions to protect public health and water quality.

In general, the levels of treatment for recycled water use are based on levels of human exposure and pathways of exposure leading to infection. The required levels of treatment are specified in Title 22 of the California Code of Regulations (CCR) (Division 4, Chapter 3, Section 60301 et seq.), as shown in Figure 7. The Title 22 regulations also specify monitoring and reporting requirements and on-site use area

Table 1 Recycled Water Statewide[a] Goals and Mandates

Target type [b]	Target volume (in thousand acre-feet)					Notes	Source
	2000	2010	2015	2020	2030		
Potential		1,030			2,050	Midrange of projected potential use increases above 2002 levels	Recycled Water Task Force 2003
Goal	700	1,000					Water Recycling Act of 1991
Goal			1,250				State Water Resources Control Board 2008
Goal				1,525	2,525	1 million af above 2002[c] for 2020 and 2 million af above 2002 for 2030	State Water Resources Control Board 2009b
Goal (draft)				1,000	1,300	Based on urban water management plans (UWMPs) and 2009 Municipal Wastewater Recycling Survey data	California Department of Water Resources 2013[b]
Mandate				869	1,169	200,000 af above 2009 for 2020 and an additional 300,000 af for 2030	State Water Resources Control Board 2009b

Notes:

af = acre-feet, taf = thousand acre-feet

[a] The actual 2009 statewide volume of beneficially reused municipal recycled water was 669,000 acre-feet.

[b] Potentials, mandates, and goals are terms used in the identified sources. They are developed using various approaches. Mandates are stronger objectives, but in this case they do not carry a defined penalty for non-attainment.

[c] The Recycled Water Policy (State Water Resources Control Board 2009b) indicates that 2020 and 2030 goals are determined relative to the 2002 recycled water levels. The 2001 and 2002 numbers are considered the same because they were based on the same data.

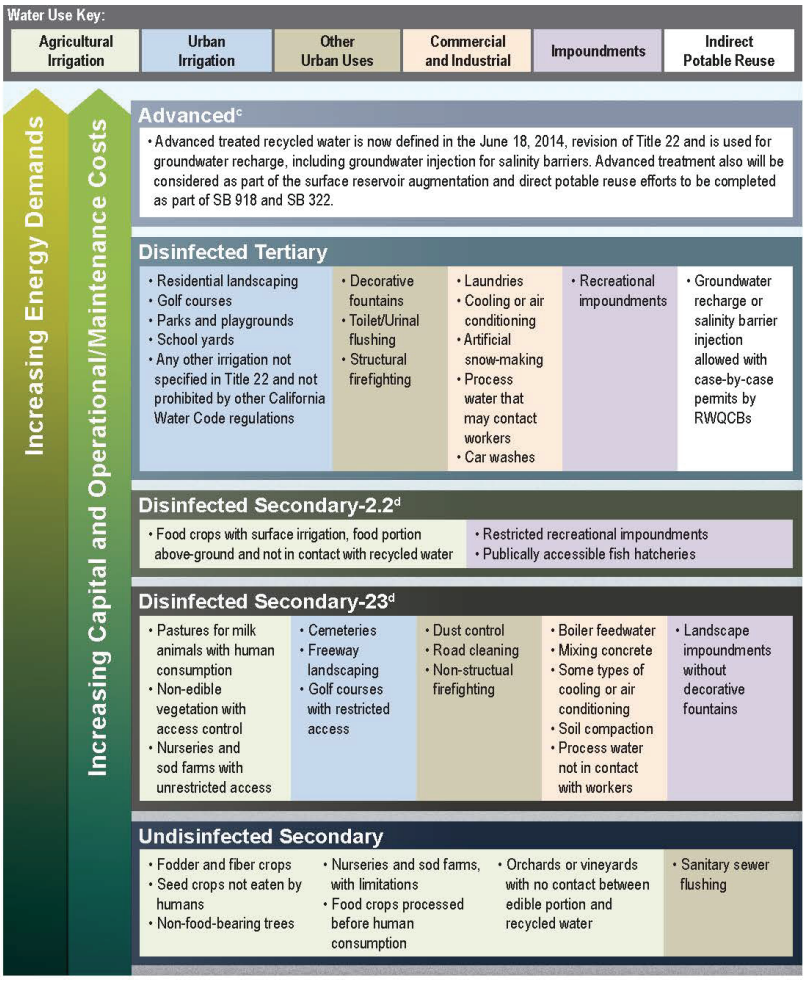
requirements. For example, municipal wastewater that has completed tertiary treatment can be used to irrigate school yards, parks, residential landscape, and food crops for human consumption that do not require further processing or washing, as well as industrial applications, or toilet and urinal flushing in office and institutional buildings. Wastewater that has been treated to secondary levels is generally suitable for uses that do not include contact with people or unprocessed food crops, such as agricultural irrigation of animal feed crops.

Aside from the need to protect human health, there are special water quality needs for uses in agriculture or industry to grow crops or manufacture products. Higher levels of treatment may be needed for some industrial applications. Some agencies are able to provide multiple levels of recycled water treatment for various customer uses.

Recycled Water Roles

The current framework for regulating municipal recycled water has been in place since the 1970s. As established in State law, primary authority for overseeing municipal recycled water is divided between the SWRCB, including the nine regional water quality control boards (RWQCBs), and the CDPH. A

Figure 7 Title 22 Water Uses and Treatment Issues



a: Based on California Code of Regulations Title 22, Section 60001 et seq.

b: Uses for increasing levels of treatment also include all uses for lower treatment levels.

c: Wastewater treated with reverse osmosis and advanced oxidation processes.

d: Recycled water with a median concentration of total coliform bacteria not exceeding a most probable number of 2.2 or 23 per 100 milliliters (see California Code of Regulations, Title 22).

memorandum of agreement between the two agencies documents this arrangement and clarifies the roles of the agencies. The CDPH regulates public water systems and sets standards for wastewater reuse to protect public health by adopting water recycling criteria based on water source and quality and by specifying sufficient treatment based on intended use and human exposure. The treatment objective is to remove pathogens and other constituents, making the water clean and safe for the intended uses. The SWRCB, through the RWQCBs, has the roles of permitting and providing ongoing oversight authority for water recycling projects. The permits incorporate applicable CDPH Title 22 requirements and specify approved uses of recycled water and performance standards.

It is possible that CDPH's Drinking Water Program may be moved to the SWRCB in 2014. The details of how this transition would be accomplished if it occurs, as well as how various responsibilities for managing recycled water would change, are still being addressed as of the publication of Update 2013.

Table 2 Regulatory Agency Roles and Responsibilities for the Regulation and Use of Municipal Recycled Water

Agency	Role	Responsibility	California Code of Regulations Title Number
California Department of Public Health	Protects public health	• Adopts uniform recycled water criteria for non-potable and potable recycled water projects [a] • Provides recommendations for recycled water project permits • Reviews and makes recommendations on sites proposed for recycled water use • Oversees cross-connection prevention [b] • Oversees protection of drinking water sources • Regulates public drinking water systems	Titles 17 and 22
State Water Resources Control Board	Protects water quality and water rights	• Establishes general policies governing recycled water project permitting • Oversees regional water quality control boards • Provides financial assistance to local agencies for recycled water projects • Allocates surface water rights	Title 23
Regional water quality control boards (nine)	Protect water quality	• Issue and enforce permits for recycled water projects, incorporating California Code of Regulations Title 22 requirements and California Department of Public Health recommendations • Protect surface water and groundwater quality from recycled water impacts	Title 23
California Department of Water Resources	Manages statewide water supply	• Evaluates use of and plans for potential future recycled water uses through the preparation of *the California Water Plan* • Provides financial assistance to local agencies for recycled water projects • Adopts standards for recycled water indoor plumbing	Title 24 (California Plumbing Code, Chapter 16A, Part II)
California Public Utilities Commission	Oversees rates and revenues of investor-owned utilities	• Approves rates and terms of service for the use of recycled water by investor-owned utilities	Title 20
California Department of Housing and Community Development	Oversees building standards for dwellings, including institutions and temporary lodgings	• Adopts standards for gray water systems in residential structures • Adopts standards for non-potable water systems within buildings over which it has jurisdiction	Title 24 (California Plumbing Code, Chapter 16A, Part I; Chapter 6)
California Building Standards Commission	Oversees adoption of standards for buildings	• Adopted standards for gray water systems in non-residential structures in 2011 cycle of California Building Standards Code • Oversees the adoption of the California Plumbing Code, including provisions added by other State agencies	Title 24 (California Building Standards)

Agency	Role	Responsibility	California Code of Regulations Title Number
Local building officials	Oversees building design, including plumbing	• Enforce building standards, including the California Plumbing Code	Title 24
County environmental health departments	Protects drinking water systems	• Enforce cross-connection control • Review and make recommendations on proposed recycled water use sites	Titles 17 and 22

Notes:

[a] As of November 2011, the California Department of Public Health has adopted regulations in Title 22 for non-potable use of recycled water, but not for potable reuse projects. Senate Bill 918 requires the department to adopt uniform water recycling criteria for indirect potable reuse projects involving groundwater recharge and surface water augmentation.

[b] The California Department of Public Health may delegate some responsibilities for review of new sites and cross-connection control to the local county health departments with the permission of the local recycled water provider.

Four other state agencies are directly involved with municipal recycled water issues in California and implement various sections of State law: DWR, the CPUC, the California Department of Housing and Community Development (HCD), and the California Building Standards Commission (CBSC). Statutes governing municipal recycled water are currently contained within the CWC, the California Health and Safety Code, the California Government Code, the Public Resources Code, and the Public Utilities Code, and regulations are in various subdivisions (titles) of the CCR. State agency roles and responsibilities are summarized in Table 2.

In addition to the statewide agencies, local city and county officials also have a regulatory role affecting municipal recycled water projects. In some cases, the CDPH can delegate responsibilities to local officials if local sponsors of municipal recycled water projects agree with the delegation.

Recycled Water Use Statutes, Regulations, and Policies

Since the 1970s, various statutes, regulations, and policies have been enacted and developed to address recycled water generation and use. Table 3 highlights some of them. Additionally, there are several new and pending regulations, which are discussed here. The following discussion is based on conditions in early 2013. Some revisions to State statutes have been introduced into the Legislature to consolidate and streamline existing recycled water laws to facilitate uniform implementation.

Recycled Water Policy of 2009

In 2009, the SWRCB adopted the Recycled Water Policy to address issues of concern for permitting recycled water and protecting water quality, including salinity management, regulation of incidental runoff, and monitoring and regulation of chemicals of emerging concern. The policy (State Water Resources Control Board 2009b) calls for managing basins or subbasins through stakeholder involvement and implementation of salt and nutrient management plans and regulating incidental runoff through waste discharge requirements and best management practices. It also prioritizes approval of groundwater recharge projects utilizing municipal recycled water treated by reverse osmosis.

Table 3 Important Recycled Water Policies and Regulations

Year	Action	Organization	Summary
1984	Water Quality Order 84-7	State Water Resources Control Board	Pursuant to California Water Code, Section 13142.5(e), in cases where discharges of wastewater to the ocean are proposed in "water-short" areas, the report of waste discharge should include an explanation as to why the effluent is not being recycled for further beneficial use.
2001	Assembly Bill 331, Recycled Water Task Force	California Assembly	This bill established a 40-member Recycled Water Task Force to evaluate the current framework of State and local rules, regulations, ordinances, and permits to identify the opportunities for, and obstacles or disincentives to, increasing the safe use of recycled water. The task force was composed of individuals representing federal, State, and local government; public health professionals; private sector entities; environmental organizations; the University of California; internationally recognized researchers; and public interest groups. The task force was a cooperative effort of DWR, the State Water Resources Control Board, and the California Department of Health Services (now the California Department of Public Health).
2003	Recycled Water Task Force	California Department of Water Resources	The Recycled Water Task Force presented its findings and recommendations in a final report titled *Water Recycling 2030: Recommendations of California's Recycled Water Task Force*. The task force estimated the future potential and costs of water recycling and made a wide variety of findings, many of which are reflected in this resource management strategy report. The task force issued 26 recommendations to increase water recycling. The recommendations are broad, are not limited to legislative actions or statutory changes, and as of this update are still worthy recommendations in need of being fully implemented. Work has been accomplished on many of the recommendations.
2003	Assembly Bill 334, Water Softening and Conditioning Appliances	California Assembly	This bill authorized local agencies to adopt regulations governing water softeners or conditioning appliances that discharge salt into the community sewer system. The Water Softening and Conditioning Appliances bill specifically authorizes local agencies, by ordinance, to limit the availability or use, or prohibit the installation, of water softening or conditioning appliances that discharge to the community sewer system.
2004	Incidental Runoff of Recycled Water memorandum	State Water Resources Control Board	This memorandum reviewed the legal requirements of federal and State statutes and regulations that relate to the regulation of incidental runoff and, to determine the available regulatory and enforcement options, conducted legal analysis and conducted stakeholder meeting to arrive at the decisions in the memorandum.
2006	Uniform Analytical Method for Economic Analysis framework	State Water Resources Control Board	This was a partially funded research project to develop a Uniform Analytical Method for Economic Analysis framework for evaluating the benefits and costs of water reuse by the WateReuse Foundation (August 2006). The State Water Resources Control Board convened the Economic Analysis Task Force with participation from State, federal and university members in fall 2008.

Year	Action	Organization	Summary
2006	Climate Action Team, created in response to Assembly Bill 32	California Environmental Protection Agency	The Climate Action Team was created to formulate measures to mitigate the effects of climate change. Water recycling can contribute to the reduction of greenhouse gas emissions by replacing energy-intensive imported water with local recycled water. To that end, the Climate Action Team (CAT) formulated a water recycling measure to require the development and implementation of wastewater recycling plans. The water recycling CAT measure is identified in *Climate Change Scoping Plan: A Framework for Change* prepared by the California Air Resources Board in 2008.
2007	Assembly Bill 1481, Landscape Irrigation	California Assembly	This bill required the regional water quality control boards to prescribe general waste discharge requirements (a general permit) for landscape irrigation that uses recycled water for which the California Department of Public Health has established uniform statewide recycling criteria. The State Water Resources Control Board adopted the General Permit for Landscape Irrigation of Municipal Recycled Water, which further supports the use of recycled water in California while protecting the water quality.
2009	Recycled Water Policy	State Water Resources Control Board	This action was for implementing State statutes, regulations, and policies for recycled water projects to establish more uniform interpretation (State Water Resources Control Board 2009a, 2009b). This policy aims to increase the use of recycled water from municipal wastewater sources (as defined in California Water Code Section 13050(n)), in a manner that implements State and federal water quality laws.
2009	California Plumbing Code	California Department of Water Resources	This action addressed plumbing within buildings with both potable and recycled water systems. The California version of these provisions was adopted in 2009 and became effective in 2010. This section of the plumbing code will provide guidance throughout the state to safely plumb buildings for indoor use of recycled water for toilet and urinal flushing.
2009	Recycled water symbol change in code	California Department of Housing and Community Development	The department adopted a recycled water symbol change to remove the requirement for the skull-and-crossbones symbol in sections 601.2.2 and 601.2.3 of the California Plumbing Code. Now the symbol is a picture of a glass containing liquid, encircled, and with a line slashed through, indicating the liquid should not be ingested.

The policy was modified in 2013 to incorporate science advisory panel recommendations (State Water Resources Control Board 2010) on monitoring chemicals of emerging concern. Chemicals of emerging concern are classes of chemicals in the environment — such as pharmaceuticals, currently used pesticides, and industrial chemicals — that could have adverse aquatic and human health effects. These could be existing chemicals which new information indicates potential toxicity concerns or chemicals for which new information suggests possible hazards. These chemicals have the potential to be present in recycled water, which is why the SWRCB convened the scientific panel and modified the Recycled Water Policy to address monitoring requirements for chemicals of emerging concern in certain types of recycled water projects.

Senate Bills 918 and 322

SB 918, enacted in 2010 and modified by SB 322 in 2013, focuses on the issues of indirect and direct potable reuse. It requires CDPH adoption of uniform water recycling criteria for indirect potable reuse for

groundwater recharge in 2013 and surface water augmentation in 2016. It also requires the CDPH, by the end of 2016, to investigate and report to the Legislature on the feasibility of developing uniform water recycling criteria for direct potable reuse. The CDPH is required to convene both advisory and expert panels to advise it on the development of criteria for surface water augmentation and the feasibility of direct potable reuse.

In June 2013, the CDPH released draft regulations addressing groundwater replenishment using recycled water from domestic wastewater sources, for aquifers designated as a source of drinking water. The proposed regulations would replace the existing Title 22 regulations that provide the requirements for groundwater recharge projects using recycled water to be determined on a case- by-case basis. Through SB 918 (2010) and SB 322 (2013), CWC Section 13562 et seq. requires the CDPH to adopt revised groundwater replenishment regulations by Dec. 31, 2013. Although the rulemaking was not completed by this deadline, proposed groundwater replenishment and surface water augmentation projects continue to move forward.

The proposed groundwater recharge regulations seek to protect public health for projects utilizing indirect reuse of recycled water to replenish drinking water basins, by establishing criteria that cover:

- Source water control.
- Potential risks associated with pathogenic microorganisms, regulated contaminants, and unregulated contaminants.
- Effective natural barriers and multiple treatment barriers.
- Ongoing monitoring of recycled water and groundwater.
- Effective treatment processes.
- Time to identify and respond to failures.
- Review, reporting, and notification processes.

Recycled Water Policy Framework for Investor-Owned Utilities

The CPUC is in the process of developing a comprehensive policy framework to cover recycled water projects, production, and recycled water use for the investor-owned water and sewer utilities that it regulates. This action, required under the CPUC's Order Instituting Rulemaking 10-11-014, applies to investor-owned utilities with a customer base of 2,000 or more connections. The goal of the policy framework is to facilitate the cost-effective use of recycled water where it is available or can be made available and to reduce the barriers to collaboration between wholesalers and retail recycled water purveyors. The policy framework is expected to provide guidance to investor-owned water and sewer utilities that are in a position to identify, evaluate, and pursue opportunities to add recycled water to water supply portfolios. The policy framework will take into account the most recent State policy and legislation for the production, delivery, and use of recycled water and will encourage interagency coordination and collaboration in the implementation of these policies.

Recycled Water Use Funding

Recycled water projects are funded directly by local water agencies and water users through rates, bonds, or rebates. Individual water users may also pay for projects that directly benefit them, such as an industrial facility installing on-site or off-site infrastructure to receive recycled water or implementing a process modification. Local agencies take the lead in identifying, analyzing, and prioritizing the water

resource projects in their jurisdictions to help achieve their identified goals. They then proceed with the best option to implement their identified projects. Once projects are constructed, revenue from the sale of recycled water, revenue from the sale of potable water, and tax assessments are options for operation, maintenance, and debt service financing.

Other funding options include obtaining grants or loans from both State and federal sources, including the sources listed below.

- **IRWM Grant Program**, administered by DWR. The IRWM grants (funded by Proposition are used by communities in IRWM regions to implement water supply and management projects. Water recycling is one of many strategies that may be considered by IRWM regions in developing their water resource management portfolios.
- **Water Recycling Funding Program,** administered by the SWRCB. This program provides low-interest financing and grants to local agencies (funded by a variety of sources, including Proposition 13). Water recycling is a key objective in the SWRCB's Strategic Plan Update 2008-2012 (State Water Resources Control Board 2008), which identifies priorities and direction for the SWRCB and its nine RWQCBs.
- **Clean Water State Revolving Fund**, administered by the SWRCB (and funded by the federal Clean Water Act and State bonds). This program provides low-interest financing primarily for wastewater collection, treatment, and disposal, but it also funds recycling projects.
- **Title XVI**, administered by the U.S. Bureau of Reclamation. This federal program (authorized by Title XVI of Public Law 102-575) funds water reclamation and reuse projects throughout the western United States.

With State budget constraints, it is likely that additional sources of funding will be limited in the future. This is a challenge, because implementation of recycled water projects often requires significant capital outlay, which many water suppliers are not able to fund without outside resources. However, given the importance of a reliable water supply to the state's economy, legislative support of providing additional funding for recycled water projects is a critical component of continued recycled water development.

Later in this resource management strategy report, the subsection "Affordability" describes sharing costs, regional approaches, planning considerations, and actions that could support implementation costs.

Potential Benefits

Water recycling provides many benefits to local and statewide water supply reliability. Municipal recycled water increases local supplies, supports drought preparedness, supports climate change mitigation and adaptation strategies, provides environmental benefits, and can reduce energy consumption by lowering dependence on imported supplies.

Local Supply

Municipal recycled water has the advantage of being locally generated and reused. The availability of additional local supplies can provide resource-limited communities with additional options for meeting water supply demands. Areas with constrained or declining groundwater supplies or heavy dependence on imported water may realize significant benefit from appropriate reuse of treated municipal wastewater. Recycled water may provide more cost-effective water self-sufficiency options than other resource

development alternatives. It can also provide additional water resources to address increased demands from population growth.

Drought Preparedness

Establishing recycled water capacity provides a more reliable water supply resource for water managers to access during drought cycles. Municipal recycled water as a water supply has less variability than traditional resources because domestic water disposal continues even during droughts. Wastewater production will decrease during a drought as households and commercial and industrial facilities conserve, but some wastewater generation will still occur.

Climate Change

Climate change is expected to increase atmospheric temperatures, resulting in a more variable precipitation regime and declining snowpack (California Department of Water Resources 2008). Consequences of the warming climate are anticipated to increase water demand for urban, agricultural, and environmental uses, with a concurrent reduction in water supply availability and reliability.

Municipal recycled water can support climate change adaptation by contributing to sustainability for urban water supplies facing changing climate conditions, particularly where local water supplies are limited. Recycled water can support climate change planning as a source of water for groundwater recharge, surface reservoir augmentation (not currently occurring in California, but occurring in other parts of the country), and salinity barriers for coastal aquifers. Although recycled water supplies can be affected by drought and increased conservation, the fluctuation is usually lower than other resources and is considered to be less sensitive to temperature and precipitation variation expected with climate change.

Energy Savings

Wastewater treatment serves two functions — it makes the water suitable for discharge to the environment and then makes it suitable for beneficial use. When projects are analyzed, treatment energy is allocated to the two functions. Wastewater treatment — and its required energy and GHG emissions — to protect the environment are allocated to pollution control. Any additional treatment necessary to enable the water to be used beneficially is allocated to water supply. When recycled water is used as a water supply source, the energy required above that required for discharge plus the energy for distribution, is the allocation that would be compared for evaluation and comparison of alternative water supply options.

Implementing municipal water recycling could reduce energy consumption, which may also support California's climate change mitigation efforts. The water sector uses a significant amount of energy to convey water from its source to its use. The State Water Project uses two-three percent of the energy consumed in the state and is the single largest user of energy in California (Natural Resources Defense Council 2004). Water recycling can provide a lower-energy source of local water compared with importing water from other regions and desalination of ocean water or brackish waters. Energy savings are greatest when recycled water is used in close proximity to wastewater treatment sources and when additional treatment is not required beyond the treatment needed for wastewater disposal.

Wastewater generally is required to be treated to at least a secondary treatment level before it can be released to the environment. However, in many cases, tertiary treatment of wastewater discharge is required to protect public health or the environment. Recycled water used for most urban applications

requires tertiary treatment, which requires a greater amount of energy to produce and, therefore, produces more greenhouse gases (GHG). GHG savings can be realized in two ways — first, not overtreating water that can be beneficially reused at lower levels of treatment, and second, reusing water beneficially that does not have downstream flow requirements. When tertiary treatment is already required for discharge, to take the further step to recycle the wastewater for urban uses, it is necessary only to install infrastructure to convey the recycled water to end users.

Energy savings realized by implementing a recycled water project depend on multiple factors, including the source of the water offset by the recycled water, the amount of increased treatment above that already required for disposal needed to reuse the water, and distance to the point of recycled water use. Research is also ongoing to develop lower-energy recycling methods, which would in turn reduce the GHG generation during the water recycling process. Overall, it is assumed that implementing recycled water would provide an energy use benefit by developing local resources versus importing fresh water. This energy use benefit would also be realized by considering "fit for purpose" in recycled water use planning and by avoiding treating water to a higher level than is necessary for its planned reuse, thus improving energy resource efficiency.

Potential Costs

Augmenting statewide municipal recycled water funding, even in light of current statewide budget issues, is a long-term benefit because it develops local, reliable water supplies. The costs to implement recycled water projects vary based on the amount of water to be treated, treatment requirements, infrastructure needs, project planning, permitting, and financing. As a result, project costs can vary widely, as described further below.

Overall Costs

California's Recycled Water Task Force (2003) estimated that between 2003 and 2030, an additional 1.4 million to 1.7 million af of additional wastewater could be recycled annually in California, based on growth in available wastewater and increased percentage of wastewater recycling. Of this, 0.9 million to 1.4 million af (62 percent to 82 percent) of the additional recycled water would be from discharges that would otherwise be lost to the ocean, saline bays, or brackish bodies of water (Recycled Water Task Force 2003). To add 1.4 million to 1.7 million af per year of recycled water, the task force estimated that a capital investment of between $9 billion and $11 billion would be required (in 2003 dollars) (Recycled Water Task Force 2003). This amount would be the incremental capital cost above the cost of wastewater treatment for discharge to a water body.

Given the variability of local conditions and their effect on treatment and distribution costs, the current estimated range of capital and operational costs of water recycling range from $300 to $1,300 per af of recycled water, but in some instances costs are above this range. The upper end of the current unit costs for recycled water projects comes from cost estimates recently prepared for two Southern California projects, in San Diego and Oxnard. Costs per af for those projects are estimated to be between $1,191 and $1,900 (Fikes 2012; Wenner 2012). These are urban projects and are reflective of higher-end projects, as well as the increasing costs of implementing recycled water projects. Therefore, for planning purposes, the State should consider that overall costs to reach the Recycled Water Task Force (RWTF) potential estimate will be at the higher end of the estimate range, if not beyond this.

Increased focus on matching water use to water quality is an approach to implement more cost- effective projects while attempting to lessen ratepayer impacts for these projects. In a state where between 70 percent and 80 percent of developed water is used for agriculture, projects that can convey secondary effluent to agricultural users and develop cooperative solutions could be a cost- effective way to meet water resource needs. Overall, the actual cost of recycled water projects will depend on the quality of the wastewater, the level of treatment required, the proximity of potential users to the sources of recycled water, and user costs associated with required upgrades or operational modifications. Uses that require higher water quality or have greater public health concerns, or both, will incur higher costs.

The cost to install new distribution systems is a major obstacle to the expansion of water recycling. Assessing costs of implementing recycled water programs should consider not only the cost of municipal infrastructure and its operation and maintenance, but also the cost to users. In particular, larger industrial, agricultural, or commercial users that may need on-site modifications to maintain a separate water system, including physical barriers for backflow prevention, or process modification to utilize a different water quality. In addition, a user may have additional operating costs for recycled water use as that user integrates recycled water into its water supplies.

Because recycled water is not classified as potable, regulatory constraints prohibit conveying recycled water and potable water in the same pipelines. Under current regulations, recycled water must be conveyed in a separate purple pipe distribution system that is labeled and readily distinguished from potable water lines. The cost to install new purple pipe distribution mains from treatment plants to users can exceed the costs of obtaining alternate water sources or projects — including, in some cases, the cost of potable reuse projects. As a consequence, extension of purple pipe systems to areas near treatment plants can be more cost-effective than extending infrastructure and service to more distant users. Distribution system cost can be an obstacle when evaluating the feasibility of supplying recycled water to large numbers of users or users more distant from urban wastewater treatment plants. Some agencies have constructed satellite water recycling facilities to provide recycled water at locations near large concentrations of use.

How cost is a potential issue to increasing recycled water use in California is discussed further in the next section.

Individual User Costs

Additional costs that individual recycled water users may need to incur to receive recycled water include installing dual plumbing, modifying facility processes to use water of a different quality, and implementing cross-connection prevention. These can be significant cost components to potential recycled water customers using both potable and non-potable water.

Cross-connections, the accidental direct contact between potable and non-potable water systems, can contaminate potable water systems. Air gaps, valves, or other controls are installed to prevent cross-connections because of inadvertent pipe connections, pressure loss, or other failures. Specific requirements vary by the water supplier or governmental agency. State regulations to protect public potable water systems from contamination by non-potable water are in CCR Title 17 adopted by the CDPH.

The California Plumbing Code specifies protections to prevent potable water lines on the property of users from contamination. Its provisions governing dual plumbing in buildings were adopted in California in 2009. These codes established statewide standards to install both potable and recycled water plumbing systems in commercial, retail, and office buildings; theaters; auditoriums; condominiums; schools; hotels; apartments; barracks; dormitories; jails; prisons; reformatories; or other structures as determined by the CDPH. Some potential recycled water customers have faced challenges working with local inspectors to implement dual-plumbed systems, but these issues are expected to decrease as the systems become more common.

Major Issues

There are many issues involved in planning and implementing recycled water projects. However, based on the many successful projects in California, potential obstacles are not insurmountable. Awareness of potential issues and sound planning practices to address or prevent negative impacts are key components of successful project development. Successfully implemented projects have also included early involvement of affected agencies, potential recycled water customers, other stakeholders, and representatives of public interests.

Identifying and planning successful approaches to issues that could hinder the implementation of increasing recycled water use both locally and statewide is critical for continued growth. The Recycled Water Task Force (2003) identified 26 recycled water "issues, constraints, and impediments" and provided recommendations to address them. More recently, three efforts conducted since Update 2009 addressed issues (also referred to as barriers or challenges) facing increased municipal recycled water use. These efforts were:

- Integrated Water Resources Plan: 2010 Update (Metropolitan Water District of Southern California 2010).
- Draft Commercial, Institutional and Industrial Task Force Water Use Best Management Practices Report to the Legislature (California Department of Water Resources 2013a).
- Water Reuse: Potential for Expanding the Nation's Water Supply Through Reuse of Municipal Wastewater (National Research Council 2012).

Input from these documents supported development of the issue discussions included in this section. However, continued discussion regarding sometimes opposing recycling issues, such as how to finance projects, higher costs for higher treatment, matching water quality to use, chemicals of emerging concern, regulatory requirements, and public acceptance continue to challenge expansion of recycled water use. As part of future recycled water planning, it is recommended to reconvene the RWTF to provide a forum to discuss these issues and develop implementable solutions. It is recommended that the reconvened RWTF work in cooperation with the Advisory Panel being established by CDPH and to assess direct potable reuse and indirect potable reuse issues.

The issues addressed below are commonly confronted in planning and developing local and regional recycled water projects. DWR and other State agencies directly involved with recycled water will support local efforts by preparing applicable statewide recycled water planning documents. This will include reviewing the National Research Council's recommendations (2012) and other applicable documents (e.g., National Water Research Institute 2012) and integrating those that are applicable to California.

Affordability

The affordability of recycled water has to be viewed from various perspectives, such as those of agencies implementing recycled water projects, users of recycled water, suppliers of potable water whose revenue may be affected by recycled water use, and sewer and potable water ratepayers who may see their rates affected by recycled water use. The costs of recycled water projects may include: additional treatment above current wastewater treatment, disposal of treatment byproducts, storage and pump facilities, and recycled water pipeline distribution systems. In addition, there may be on-site costs at user sites for specialized treatment of the recycled water, including on-site plumbing, cross-connection control devices, and potential modification of commercial or industrial processes to accommodate recycled water. The responsibility for payment of these costs depends on sources of revenue or financial assistance and how agencies agree to share costs based on the perceived beneficiaries.

The common reference point for water suppliers and users is what they currently pay for alternative water sources, such as potable water, or what agencies will have to pay in the future for new water supplies. Water suppliers in California are often dependent on other wholesale suppliers for their water supply. Prices for water often are set to recover costs from past projects and do not reflect the more expensive costs of new water supplies. Thus, prices are not a good benchmark for the true economic cost of new water supplies. New freshwater supplies are often developed at the regional or state level, whereas recycled water projects are often developed at the sub-regional or local level. It is difficult for any one water supplier or user to see the total water supply picture from the standpoint of costs.

Much of the water provided by federally funded projects is provided at discounted prices. Artificially low rates discourage adoption of water recycling and similar conservation programs. Consequently, there is growing recognition that pricing should more closely reflect the true costs to provide water and thus encourage more efficient use of existing water supplies. As stated in the National Research Council's 2012 report on national water recycling, "Current reclaimed water rates do not typically return the full cost of treating and delivering reclaimed water to customers." Water pricing issues need to be considered early in the planning process for recycled water and thoroughly vetted with potential customers.

Some benefits or costs can be difficult to quantify and, even though real, are accrued indirectly such that they are not reflected in project costs. Recycled water has a benefit of reliability during droughts, but the monetary benefit accrues to the general economy and not to water suppliers.

Economic tools can provide a quantification of many indirect costs and benefits, and an economic analysis can be used to compare recycled water and other water projects on an equal basis by looking at total costs and benefits to society as a whole. When economic analysis finds recycled water to be cost-effective compared with alternative water supplies, the challenge should then be to allocate costs according to beneficiaries and to use financial incentives, such as regional rebates or State and federal loans and grants, to encourage local water suppliers to build recycled water projects.

Interagency cooperation can be a way to allocate costs according to beneficiaries and to achieve multiple objectives. Recycled water can improve regional water reliability and offset potable water that can be used in other areas. Regional water supplier partners can help local recycled water projects by contributing to construction and operation costs reflecting the regional benefits. Because of high initial infrastructure costs, many California communities are developing cooperative recycled water projects.

These projects are developed and implemented locally to best serve the local needs. Projects have been developed where one community provides wastewater to another that then treats it to recycled water standards and distributes it. Another institutional arrangement involves a wastewater agency producing recycled water and a partnering water agency distributing it. Yet another option is for large wholesale water purveyors to finance, construct, and operate regional distribution systems within their service area to serve multiple small retail purveyors that may not have the resources to pursue individual projects or may not be proximate to the source of recycled water.

Advancements in water recycling treatment technology may bring down costs in the future, especially for indirect and, potentially, direct potable reuse, where high levels of treatment are often required. Another way of reducing costs is to incorporate purple recycled water pipelines in new developments at the same time as potable water lines are being installed. Long-range planning can anticipate where future recycled water users should be.

Nevertheless, dedicated recycled water distribution systems are costly. Adding recycled water to sources of drinking water (e.g., aquifers or surface reservoirs) eliminates the need for dual distribution systems. Introducing highly treated recycled water directly into potable water pipelines could also eliminate the need for separate recycled water lines. Groundwater recharge is widely practiced in California, but suitable aquifers are not available everywhere. Indirect potable reuse by augmenting surface drinking water reservoirs with recycled water and direct potable reuse currently does not occur in California, but such practices would give communities more flexibility in how recycled water could be used at potentially lower cost than non-potable reuse through separate recycled water pipelines. SB 918 and SB 322 established a schedule for the CDPH to evaluate surface water augmentation and adopt regulations and to evaluate direct potable reuse and report to the Legislature.

The availability of local funding sources continues to challenge the implementation of new projects or the expansion of existing projects. Where a recycled water project is found to be cost-effective from an evaluation of all costs and benefits from society's perspective, but more expensive than alternatives from a local perspective, there is a role for regional, State, and federal financial assistance to encourage the optimum water resource solution. As discussed earlier, a key source of State funding has been the Water Recycling Funding Program administered by the SWRCB, which provides low-interest loans and grants to local agencies. DWR administers the IRWM Grant Program. Water recycling is a resource management strategy that must be considered by an integrated regional water management plan (IRWMP) and may be utilized as an active component of the plans to help a region meet water management goals and objectives. Inclusion of wastewater agencies in the IRWM process has occurred in some regions. Continued and expanded inclusion facilitates the identification of municipal recycled water projects as viable water supply projects and facilitates the interaction of water and wastewater agencies to identify mutually beneficial solutions to common issues. Water recycling projects identified in IRWMPs to be a key strategy may qualify for IRWM grant funding. The federal government, through the U.S. Bureau of Reclamation, has been a major contributor of grants and loans to recycling projects in California, primarily through the Title XVI program, but like State programs, has had availability and accessibility challenges.

Water Quality

Water quality criteria for recycled water, established by the CDPH, define water quality and treatment requirements to protect public health for most expected uses of recycled water. RWQCBs establish water quality requirements to protect the beneficial uses of surface and groundwater bodies. Under current regulations, RWQCBs issue the waste discharge or water reclamation permits to recycled water producers, distributors, and users. These permits incorporate water quality and monitoring requirements for recycled water projects, including health department criteria to protect public health and any site-specific requirements for protecting water quality.

Recycled water quality is to protect environmental and human health in order to support current uses and long-term sustainability. Recycled water quality issues include:

- Pathogen content (primarily bacteria and viruses).
- Salinity.
- Nitrogen compounds.
- Heavy metals.
- Organic and inorganic substances (often of commercial and industrial origin, but also pharmaceuticals and personal care products, household chemicals and detergents, fertilizers, pesticides, fungicides, and hormones), including chemicals of emerging concern.

Chemicals of emerging concern, described earlier in this resource management strategy report within the section about the Recycled Water Policy, are found in wastewater and may occur in recycled water at very low concentrations. Research is ongoing regarding potential impacts of chemicals of emerging concern in recycled water, particularly with respect to effects on human health or the environment. Currently, there are no established regulatory limits for chemicals of emerging concern, but some monitoring is required by the CDPH and the SWRCB as a precaution for protection of human health and the aquatic environment.

The SWRCB's expert panel on chemicals of emerging concern (State Water Resources Control Board 2010) provided recommendations, based on available information, for constituents to be included in required monitoring of various types of recycled water projects. These recommendations have been incorporated into the Recycled Water Policy. As additional information becomes available, future changes can be made to regulations and policies to protect California's water resources while supporting implementation of new projects.

The Recycled Water Policy encourages the development of salinity and nutrient management plans. These plans address salinity and nitrogen issues, including changes that may occur with the use of recycled water. Therefore, implementation of a recycled water program may be enhanced by the parallel development of a salinity and nutrient management plan. In addition to water quality being protective of human and environmental health, aligning water quality to end use is a key component of recycled water planning and implementation (see the resource management strategy report, *Matching Water Quality to Use*). The planned end uses and commercial/industrial application compatibilities are crucial recycled water considerations. In many cases, recycled water is integrated into existing processes. Most commercial and industrial applications are sensitive to water quality, and recycled water typically has more minerals and organic content than many available alternative supplies. Subtle changes in water quality, such as increases or decreases of certain minerals or chemical species, can dramatically change

the suitability of recycled water or the treatment requirements for use in an industrial process. Many water quality concerns associated with recycled water can be and are addressed with additional treatment by the water utility, on-site treatment, or other water management practices. These additional efforts have to be considered during recycled water planning, along with financial impacts and responsibilities.

Public Acceptance

Public acceptance of recycled water projects is critical for their success. Water quality and cost factors are two issues often raised by the public. Integrating public input into the project planning phase has been a successful approach for many agencies.

In general, there is public acceptance and support for most non-potable recycled water applications, such as agricultural and landscape irrigation, where there is a lower degree of direct human exposure. Public acceptance can be lower for projects with more direct links between recycled water and human consumption or contact. In addition, the public expects assurances that recycled water is safe and regulations protect the public from misuse. Outreach, education programs, and involvement during project planning can provide public reassurance that recycled water is adequately regulated to protect public health.

Environmental buffers — natural processes separating treated recycled water from human end uses — frequently enhance public acceptance of recycled water projects and differentiate indirect and direct potable reuse, as explained earlier. For example, public concern about mixing recycled water with groundwater appears to be partly alleviated when infiltration, percolation, and underground residence time expose the water to natural cleansing processes after engineered treatment. The actual benefit of environmental barriers versus engineered treatment with system controls has not been fully quantified. Additional research and planning may support how environmental buffers and engineered controls are perceived by the public and implemented in future projects.

Impacts on Downstream Users

Communities that discharge wastewater to rivers and streams contribute to the ambient water available for use by downstream users. The implementation of water recycling in upstream communities would reduce the volume of such discharges, potentially reducing the volume of ambient water available for downstream reuse or fulfillment of environmental needs. In some circumstances, downstream users may have rights to the use of discharged wastewater, potentially preventing upstream communities from implementing recycling.

In the case of groundwater recharge with recycled water, the availability of groundwater downgradient may be increased, but there may be water quality impacts. Whether for storage or planned indirect use, the discharge of recycled water to wells, infiltration sites, or other locations underlain by permeable soil and geologic materials has the potential to introduce contaminants, including salts, into potable groundwater sources and aquifers. Modern microfiltration, reverse osmosis, and disinfection practices produce exceedingly high-quality recycled water, but concerns about pathogens, emerging contaminants, or other potentially unknown contaminants warrant continued research to advance the science and technology in this area. Presently, California does not approve direct potable reuse projects, that is, where recycled water is piped directly from a treatment plant into a drinking water supply.

Recommendations

1. **Reconvene the Recycled Water Task Force**. The RWTF presented 26 recommendations to increase water recycling in its 2003 report, Water Recycling 2030: Recommendations of California's Recycled Water Task Force. Since completion of the RWTF report, significant accomplishments have resulted from implementing the task force's recommendations. Additional statewide and local issues associated with specific approaches to increasing recycled water use continue to be discussed. Because of the wide range of issues and sometimes differing approaches, reconvening the RWTF would provide the forum for meaningful discussion, development of consensus, and guidelines for future statewide actions.
2. **Develop approaches to facilitate increasing statewide use of recycled water for agricultural and environmental uses**. DWR, in cooperation with the SWRCB and the RWQCBs, will identify obstacles to increasing agricultural and environmental reuse of recycled water, with an emphasis on applications using secondary-treated wastewater to avoid the additional treatment cost and GHG emissions of higher levels of treatment. The focus of this effort is to implement "fit for purpose" and matching wastewater treatment levels to water quality requirements for the planned reuse to support meeting the State's 2020 and 2030 targets for recycled water use.
3. **Develop a uniform interpretation of State standards for recycled water**. State agencies including the SWRCB, the RWQCBs, the CDPH, DWR, and the CPUC should develop a uniform interpretation of State standards for inclusion in regulatory programs and IRWMPs and should clarify regulations pertaining to water recycling, including permitting procedures, health regulations and the impact on water quality. It is important to recognize that uniformity in State standards does not mean uniformity in permit terms and conditions, however, as implementation should account for the variability in local conditions and local needs. Implementing this recommendation could also streamline existing regulations about recycled water. Internal and cross-training of agency staff could be a key method of accomplishing this.
4. **Continue to review opportunities for recycled water development**. DWR will continue to identify opportunities to increase statewide planning, development, and implementation of recycled water. It is intended that this will be accomplished with comprehensive statewide planning documents and regional interactions over the next few years.
5. **Incorporate wastewater agencies into regional IRWM processes**. Inclusion of wastewater agencies into regional IRWM processes has been initiated in some regions. Increasing this integration will facilitate the integration of recycled water into the water supply planning process. In addition, potential recycled water customers should be involved in the IRWM and recycled water project planning process to identify potential partnerships, assess the viability of recycled water projects, and consider future CII water quantity and quality planning.
6. **Provide dedicated recycled water funding.** The State Legislature is urged to provide additional funding dedicated to planning and implementing recycled water projects in California. Although some funds are available through IRWM grants and loans, the cost of implementing these projects can make them difficult to put forth in the existing grant processes, especially with so many water suppliers facing financial challenges. If California intends to reach its water recycling mandates and goals and support future water supply reliability to support economic growth, then additional funds dedicated to recycled water implementation will need to be provided. Additional funding sources will be needed when Proposition 84 funds are no longer available.

7. **Develop reliable electronic reporting methods for recycled water data.** To be able to monitor progress in meeting targets or achieving progress in beneficially using recycled water, there is a need for reliable and periodic data collection. Voluntary surveys have been the historic method of data collection. Mandating standardized data collection integrated with electronic reporting could facilitate the collection of data and the availability of the data for use. DWR, the SWRCB, and the CDPH should work together to accomplish this objective.

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