Public Health Impacts of Urban Water Conservation in California: Opportunities to Maximize Co-benefits and Minimize Harm

With Case-Study Analysis of Water Conservation In the City of Burbank

Final Report

Prepared by the UCLA School of Public Health
Health Impact Assessment Project
in collaboration with
The Los Angeles County Department of Public Health

This project is supported by a grant from the Health Impact Project, a collaboration of the Robert Wood Johnson Foundation and The Pew Charitable Trusts.

May 2014

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*About the UCLA HIA Project

Since 2001 the UCLA HIA Project has been working to advance the science and practice of health impact assessment in the U.S. Our multi-disciplinary team has conducted a wide range of health impact assessments on policies and projects, including HIAs of Living Wage laws, food and agriculture policies, education policies and transportation projects. Our work conducting HIAs, providing HIA training and technical assistance, and developing tools for HIA, including the HIA-CLIC website (http://www.hiaguide.org) has been generous supported by the California Endowment, the CDC Foundation, the Partnership for Prevention, the Pew Charitable Trusts, the Public Health Foundation, the Robert Wood Johnson Foundation and the Health Impact Project, a collaboration of the Robert Wood Johnson Foundation and The Pew Charitable Trusts. You can find more about our work on our project website at http://www.ph.ucla.edu/hs/health-impact.

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* The authors wish to thank the members of the project's technical advisory committee for sharing their expertise and insights. Responsibility for this report's findings and recommendations and any errors is solely that of the authors

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Executive Summary (Statewide)

Rationale

In 2009 the California State Legislature passed Senate Bill 7x7 (SB X7-7 aka "20 by 2020"). Part of a comprehensive suite of water policies and infrastructure funding, SB X7-7 requires the state's water suppliers to develop and implement plans to reduce urban water usage by 20% by 2020. Urban water suppliers are allowed to select the mix of conservation measures that they deem best suited for meeting these targets. Their conservation strategies are to be outlined in their in their "Urban Water Management Plans" (UWMPs) submitted to the state's Department of Water Resources starting in 2010 with progress reports and updated plans to be submitted to the in 2015 and 2020.

Efforts to meet these targets may have unintended consequences for the health of water users and their communities. Some health effects could be beneficial; some could be harmful; some could impact different populations differently. Assessment of the potential health effects of different water conservation options will provide decision-makers and community stakeholders with information that will help identify options to minimize harm and maximize potential health benefits while achieving water conservation goals and service mandates.

Aim and scope

This health impact assessment (HIA) aims to provide local decision-makers and community stakeholders with information on potential health-related impacts linked to different water conservation measures, particularly those being considered to meet the mandates of California's SB X7-7. According to Section 10631(g)(1) of the State Water Code, water suppliers to consider health and other secondary effects of water conservation measures. Information from this HIA can be used to help weigh the pros and cons of alternative conservation options, develop

mitigation measures to minimize potentially harmful effects, and identify strategies to maximize potential health benefits.

This HIA starts with the premise that water is a valuable resource for health. From this perspective, water is not something to be rationed, but rather to be used wisely and efficiently. A second premise is that efforts to advance public health must focus on those who bear the greatest burden of ill health. Throughout this HIA, social equity concerns and reduction of health disparities will be raised repeatedly. Public health has long recognized that social and economic inequalities provide fertile ground for disease, disability and early death. Water conservation efforts that seek to protect and promote the public's health need, at a minimum, to avoid exacerbating these inequalities, and better yet should seek to reduce them and provide protection against their effects.

The assessment is divided into two sections: (1) a general portion describing research on the linkages between specific water conservation options and health-related conditions, general estimates of the size and significance of effects, effects on vulnerable populations and descriptions of current conditions throughout the state, and (2) a case-study analysis of water conservation in the city of Burbank California.

Water conservation measures for achieving SB X7-7 targets

Although SB X7-7 does not mandate how water providers meet their water use reduction targets, it does require that providers report on their implementation of fourteen "demand management measures" (DMMs) as part of their Urban Water Management Plans (UWMPs) submitted to the state every five years. Most utilities develop their water conservation programs around these fourteen DMMs. These DMMs are similar to the Best Management Practices (BMPs) developed by the California Urban Water Conservation Council (CUWCC), a voluntary organization of water agencies and utilities. In general, the state's DMMs are more specific and measurable than the CUWCC's BMPs (see Table ES1-1 below), making them more conducive for analysis in an HIA, since fewer assumptions are needed for the analysis.

Demand Management Measures SB X7-7 (CA Water Code Section 10631)

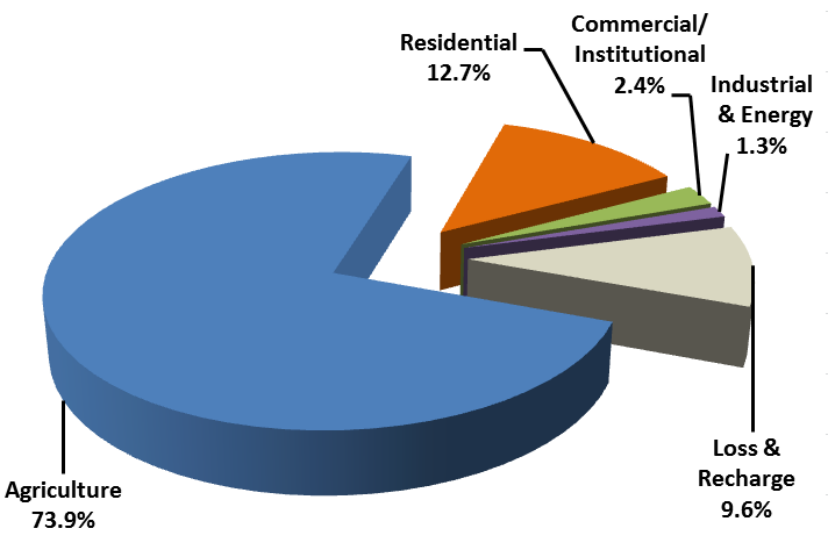
A. Water survey programs for single-family residential and multifamily residential customers
B. Residential plumbing retrofit
C. System water audits, leak detection, and repair
D. Metering with commodity rates for all new connections and retrofit of existing connections
E. Large landscape conservation programs and incentives (*not addressed*)
F. High-efficiency washing machine rebate programs
G. Public information programs (*not addressed*)
H. School education programs (*not addressed*)
I. Conservation programs for commercial, industrial, and institutional accounts
J. Wholesale agency programs (*not addressed*)
K. Conservation pricing
L. Water conservation coordinator (*not addressed*)
M. Water waste prohibition
N. Residential ultra-low-flush toilet replacement programs

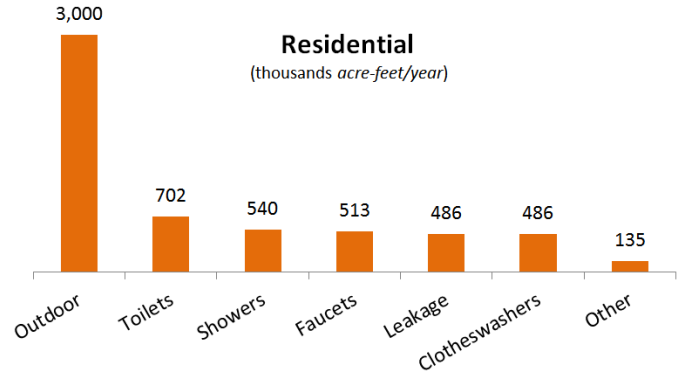
Table ES1-1: Demand Management Measures (DMMs) for Urban Water Conservation listed in the California State Water Code.

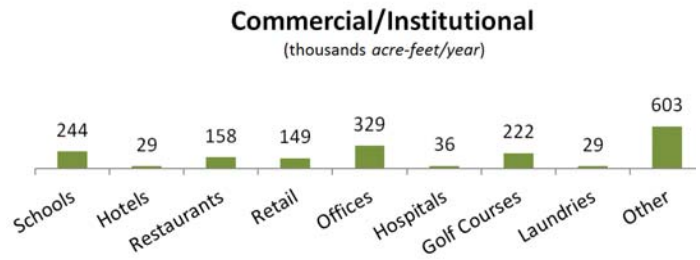
Urban water uses are typically categorized as residential, commercial/industrial and institutional, with non-residential uses collectively referred to as CII uses. Residential use accounts for nearly half of urban water use (Figure ES1-1). Among different residential water end-uses, outdoor water use comprises by far the largest share. Because these uses seem to offer the greatest potential for urban water use reduction, the DMMs that address these uses are emphasized in the analysis. In addition to DMMs, which focus on reducing water use among end-users, this HIA also examines expanded use of recycled water to reduce use of potable water but which does not necessarily reduce water consumption overall.

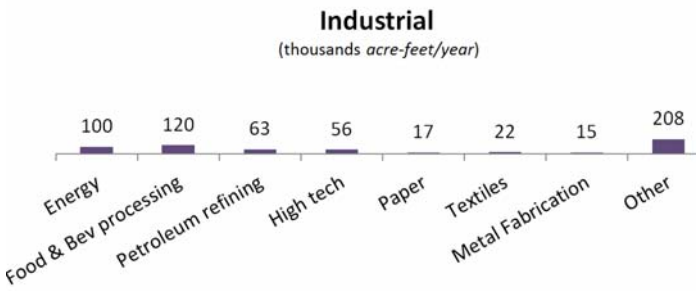
Linkages between health and water conservation

A systems view of the state's water delivery system can help guide understanding of how conservation measures might affect health. Key components flowing through this system are water, money and energy (Figure ES1-2). The HIA follows the effects of conservation measures on these components and how they in turn affect various health determinants and outcomes.









Notes: Sector totals from the CA Dept. of Water Resources. State Water Plan: Update 2009. Data Summary: 1998-2005, Water balances (revised 03-10-11). Residential total and split of indoor residential uses from California Urban Water Plan 2013 Update and DeOreo et al., 2011. Analysis of Water Use in New Single Family Homes. Split of use by industry and commercial use from Gleick et al. 2003 cited in Pacific Institute 2012. Pacific Institute, 2012. Urban Water Demand in California to 2100: Incorporating Climate Change. August 2012.

Figure ES1-1: Water use in California. Annual averages 2005-2009 (*excluding environmental*)

Changes in water availability and quality

Proactive, strategic water conservation measures help ensure sufficient water for priority uses. Decisions about which uses, which users and whether water use reductions are achieved through simple restrictions or improved efficiencies have important implications for health. Water is crucial for bathing, washing clothes and dishes, and for the function of sewer systems. Clean drinking water is essential for life and the prevention of waterborne disease. How these affect health is fairly obvious, but urban water also supports health in other ways. In most areas of California, urban vegetation is dependent on the application of water. This vegetation provides places to play and relax and helps reduce urban heat island effects by providing shade and through the evapotranspiration of leaves.

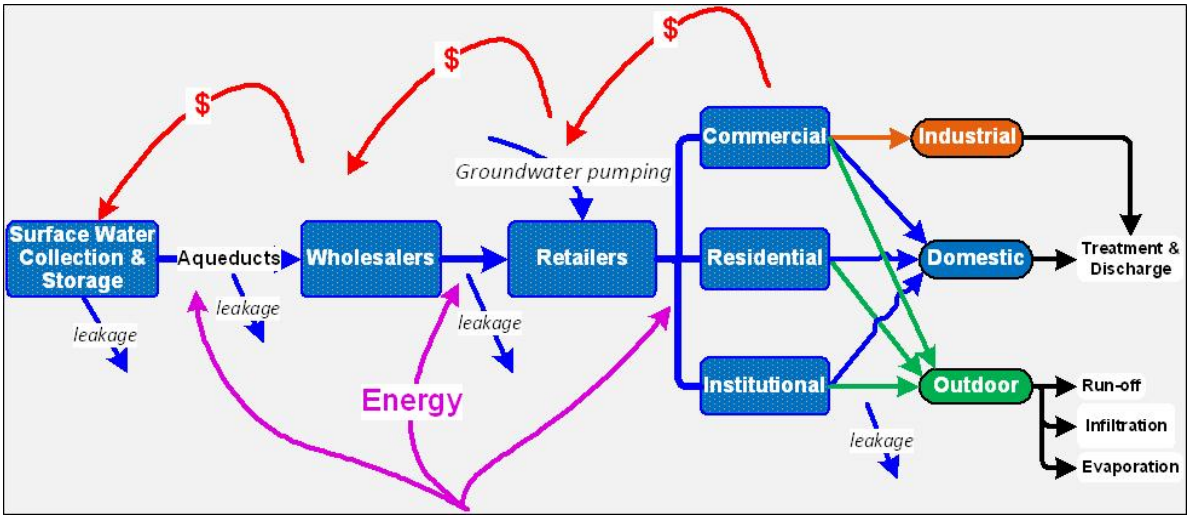


Figure ES1-2: The flow of water, energy and money in the urban water delivery system

Changes in water costs

The distribution of water costs among different users, as well as water suppliers, affects equity and health, the sustainability of the water delivery infrastructure, and the ability of utilities to provide safe, dependable water supplies. Water costs and revenue are affected by changes in water in water supplies and use (i.e. demand) that may be the result of conservation and other water management decisions, as well as climate and environmental changes. Conversely, price increases can reduce demand. Reduced demand resulting from conservation efforts can also lead utilities to increase water prices since reduced demand may push revenue below levels needed by utilities to cover their fixed costs.

Changes in energy usage

The third dynamic component of the urban water delivery system is energy. Moving and treating water requires substantial amounts of energy. Thus, water conservation is also energy conservation. The energy intensity of water, (i.e. the amount of energy needed to move and treat a given volume of water), varies greatly between different sources (Figure ES1-3). In the Los Angeles Department of Water and Power service area, the energy-intensity of desalinated ocean water (not yet in production) is over 100 times greater than water from the Los Angeles Aqueduct and more than 39 times higher than recycled water. Decisions that change the total volume of water or that shift reliance from one source to another source have significant effects on energy consumption and air emissions associated with the production of that energy.

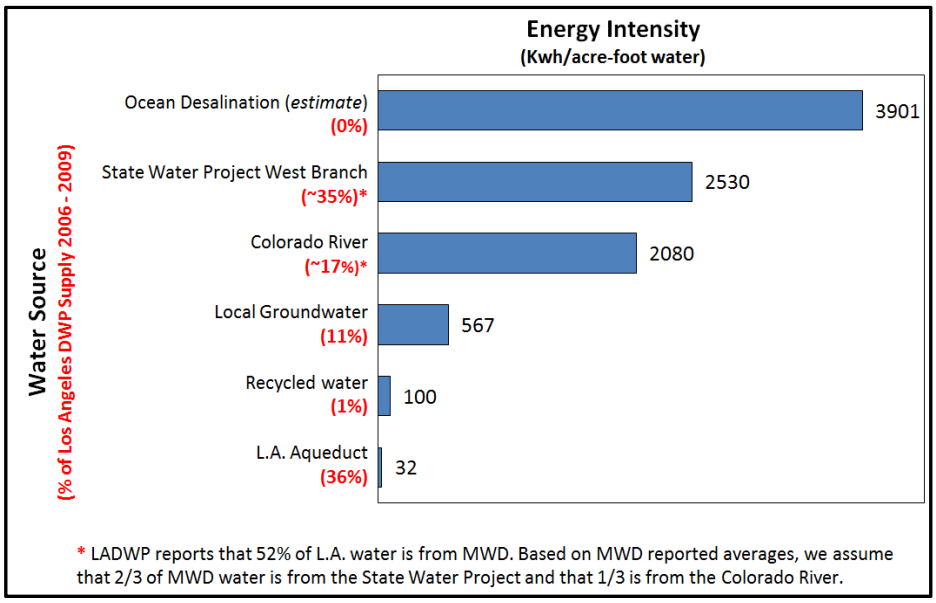


Figure ES1-3: Energy intensity (i.e. embedded energy) of different water sources drawn on by the Los Angeles Department of Water and Power.[1]

[1] Energy intensity of LADWP water sources includes energy for conveyance and treatment but excludes energy for delivery and wastewater treatment since these do not vary by source. Data from:
LADWP 2010 Urban Water Management Plan.
http://wwwwatercagov/urbanwatermanagement/2010uwmps/Los%20Angeles%20Department%20of%20Water%20and%20Power/LADWP%20UWMP_2010_LowRes.pdf.
California Sustainability Alliance 2012 The Role of Recycled Water in Energy Efficiency and Greenhouse Gas Reduction: Appendix E: Water Agency Profile: City of Los Angeles
http://sustaincaorg/sites/default/files/FINAL%20APPENDIX%20E%20MAY%202%202008pdf
Energy intensity estimates for desalination from Wilkinson RC 2007 Analysis of the Energy Intensity of Water Supplies for West Basin Municipal Water District http://eecucdavisedu/events/documents/water-energy_ucsb_methodology-for-analysis-of-the-energy-intensity-of-ca-water-systemspdf

How water is used, not just its source, affects energy intensity, as well. Indoor water from toilets, showers and sinks drains into sewer systems where energy is used to pump and treat it. Hot water usage is highly energy-intensive due to the energy needed to heat that water. Thus, low-flow showerheads and high efficiency clothes washers and other conservation measures that decrease hot water usage result in especially large energy savings (Figure ES1-4).

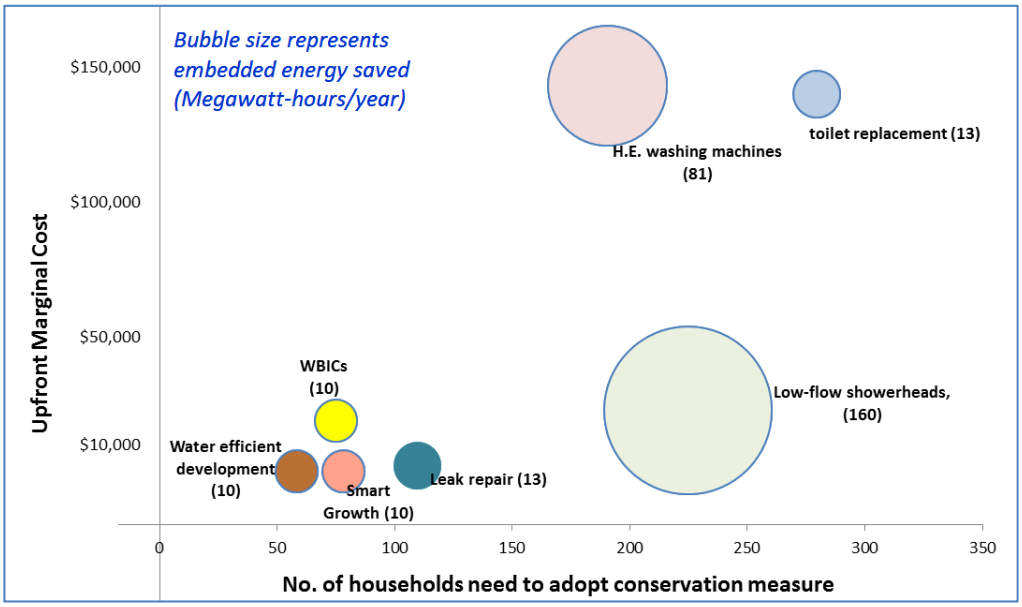


Figure ES1-4: Cost and energy savings of saving one million gallons of water using different conservation

The HIA logic framework (Figure ES1-5) organizes the water conservation options, water system components and effects on health determinants and outcomes into a hierarchy of effects. HIA logic frameworks typically show specific causal pathways linking policy alternatives with downstream health effects. In this case, however, showing each of these linkages would result in a graphic that was more confusing than helpful. The underlying logic, evidence and magnitude of each linkage is still addressed in the text of the HIA.

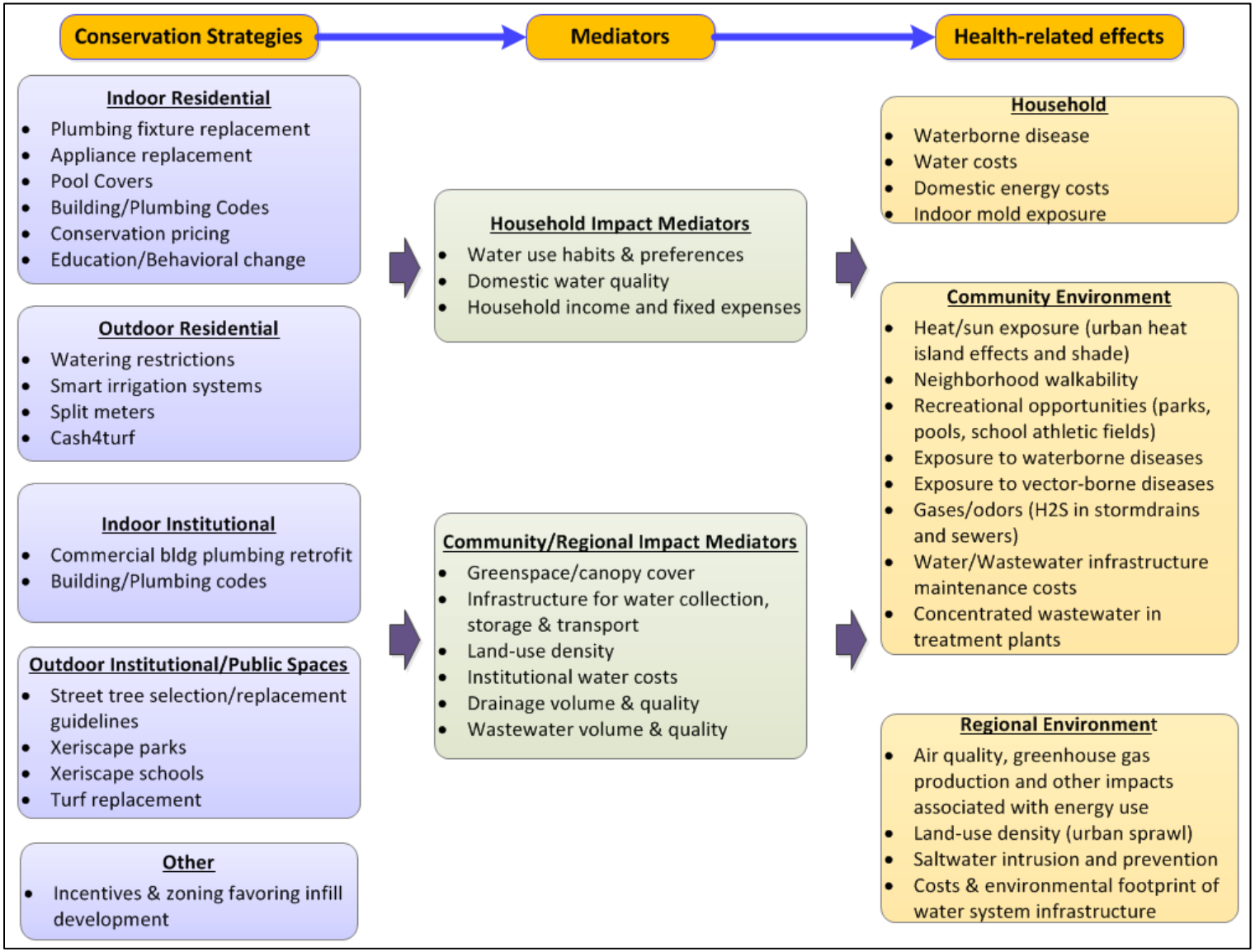


Figure ES1-5: Logic Framework showing potential health effects related to urban water conservation strategies

Health-related effects of specific conservation measures

The linkages between conservation measures and potential health effects are grouped into seven main pathways, including:

- **Air quality and greenhouse gas emissions** on a regional and global scale from energy production related to the embedded energy of water, local air emissions from gasoline-powered lawn maintenance equipment and from stagnant wastewater;
- **Ambient temperature/urban heat island effects** modified by changes in the composition and irrigation of landscape vegetation;
- **Water quality and waterborne disease risks:** run-off affecting surface water quality, groundwater quality affected by recharge using recycled water, exposure to pathogens through the use of recycled water and graywater in outdoor landscape irrigation and other applications;
- **Arthropod-borne disease risks** affected by landscape irrigation and run-off;
- **Household finances and fiscal equity** affected by conservation pricing and by rate increases in response to declines in revenue for water suppliers due to decreased sales;
- **Access to park and greenspace** affected by decisions to change the composition and irrigation of landscaping in parks and alongside streets;
- **Exposure to mold and indoor air pollution** affected by water leaks in structure that can be detected and repaired as part of efforts to control water losses.

Summary and Recommendations

Achieving SB x7-7 water use reduction targets will be easier for some communities than others, but virtually all will need to employ a combination of strategies. The information in this HIA can help decision-makers and the public weigh public health considerations as they plan and prioritize strategies for water conservation. In many cases implementation of water conservation measures will yield valuable co-benefits for public health (see Figure ES1-6 and Table ES1-3). When water conservation measures have the potential to negatively impact the public's health,

mitigation measures can be adopted to minimize harm, or based on this awareness a community may decide to first adopt other measures with less potential for harm.

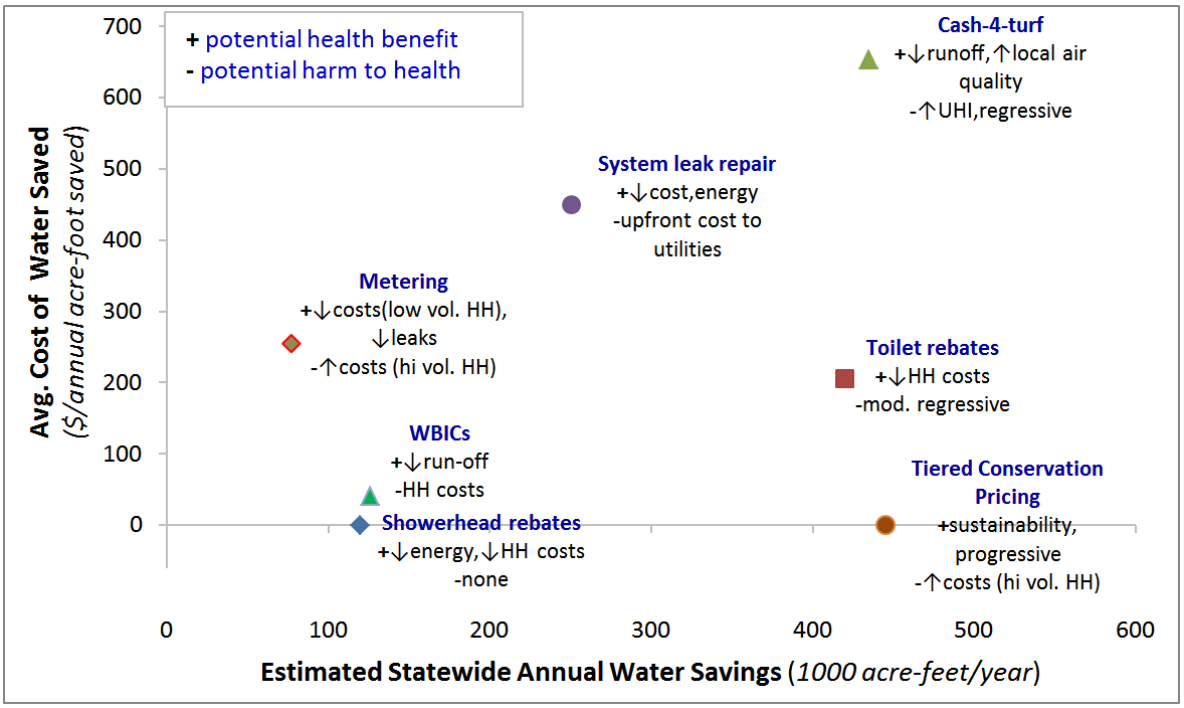


Figure ES1-6: Potential water savings, costs and health impacts of select conservation measures (Detail in Appendix B)

In prioritizing strategies for reaching SB X7-7 water use reduction targets water suppliers and communities need to weigh many factors including the appropriateness of a particular conservation measure for that service area, its potential effectiveness, cost and cost-effectiveness. While water agencies may not see it within their purview to consider broad health impacts, priority should be given to strategies that generate more co-benefits, such as reductions in air emissions from decreased energy usage, and fewer unintended harmful side-effects, such as loss of urban park and greenspace. As illustrated by the City of Burbank case-study, local elected officials can play a valuable role in passing ordinances to support conservation goals and prioritize conservation strategies that generate the broadest range of community benefits along with water use reductions.

The 20% reductions for SB x7-7 are just a first step. On-going efforts will be needed to maintain these reductions and deal with the water needs of a growing population in the face of shrinking and less dependable supplies resulting from climate change. Sustainable conservation actions pose difficult choices that only become more difficult and expensive if they are delayed. Wise, effective action now can help keep future options open and make future reductions easier without compromising the economic, quality-of-life and health benefits provided by water.

Table ES1-3: Water savings and health impacts of urban water conservation measures

	Water conservation measure ★Priority ✓Good !Caution	Water Savings	Potential Health-related Effects Benefit	 Harm	Recommendations
Residential	Free in-building leak detection services, targeting homes with higher likelihood of leaks ★	Fair	Cost savings to homeowners. Decreased mold exposure.	Wastewater concentration	Water savings are contingent on taking follow-up action. Potential benefits with little downside
	Rebates for water-efficient fixtures and appliances ★(faucets, toilets) ! (*expensive appliances*)	Moderate-High	Cost savings, particularly when out-of-pocket costs are low relative to savings on water costs. Reduced energy footprint, esp. for hot water fixtures	Rebates for expensive items (e.g. washing machines) may be fiscally regressive, Wastewater concentration	Eventually diminishing returns but should be a high priority
	Requirements on water efficiency of appliances and fixtures sold in state ✓	Moderate	Energy/environmental benefits	May increase costs of appliances. Wastewater concentration	Would avoid problems of uptake. Does not speed up retrofit.
	Rebates and tax incentives for owners of rental housing installing water-efficient fixtures and appliances ✓	Moderate	Water cost savings to renters if they pay water bill directly.	May increase rental prices. Wastewater concentration	
	Building standards requiring water-efficient fixtures ✓	Moderate	Decreases the environmental footprint of new housing	Marginal increase in new housing prices. Wastewater concentration	Benefit primarily for more affluent HHs and communities with new housing
	Restrictions on outdoor watering ✓	Moderate to high	Reduced run-off	Home gardens impacted if ban on outdoor watering is absolute	Needs on-going enforcement
	Rebates for WBICs	Moderate but Variable	Decreased run-off from lawns, improved surface water quality		Water savings depend on correct installation and maintenance. May <u>increase</u> water use.

Water conservation measure ★Priority ✓Good !Caution		Water Savings	Potential Health-related Effects Benefit	Potential Health-related Effects Harm	Recommendations
	Rebates for converting lawn to water-efficient lawnscapes ✓ !	Moderate to very high	Decreased run-off from lawns, improved surface water quality. Decreased water costs	Out-of-pocket costs. May be fiscally regressive	Potentially high, persistent savings but depends on the quality of the landscaping, type of irrigation, and previous water use
	Conservation pricing ★	Very high	Protect low income households from rate increases	Cost impacts on households that have high water use that cannot quickly be reduced	Priority. Success depends on budget-based, tiered rates with steep gradient.
Parks, Streetscapes	Install more efficient sprinkler heads ✓	Low-High	Reduced run-off. May lower contamination risk if recycled water is being used.		Water savings contingent on types of sprinkler heads now in use
	Install weather-based irrigation controllers (WBICs) ✓	Moderate	Reduced run-off		Suitability depends on climate and size of area
	Convert turf to low water use landscape	High	Reduced run-off. Since conversion typically uses drip irrigation, any risk of pathogen exposure from recycled water will be reduced.		Needs to be done carefully in order to maintain environmental and health services of irrigated landscape
Commercial	Expanded use of recycled water ★	High	Cost savings if rates for recycled water are lower than drinking water	Requires proper treatment and application to prevent transmission of communicable disease	Under-utilized resource. Cities can use permitting rules to incentivize expansion of recycled water systems and utilization
System	System leak detection. Infrastructure improvements to decrease water loss ★	Very High	More efficient usage, increased	Substantial costs may lead to higher taxes and/or water rates. May be cost-prohibitive for small utilities.	Federal and state governments should explore ways to incentivize
	Expanded use of recycled water ★	High	Cost savings if rates for recycled water are lower than drinking water	Requires proper treatment and application to prevent exposure to pathogens.	Under-utilized resource. Building & zoning rules can incentivize expansion of recycled water systems and use.

Specific Recommendations

1. **Make early, well planned efforts to conserve water that lead to significant, maintained reductions in usage**

   Failure to use less water and to make water-use more efficient will harm the public's health, particularly the health of low income households and communities. Further long-term reductions in per capita water use are necessary to avoid water crises brought on by the confluence of increased water demands of a growing population and shrinking water supplies due to climate change. Since low income households tend to have less discretionary water use than higher income households, draconian water rationing and escalating water prices in response to these shortages will hit these households hardest.

2. **Prioritize conservation measures that have environmental and health co-benefits**

   2.1. Plan based on quadruple bottom-line – water savings, cost, greenhouse gas emissions, local health impact.

   2.2. Promote high efficiency showerheads. This low cost alternative can yield substantial water, cost and energy savings.

   2.3. Make water-efficient toilets, showerheads and faucets a condition of home resale and rental. Consider requiring a "Water Efficiency Disclosure Statement" for home sale transactions.

   2.4. Expand recycled water use and infrastructure. Prioritize review and updating of public health restrictions on recycled water use based on newest technologies and research. Use business and land-use permitting processes to incentivize expansion of recycled water systems and to bring down the initial costs of building out recycled water systems.

   2.5. Explore the development of a recycled water pricing system, similar to pricing schemes for pollution reduction,[2] which would incentivize recycling by pricing water discharges and use a portion of proceeds to fund expansion of water recycling infrastructure.

[2] World Resources Institute. 2009. Issue Brief: Water Quality Trading Programs: An International Overview. http://www.wri.org/sites/default/files/pdf/water_trading_quality_programs_international_overview.pdf

2.6. Draw on funds from Carbon Cap & Trade, energy efficiency and air quality incentive programs to fund household, community and regional water conservation programs that reduce both energy and water consumption.

3. Encourage property owners to install and properly maintain more water-efficient landscapes while taking steps to minimize unintended harm

3.1. Provide strong incentives for water-efficient landscaping. Irrigation of residential landscapes accounts for over 50% of urban water use in California. Achieving long-term reductions in urban water use will require significant reductions in water used for outdoor landscape irrigation. Careful planning that accounts for local needs and conditions can reduce water used for landscape irrigation while maintaining most of the benefits of outdoor vegetation. Rebates, rates and fines used to reduce outdoor water use need to be structured in a way that is not fiscally regressive (e.g. increasing rates for low income households while providing rebates for higher income households).

3.2. Encourage the use of locally appropriate, cost-effective technologies for reducing demand for system-supplied water through the use of rainbarrels and graywater systems.

4. Invest in infrastructure that reduces wastage, thereby reducing consumer costs and increasing the use efficiency of water

4.1. Provide free in-home leak audit, identify homes and areas where leaks are more prevalent to target leak detection efforts.

4.2. Improve water delivery systems with targeted, proactive identification and repair of potential failure of pipes and other equipment. Consider grant programs and no interest loans to assist small water agencies with small cash flows.

4.3. Replace old system elements that waste water, such as dead-ends and old pipes that require frequent flushing.

5. Minimize regressive combinations of rebates and rate increases that benefit higher income households while increasing water costs for low income households

Adopt tiered conservation pricing to promote conservation, minimize unintended regressive revenue transfers and help stabilize revenue streams.

6. **Institutionalize integrated inter-agency conservation planning at the local level to develop joint sustainability plans to improve water and energy efficiency while supporting economic and health goals. Expedite implementation with state-issued benchmarks and incentives.**

7. **Monitor health impacts of water conservation policies with metrics such as the ones outlined in this report. Since many of these metrics are outside the expertise of water agencies, monitoring will require the cooperation of multiple agencies and sectors.**