Urban Land Institute

WATER WISE

Strategies for Drought-Resilient Development

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COVER PHOTO: Phoenix midtown skyline with a saguaro cactus and other desert scenery in the foreground. (iStock)

2001 L Street, NW | Suite 200 | Washington, DC 20036-4948

Recommended bibliographic listing: Urban Land Institute. *Water Wise: Strategies for Drought-Resilient Development.* Washington, DC: Urban Land Institute, 2022.

ABOUT THE URBAN LAND INSTITUTE

The Urban Land Institute is a global, member-driven organization comprising more than 45,000 real estate and urban development professionals dedicated to advancing the Institute's mission of shaping the future of the built environment for transformative impact in communities worldwide.

ULI's interdisciplinary membership represents all aspects of the industry, including developers, property owners, investors, architects, urban planners, public officials, real estate brokers, appraisers, attorneys, engineers, financiers, and academics. Established in 1936, the Institute has a presence in the Americas, Europe, and Asia Pacific regions, with members in 80 countries.

More information is available at uli.org. Follow ULI on Twitter, Facebook, LinkedIn, and Instagram.

ABOUT THE ULI URBAN RESILIENCE PROGRAM

ULI's Urban Resilience program is focused on how buildings, cities, and communities can be more resilient to the impacts of climate change and other environmental vulnerabilities. The program works with ULI members to provide technical assistance, advance knowledge through research, and catalyze the adoption of transformative practices for real estate and land use policy.

RESEARCH CONTRIBUTORS AND PROCESS

ULI is grateful to the Kresge Foundation for its support of this project and ULI's Urban Resilience program.

To better understand how drought affects real estate and land use, ULI's Urban Resilience program and district councils conducted regional focus group meetings in Arizona, California, Colorado, New Mexico, Nevada, Texas, and Utah with more than 80 participants and interviewed more than 20 real estate developers, designers, land use policymakers, nonprofit leaders, and drought experts. The authors also worked with a team of ULI member advisers with expertise in drought resilience and related topics, as well as with colleagues from ULI district councils, to draft this report. A full list of the organizations that shared their knowledge and perspectives in focus groups and interviews, nominated case studies, edited the text, provided supporting materials, and otherwise advised on the creation of this report is provided in the Report Team and Acknowledgments sections.

SHUTTERSTOCK

“Bathtub rings” illustrate historically low water levels in Reflection Canyon of Lake Powell, Utah.

CONTENTS

Water-smart developments, like Sterling Ranch in Douglas County, Colorado, are leading the way in water conservation, which ultimately protects them from droughts.

ABOUT THIS REPORT

Water Wise: Strategies for Drought-Resilient Development introduces the challenges and opportunities associated with drought and limited freshwater availability, and provides best practices for real estate and land use professionals to address them. The report includes the following:

- The science behind the increasing prevalence of drought and its impacts;
- The business case for water-smart real estate development and landscaping;
- Strategies and best practices for addressing water scarcity through water-smart development and landscaping;
- Public-sector policies and practices that can support responsible water use; and
- Profiles of water-smart developments and their outcomes.

As of 2022, all continents except Antarctica are facing unprecedented levels of drought.[1] These droughts have significantly reduced freshwater availability and fuel regional wildfires. Although this report focuses on the arid regions of the western United States—where a megadrought has led to the driest two decades in at least 1,200 years[2]—the strategies in this report for water-smart development and landscaping can and should be implemented everywhere for greater stewardship of the planet's limited freshwater resources.

The good news is that real estate and land use professionals are already leading the way in innovative solutions. Their best practices are included throughout this report, demonstrating that saving water saves money and generates long-term value for assets, communities, and the environment.

The report's key takeaways follow and are explored in further detail throughout the report.

Key Takeaways

- **Climate change:** The frequency, intensity, and duration of droughts are increasing in many areas of the world, and this pattern is expected to continue with climate change. As of 2022, about half the world's population faces severe water scarcity at least part of the year. Droughts can lead to other disasters, including wildfires, floods, erosion, and famine.
- **Market outlook:** With the combination of population growth, water scarcity, and water quality issues, many communities are beginning to forecast an inability to accommodate future water needs. Some of these communities are halting real estate development, and others are requiring that developers acquire their own water supplies.
- **Policy landscape:** Public officials at all levels of government increasingly recognize drought as a threat to their communities and are enacting policies to address water stress. While historically many of these policies focused on supply-side water management (acquiring water supplies through diversions, dams, and desalination), most policies at the local levels are now focused on demand-side water management (water conservation, efficiency, and reuse), much of which relates to the built environment. Water conservation, efficiency, and reuse are the most cost-effective and least environmentally damaging ways of meeting collective water needs.
- **Public demand:** Consumers are increasingly showing a preference for water-efficient fixtures, appliances, buildings, and landscapes, especially in drought-prone regions. Consumers also prefer buildings that incorporate sustainability measures, including water efficiency.
- **Good business:** Investing in water efficiency and conservation measures at the site scale mitigates the risk of water shortages, policy changes, and rising water prices and garners water and energy cost savings, providing long-term value to owners and investors. Upfront investment in water and energy efficiency measures increases asset value, in some cases by 10 percent or more.
- **Savings over time:** The incentives to maintain water efficiency grow over time as the water and energy savings add up. To maintain or improve a property's water efficiency over time, ongoing water management is important. Education of and communication with property owners, managers, tenants, and others are essential for reducing the water footprint of real estate through human behavior.
- **Watershed protection:** Compact, walkable, and transit-oriented development accommodates growth without increasing impervious surface cover and contaminated stormwater runoff, helping protect watersheds, recharge groundwater, and mitigate climate change.

Hoover Dam overlooks the Colorado River as it passes through Lake Mead, where water levels are at their lowest since the dam was built, at about 30 percent of capacity.

Aerial view of the Colorado River, where flows have been consistently dropping over the past 20 years.

SHUTTERSTOCK

INTRODUCTION

Less than 1 percent of the Earth's water is available for human use.[3] While population growth and demands on freshwater resources are increasing, that available water supply diminishes in many areas with climate change, aging infrastructure, overallocation, and contamination.

According to the Intergovernmental Panel on Climate Change's 2022 assessment report, about half the world's population faces severe water scarcity at least part of the year.[4] Drought extended across 51 percent of the United States as of March 15, 2022.[5] The frequency, intensity, and duration of droughts are increasing in many areas, and this pattern is expected to continue with climate change.[6]

Water is essential to all life, and its availability greatly influences not only the value of land, but also the ability of communities to thrive and grow. Communities across the western United States, where a megadrought has led to the driest two decades in at least 1,200 years, have begun halting real estate development because of limited water supplies.[7,8,9,10] With the combination of population growth, water scarcity, and water quality issues, many communities are beginning to forecast an inability to accommodate future water needs.[11]

"If the 20th century was the age of dams, diversions, and depletion, the 21st century can be the age of replenishment, the time when we apply our ingenuity to living in balance with nature. In so doing, we can quench our own thirst while leaving a healthy water cycle for future generations."

SANDRA POSTEL
Replenish

In response, public officials at all levels are adopting increasingly rigorous water conservation measures. While historically many of these policies focused on supply-side water management (acquiring water supplies through diversions, dams, and desalination, for example), most policies at the local levels are now focused on demand-side water management (water conservation, efficiency, and reuse), much of which relates to the built environment.[12] The reason for this transition is that water conservation, efficiency, and reuse are by far the most cost-effective and least environmentally damaging ways of meeting collective water needs.[13]

Despite diminishing freshwater supplies, increasing water conservation and efficiency will allow future population and economic growth to occur in a sustainable way. Since real estate development and land use patterns have a substantial influence on the efficiency of water use and the impact of water shortages, real estate developers and land use professionals have a significant role to play.

Real estate and land use professionals have been and can continue to be part of the solution. Their best practices for incorporating water-saving measures into real estate development projects are included throughout this report, alongside strategies and recommendations for integrating land use and water management across public and private sectors. Overall, the lessons learned from these best practices are that saving water saves money and generates long-term value for assets, communities, and the environment.

Extended droughts, made worse by climate change, are drying up valuable water resources around the world.

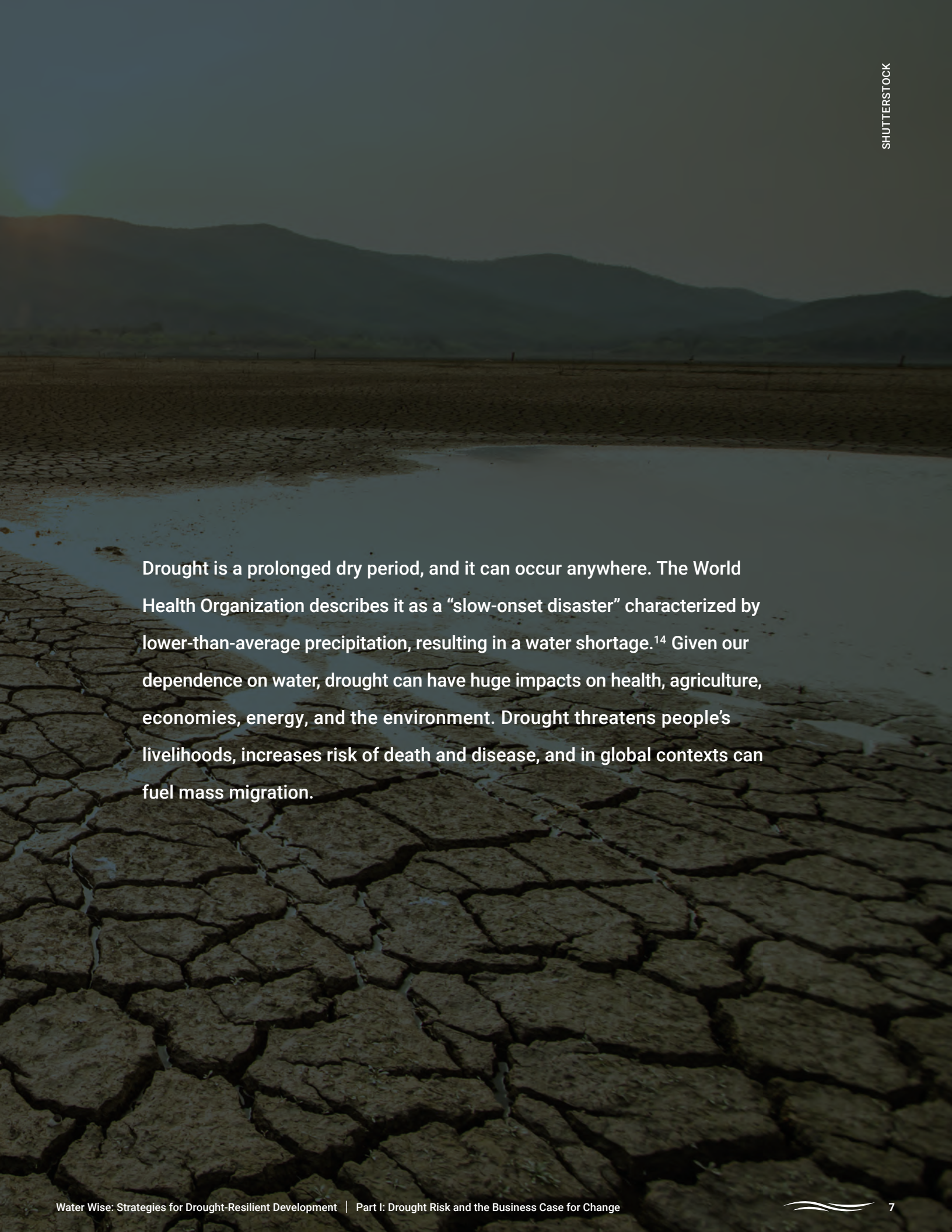
PART I

DROUGHT RISK AND THE BUSINESS CASE FOR CHANGE

Understanding Drought Risk

The Impacts of Drought

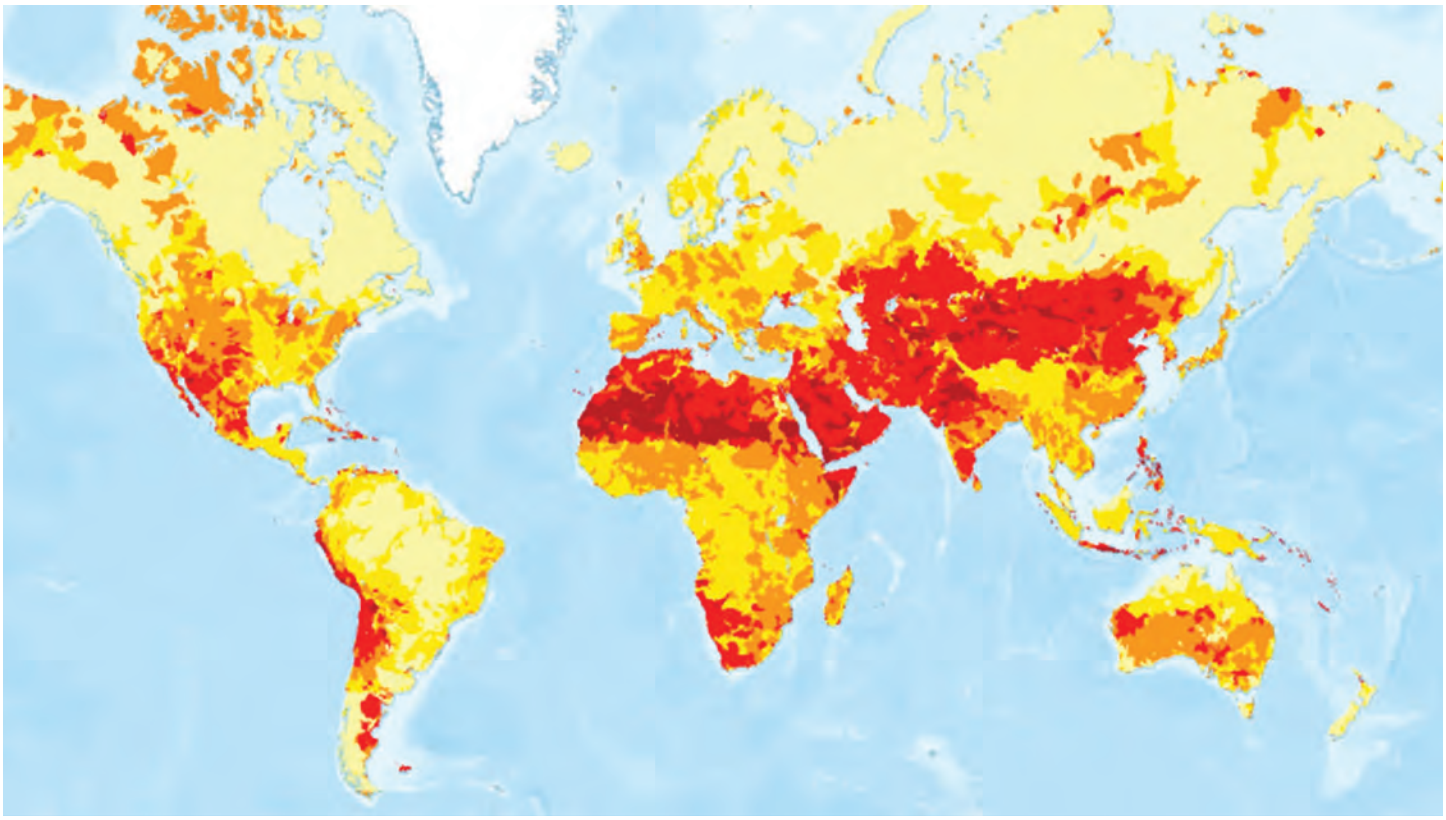
The Business Case for Water-Smart Development



SHUTTERSTOCK

Drought is a prolonged dry period, and it can occur anywhere. The World Health Organization describes it as a "slow-onset disaster" characterized by lower-than-average precipitation, resulting in a water shortage.[14] Given our dependence on water, drought can have huge impacts on health, agriculture, economies, energy, and the environment. Drought threatens people's livelihoods, increases risk of death and disease, and in global contexts can fuel mass migration.

GLOBAL WATER RISK



Source: World Resources Institute.

The World Resources Institute maps water stress around the world and has found that major regions of every inhabited continent have serious water risks. For more information, visit www.wri.org/aqueduct.

Understanding Drought Risk

As of 2022, all continents except Antarctica are facing unprecedented levels of drought.[15] According to the Intergovernmental Panel on Climate Change's 2022 assessment report, about half the world's population faces severe water scarcity at least part of the year.[16]

Drought extended across 51 percent of the United States as of March 15, 2022.[17] Scientists studying what has been dubbed the "megadrought" in the western United States have found that the prior two decades have been the driest the region has experienced in at least 1,200 years.[18,19]

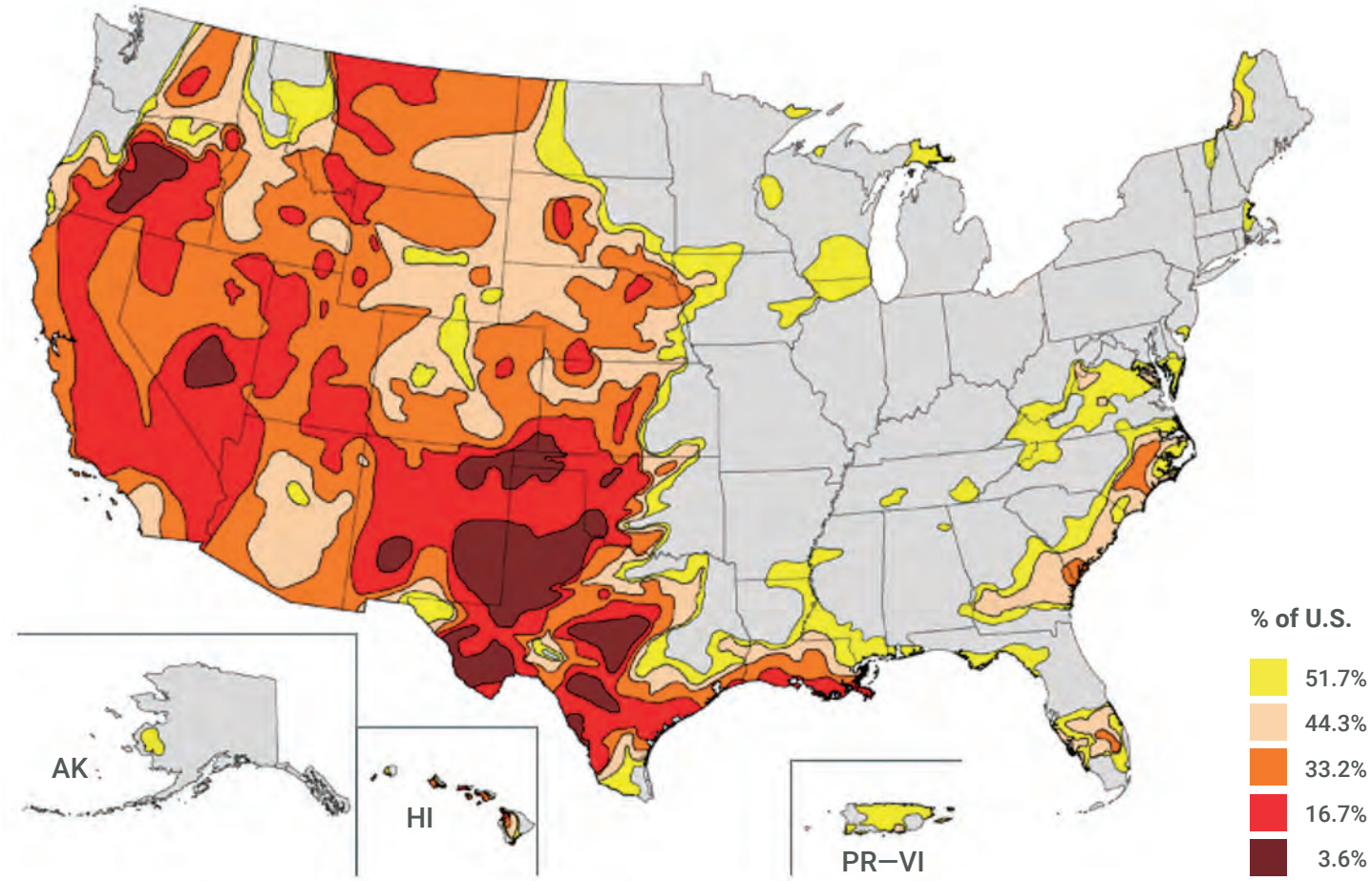
The Water Risk Filter

The World Wildlife Fund's Water Risk Filter is a free online tool that companies and investors can use to assess asset and portfolio water risk. The screening tool provides information that can be used to prioritize action on what and where it matters the most to address water risks for enhancing business resilience and contributing to a sustainable future.

For more information, visit waterriskfilter.org.

DROUGHT IN THE UNITED STATES

WEDNESDAY, MAY 18, 2022



U.S. Drought monitor category

D0–Abnormally dry | D1–Moderate drought | D2–Severe drought | D3–Extreme drought | D4–Exceptional drought

Sources: The National Drought Mitigation Center, the U.S. Department of Agriculture, and the National Oceanic and Atmospheric Administration.

The U.S. Drought Monitor reported in 2022 that about half the United States is in drought. The U.S. Drought Monitor is released every Thursday and shows the parts of the United States that are in drought. Decision-makers can use this map to trigger drought responses, such as water restrictions. For more information, visit droughtmonitor.unl.edu.

The U.S. Drought Monitor is jointly produced by the National Drought Mitigation Center at the University of Nebraska–Lincoln, the U.S. Department of Agriculture, and the National Oceanic and Atmospheric Administration. Map courtesy Drought.gov.

CLIMATE CHANGE IS EXACERBATING DROUGHT AND ARIDIFICATION

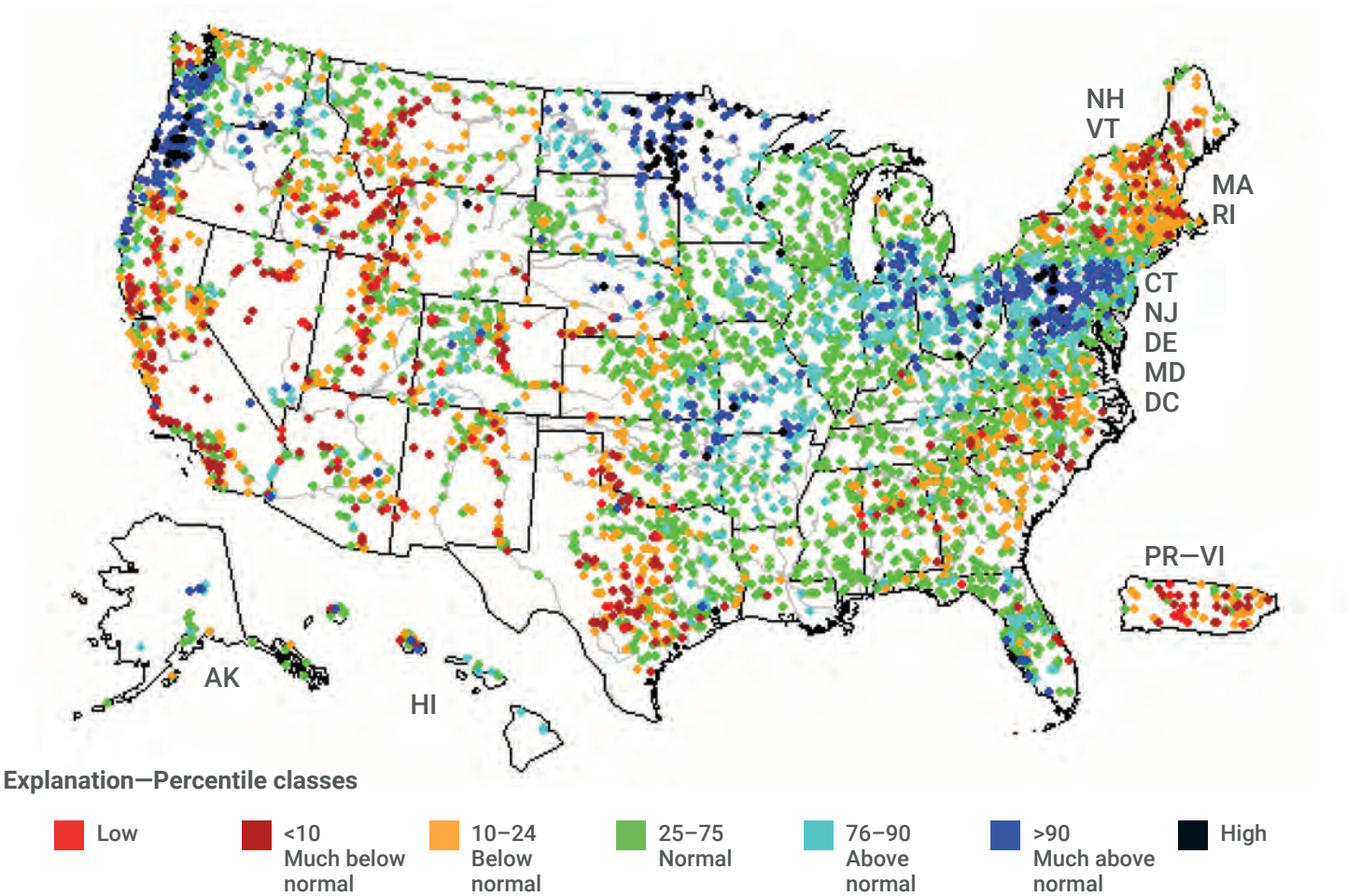
While periodic drought is a natural occurrence that can be alleviated through sufficient precipitation over time, climate change has led to greater heat and aridity in many areas, increasing the frequency, intensity, and duration of droughts.[20]

Given this situation, scientists are now referring to the climate trends in the western United States as long-term aridification.[21] The term describes "a period of transition to an increasingly water scarce environment—an evolving new baseline around which future extreme events (droughts and flows) will occur."[22] In brief, whereas drought is temporary, aridification is a more permanent state.

Extreme heat and drier soil conditions exacerbate drought and contribute to the increasing severity of related natural disasters such as wildfires, flooding, and erosion. A report on the state of water scarcity in the western United States by the U.S. Army Corps of Engineers (USACE) stated that in addition to a change in precipitation, scientists anticipate "hydrologic trends related to climate change, such as flooding and erosion during high run off events, causing murkier rivers and damaging riparian habitats, and low streamflows during the hottest months with related fish kills, water quality problems, and competition among water users, and drier western forests with more extensive insect infestations, leading to tree deaths and more frequent and intense fires."[23]

STREAMFLOW IN THE UNITED STATES

TUESDAY, APRIL 12, 2022



Source: U.S. Geological Survey.

The U.S. Geological Survey produces daily maps of current streamflow (water levels in rivers and streams) and compares it to an average of 30 years of historical streamflow for that day of the year. The western United States mostly has below-normal water levels. For more information, visit waterwatch.usgs.gov/?id=ww_current.

Wildfire Resilience Strategies for Real Estate

ULI's report *Firebreak: Wildfire Resilience Strategies for Real Estate* details the implications of wildfires for the real estate industry and explores best practices in building design and land use policy that can reduce the damage caused by wildfires and help set communities up to thrive in the long run.

The link between intense and rapidly spreading wildfires and drought is a circular one. Decades of drought have dried out large areas of forests and undergrowth, rendering them essentially tinder and dry fuel. The low moisture content allows the fires to spread more quickly, and in some cases start spot fires far away from the main fire as a result of shooting embers.[24] Scientists have found that after a fire, burned forests tend to landslide, and scorched soil does not hold moisture, which can lead to runoff, erosion, and floods following heavy rain. Not only do contaminants and other burned material run downstream instead of being filtered out through the soil, but the downstream debris deposits in riverbeds, reservoirs, and water treatment plants, causing economic and health problems, as well as ecological problems.[25]

REGIONAL POPULATION GROWTH IS PUTTING INCREASED PRESSURE ON WATER

In addition to climate change and aridification, population growth places additional strain on water supplies. Eight of the ten fastest-growing states in the last decade are in the western United States and Texas (which the U.S. Census Bureau considers to be in the South Region). A significant amount of the growth is occurring in suburbs around cities.[26] Suburban developments often include large, landscaped lots that require more water to maintain. Developments built far from municipal water sources take even more resources to either connect to a local water source or find their own sources of water, which can be even more expensive to construct and maintain.

All people, and therefore property, need access to potable water. We need water for drinking, for hygienic purposes (toilets, showers, sinks), and for our buildings that have washing machines, dishwaters, heating and cooling equipment, pools, and landscaping. Properties can access water in various ways, but ultimately all those mechanisms for accessing water draw from limited sources. Properties can connect through an existing local water network, either public or private, or access water independently on site, but in both cases water is drying up in arid regions.

Water sources in the western United States are so drained the USACE reports that "there are few undeveloped resources to draw upon to satisfy new demands or to restore depleted rivers and aquifers. Most rivers have been dammed to capture high spring runoff and to recapture water downstream for subsequent use."[27] This means that water scarcity is a problem for existing properties as well as a barrier for new development. The situation is causing municipalities to reevaluate whether to allow new construction, which will require new hookups to their dwindling water supplies.

The wastewater sector is also under increased pressure from worsening drought and population growth. U.S. wastewater infrastructure is aging. The American Society of Civil Engineers' (ASCE) infrastructure report card gives the U.S. wastewater systems a grade of D+.[28] The ASCE 2020 report also notes that new challenges and growing demand are shaping infrastructure needs, and it points to population growth and climate change as the two driving factors.[29] Consequently, the wastewater sector will have to make significant infrastructure investments to ensure that wastewater can be effectively treated. In addition, wastewater agencies have reported at least some increase in costs for treatment, operations and maintenance, and capital improvements during drought.[30]

Droughts contribute to the increasing prevalence and severity of wildfires.

The Impacts of Drought

Understanding drought requires understanding its impacts, which affect all constituent parts of the environment and communities. Learning from the interrelated effects of drought can assist in dealing with future drought conditions.

ENVIRONMENTAL IMPACTS

Droughts compromise a wide range of ecosystem services, including freshwater and food. They also influence soil fertility and nutrient cycling, which can have long-term effects for the region and its ability to support life. Significant and persistent droughts can compromise essential ecosystem functions, goods, and services, resulting in diminished or damaged environmental functioning.[31] Drought is also known to contribute to the increasing severity of related natural disasters such as wildfires, flooding, and erosion. These impacts ultimately affect the desirability of a place.

Drought Impacts by State

No two states experience the same set of impacts during a drought. The U.S. Drought Monitor reports drought impacts for each state, based on past droughts in each state for each level of drought on the U.S. Drought Monitor.

For more information, visit droughtmonitor.unl.edu/DmData/StateImpacts.aspx.

ECONOMIC IMPACTS

A study of severe weather disasters in the United States from 1980 to 2005 revealed that 11 drought events (16.7 percent of the total types of events) accounted for $148 billion (28.6 percent) of the estimated total economic cost of all weather-related disasters.[32] The National Centers for Environmental Information website notes that, "With annual losses nearing $9 billion per year, drought is a serious hazard with substantial socioeconomic risks for the United States."[33]

In addition to direct losses, another significant economic impact in the western United States includes energy prices. Hydropower provides about 22 percent of electricity generation in the region, compared with 7 percent nationally.[34,35] As water levels in the reservoirs decrease, hydroelectric plants are at risk of having to shut down and stop producing energy from an existing renewable resource. The Hoover Dam's original hydraulic turbines have already been replaced with more efficient models that are able to spin in shallow water, and the federal Bureau of Reclamation has stated that the lower water levels have already reduced the dam's electric output by a quarter. At a certain point, Lake Mead will not have enough water to produce energy.

Water is also critical to coal, natural gas, and nuclear power plants—all of which require water to cool their systems. The less water available, the less power these plants can safely generate.[36] With rising energy demands and new investments required to generate power, the increasing costs of energy will get passed on to consumers.

AGRICULTURAL IMPACTS

Farmers, ranchers, and wineries in the western United States have all experienced the impact of water shortages. At the extreme end, dry pastureland is causing farmers to cull cows they cannot afford to feed. Wineries in Sonoma County are threatened by drought and subsequent wildfires, which caused extreme damage in 2020. Farmers are leaving fields fallow because they do not have enough water for irrigation or are finding that leasing or selling their water rights is more valuable than the crops they are able to grow. In some cases, the lack of water is causing unrest between communities, such as between Native American tribes and farmers, who are both in need of water.[37]

In some areas of the world, drought causes and exacerbates food shortages and food insecurity, leading to cascading impacts including famine, unemployment, poverty, inflation, conflict, and displacement or migration.[38]

HEALTH IMPACTS

The U.S. Centers for Disease Control and Prevention has noted that severe drought conditions can have a number of serious public health implications, such as compromised quantity and quality of drinking water; increased recreational risks; diminished living conditions related to energy, air quality, sanitation, and hygiene; mental health effects related to economic and job losses; compromised food and nutrition; and increased incidence of illness and disease.[39]

Droughts threaten agriculture and economies.

REAL ESTATE IMPACTS

Drought is also a crisis for real estate. The close link between drought and wildfires, both geographically and environmentally, means that real estate developers, investors, and insurers will be increasingly concerned about developing in parts of the world that are at risk. The wildfire events in the western United States caused an estimated $7 billion to $13 billion in damages in 2020 alone, in addition to loss of life and livelihoods.[40]

States are seeing changes in property insurance provision. In some areas, insurers are unwilling to provide insurance because of the high risk of wildfire, which is linked to drought. In California, the state is reviewing proposals backed by the insurance regulator to discourage real estate development in fire-prone areas and in some cases cutting off new construction from the state's high-risk insurance pool.[41]

The aridification of the western United States is forcing local water districts to take serious measures to conserve water. For example, banning some water uses, such as outdoor irrigation; halting new development that requires hookups to the local water system; and requiring water conservation and efficiency measures for new and renovated properties. The cost of water is also rising.[42]

All these issues can be a challenge for creating more affordable housing, which the western United States sorely needs. In the long term, the measures taken to temporarily ban new development will impact real estate markets and affordability. Many areas already face a housing affordability crisis. Without the ability to build more, housing prices will continue to rise, causing cascading negative effects on the local economy. Smaller towns in the West are already feeling the pinch, and supplying water by unsustainable means, such as trucking it in from nearby cities.[43] Without the ability to expand housing, they will lose residents, including a younger, working economic base.

The Business Case for Water-Smart Development

Water-smart development and landscaping are about adapting to a drier climate, managing the associated risks, and creating long-lasting value in development. All of this can be accomplished while maximizing returns.

Although the specific return on investment varies depending on the water-saving strategy and the site, investing in water efficiency and conservation measures mitigates the risks of water shortages, policy changes, and rising water price. It also garners water and energy cost savings, providing long-term value to owners and investors.

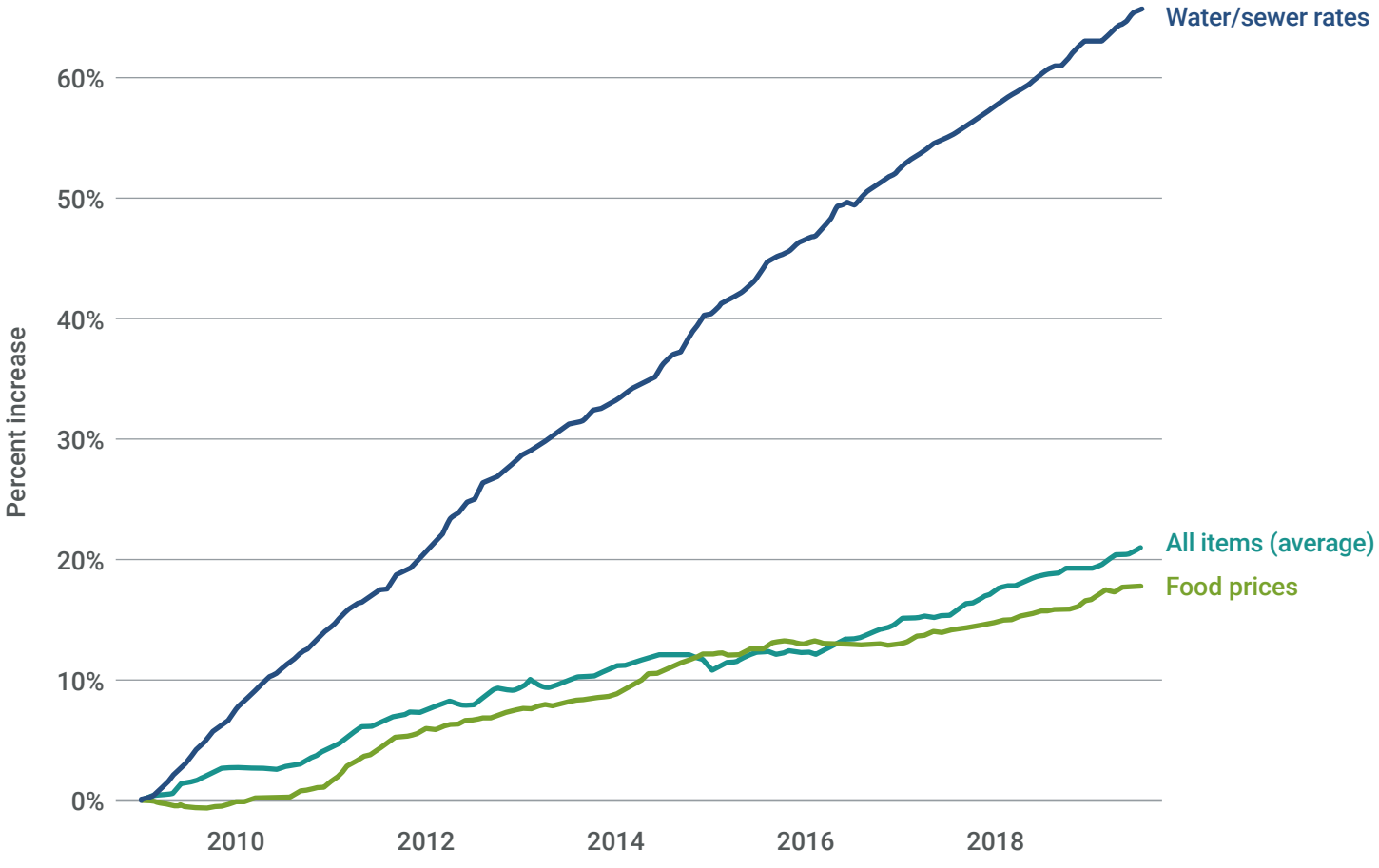
THE PRICE OF WATER IS RISING

As water becomes scarcer, the costs of accessing it increase, not only because of limited supply, but also as a result of expensive infrastructure investments necessary to treat and transport it, and government pricing mechanisms to encourage water conservation.

"The more water we use and the less we conserve, the cost of acquiring water goes up, making real estate development more difficult and more expensive."

WAVERLY KLAW
Director, Resilient Communities and Watersheds, Sonoran Institute

RISING WATER AND SEWER RATES IN THE UNITED STATES



Source: U.S. Bureau of Labor Statistics.

What Americans pay for water and sewer service has increased much faster than inflation or the price of food.

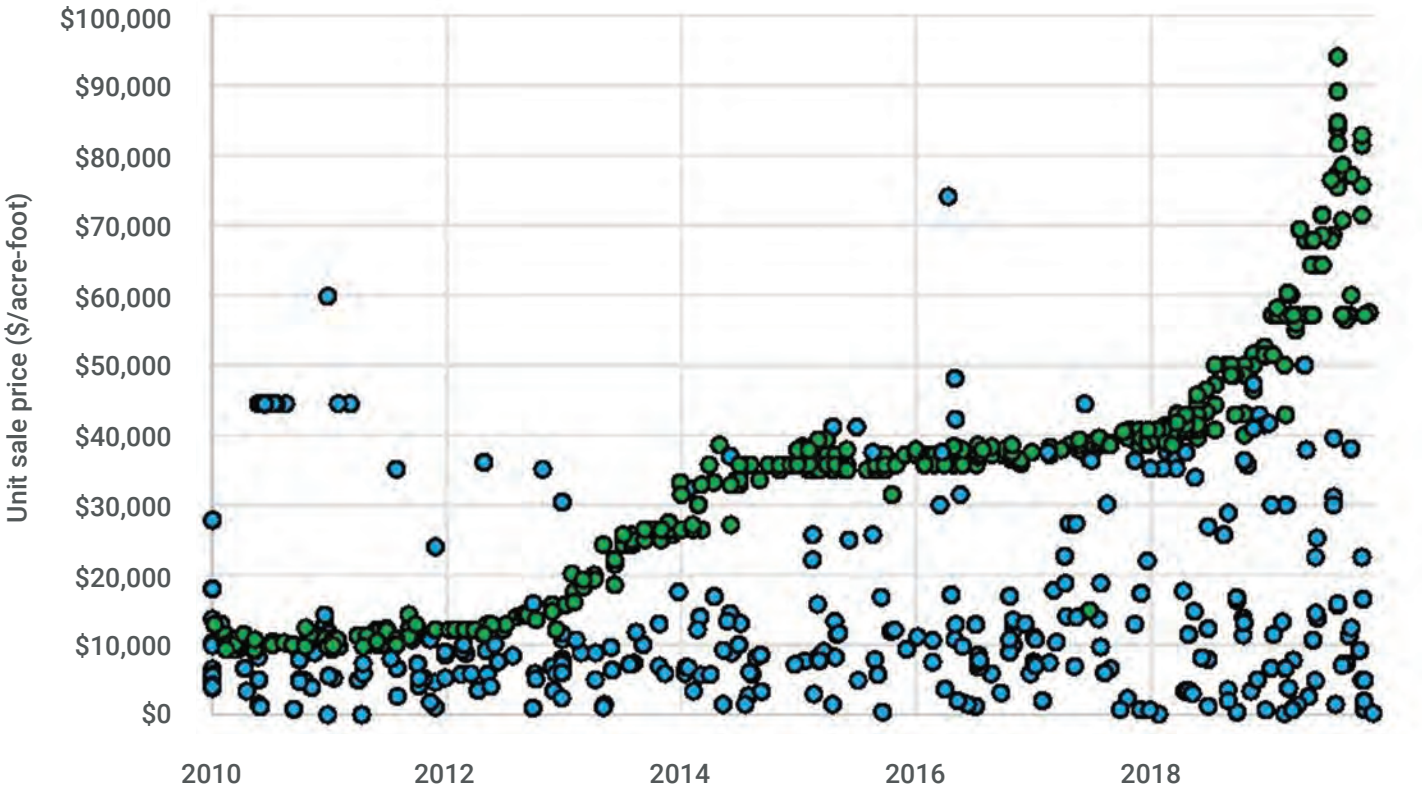
Water is also becoming more expensive because people are increasingly turning to the market to purchase access to water. While this is already happening to a small degree in the United States, it could become a major way in which water rights are bought and leased, as it is in Australia. This could put pressure on water prices and invite other types of investment and speculation that might drive water prices up, as a scarce commodity.

Water costs, when added to other development and land acquisition costs, can act as a development constraint.[44] Water-smart development can sidestep this constraint through water conservation and efficiency measures.

Returns on Resilience

ULI's report *Returns on Resilience* discusses the impact of climate change on the land use industry and the growing risks and uncertainties that affect the way projects are selected, designed, financed, and built. The report underscores the need for the real estate development sector to be aware of climate and other risks so it can adapt to future risks and mitigate known impacts, to protect buildings and sites—and ultimately tenants and residents.

WATER RIGHT SALE PRICES IN COLORADO'S NORTHERN FRONT RANGE



Source: WestWater Research LLC.

The unit sale price of water rights along Colorado's Front Range has increased exponentially since 2010. The blue dots are sale prices of ditch company shares in Northern Colorado's Front Range. The green dots are sale prices of Colorado-Big Thompson Project shares.

GETTING AHEAD OF POLICY AND REGULATIONS RELATED TO WATER CONSERVATION AND USE

Regulatory and policy changes are adjusting land use and water use to the uncertain future. These changes will have a material impact on what types of real estate can be developed, as well as where and how. It will also mean that investing in water efficiency and conservation measures at the site scale will be a way to get ahead of the curve of these changes, providing long-term value to owners and investors in addition to cost savings. For more information on policy and regulatory changes, see "The Drought Policy Landscape" section of this report.

CONSUMER PREFERENCES SHOW GROWING INTEREST IN WATER EFFICIENCY

Consumers are increasingly showing a preference for water-efficient fixtures, appliances, buildings, and landscapes, especially in drought-prone regions. Studies indicate that attitudes and behavior toward potable water use have shifted because of greater awareness of its value and increasingly widespread exposure to drought conditions.[45,46] Information from the U.S. Environmental Protection Agency indicates that 87 percent of consumers view water as the most important natural resource in their daily lives, 78 percent of Americans feel personally responsible to change their daily habits and purchasing to positively impact the environment, and 70 percent of consumers are looking for greener products.[47]

BUYERS ARE MOTIVATED TO LOOK FOR GREENER OPTIONS

Source: U.S. Environmental Protection Agency.

Information from the U.S. Environmental Protection Agency indicates that buyers are motivated to look for water-efficient products and homes. For more information, visit www.epa.gov/watersense.

Consumers are increasingly showing a preference for water-efficient fixtures, appliances, buildings, and landscapes, especially in drought-prone regions.

Consumers also prefer buildings that incorporate sustainability measures, including water efficiency.[48,49,50] The U.S. Green Building Council (USGBC) notes that the top two triggers for green building in the United States are client demands and desire for healthier buildings.[51] It also reports a growth in Leadership in Energy and Environmental Design (LEED)-certified commercial projects from 100 in 2003 to more than 110,000 as of 2021.[52] The USGBC reports that employees in LEED green buildings feel happier, healthier, and more productive.[53]

In terms of landscaping, consumers are also increasingly showing a preference for low-water landscapes. Studies have shown that landscape preferences are sensitive to community water concerns, changes in municipal water rate schedules, public education campaigns, and awareness of water conservation responsibility.[54] As a result of these influences, water-intensive landscapes are being replaced with water-efficient and climate-appropriate landscapes throughout the United States.[55,56]

Apple was one of the first technology companies to prioritize water conservation and continues to be at the forefront of water stewardship efforts. For more information, see the Apple project profile.

WATER-SMART DEVELOPMENT HAS A MARKET ADVANTAGE

Ultimately, water-smart development has market advantages. One research report by the International Finance Corporation, a global lending institution, found that green buildings have up to 8 percent higher rental income than traditional buildings and sale premiums up to 31 percent higher.[57] Green buildings also tend to have higher occupancy rates, higher tenant retention, and lower vacancy rates.[58]

"Conserving is something that people want to do. Our customers want this and believe in using less water. But they need our help to figure out how to achieve [this]."

JOHN FLECK
Director of Water Resources, University of New Mexico

Since water use requires a substantial amount of energy, water and energy are fundamentally linked, creating opportunities for greater savings.[59,60] Green buildings use about 20 to 40 percent less energy and water on average, and owners were reported to save about 15 to 20 percent on utility bills.[61] Research by the USGBC shows that upfront investment in water and energy efficiency measures makes properties more valuable, in some cases by 10 percent or more.[62]

Statistics in 2022 show that the green building and construction sector is among the fastest-growing industries worldwide.[63] It is a signal that green buildings are increasingly seen as a significant investment opportunity.

Water Rights in the United States

Western water law is governed by "prior appropriation," which means that the first person to divert water from a river or stream and put it to beneficial use is entitled to continue that use without interference from other users who make subsequent claims. The law thus says, "first in time, first in right" and is based on use rather than landownership. This system incentivizes water rights holders to use 100 percent of their historical water rights, whether they need them or not. Otherwise, they would lose their guaranteed access to water. As a result, this system limits access to water in a region facing long-term aridification and overallocation of water rights.

By comparison, Eastern riparian water law, originating from England's system of water law, is based on the ownership of riparian land—the land bordering a river, stream, or lake. In addition to being based on landownership, riparian water rights require upstream water users to be reasonable—to respect the rights of downstream water users and the public's interest in safe, clean, plentiful water.

Water rights are highly contentious throughout the United States. In the Colorado River basin, for example, water rights are overallocated, meaning that there is not enough water to go around.

Drought-tolerant landscaping, like this yard in Southern California, can be beautiful, interesting, and resilient.

PART II

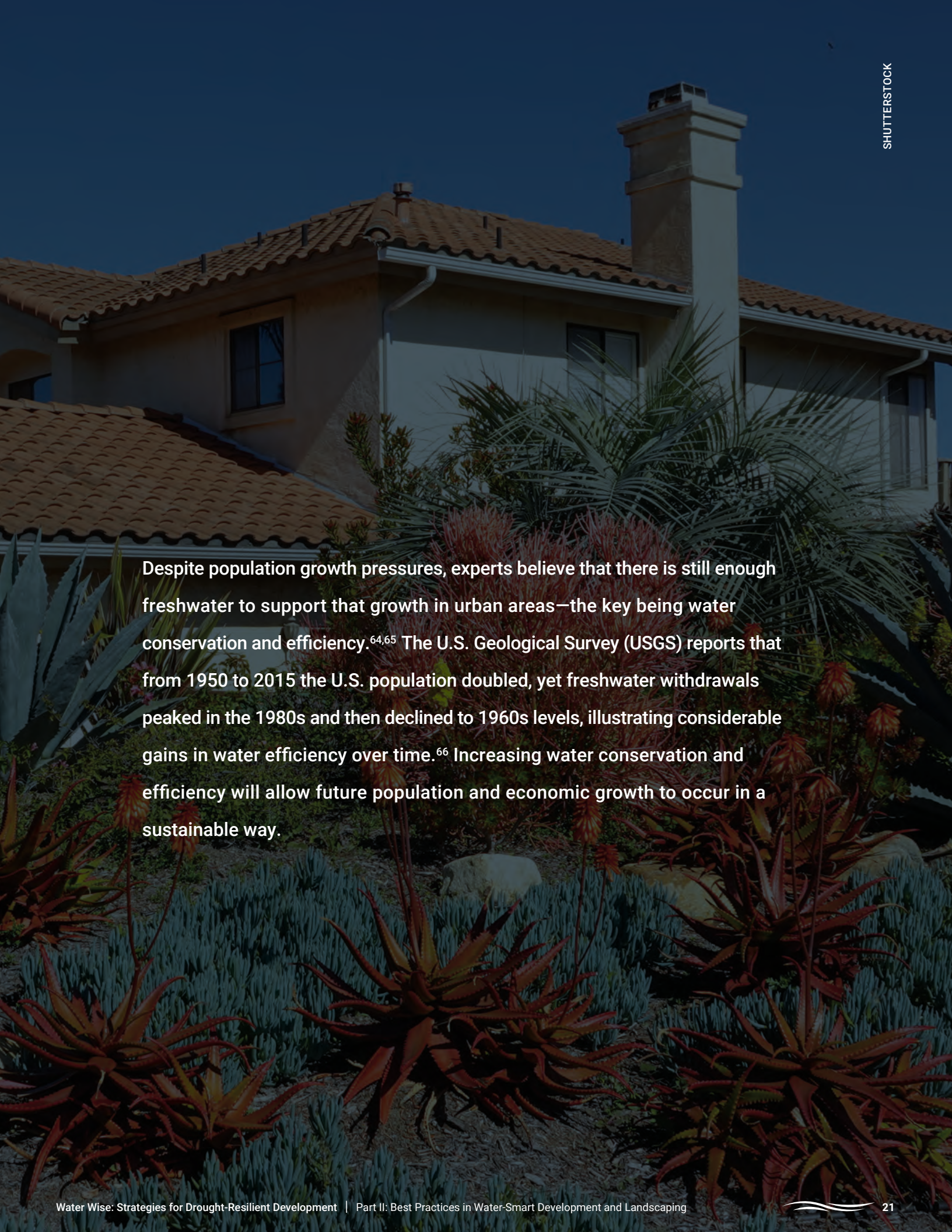
BEST PRACTICES IN WATER-SMART DEVELOPMENT AND LANDSCAPING

Pre-Development Strategies

Indoor Strategies

Outdoor Strategies

Ongoing Property and Water Management Strategies

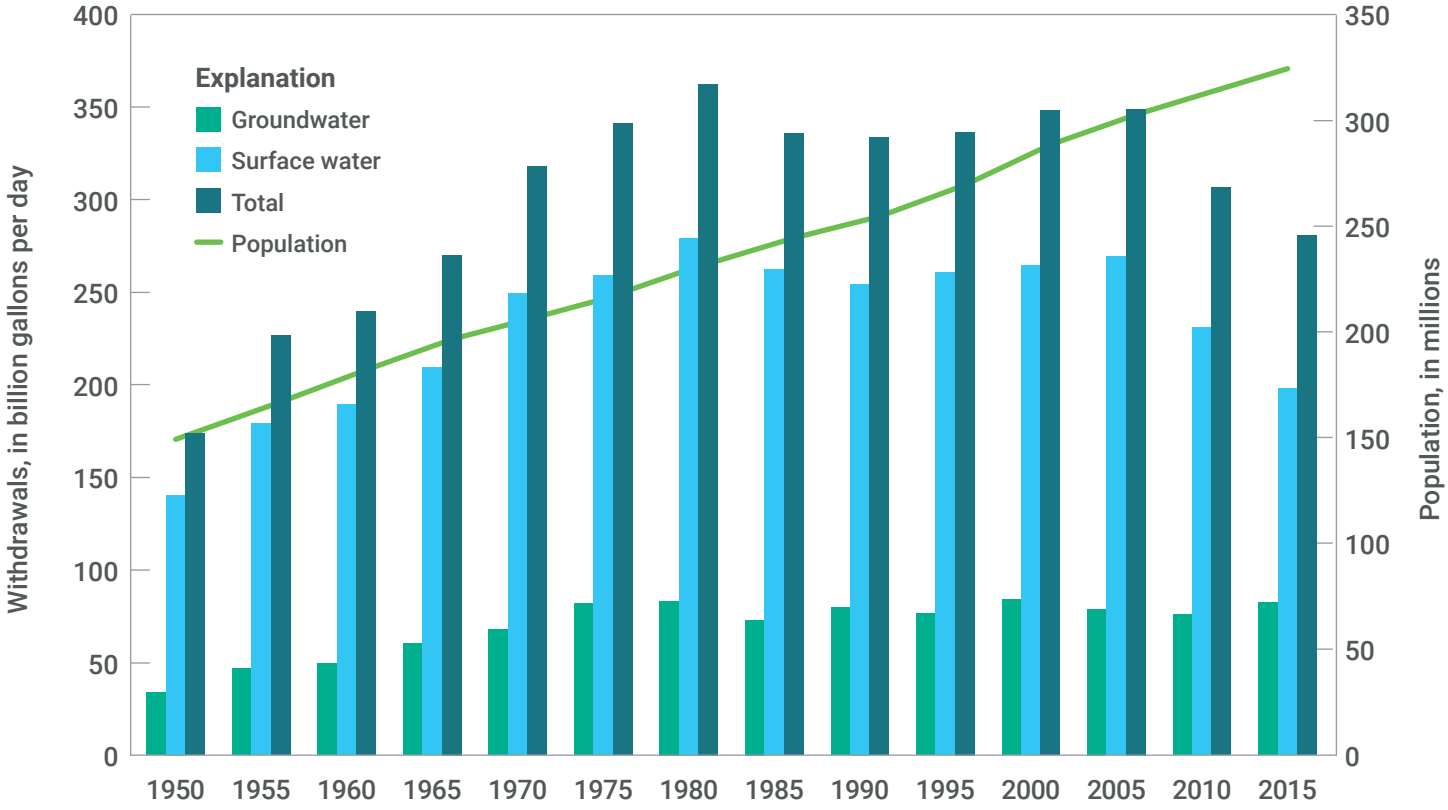


SHUTTERSTOCK

Despite population growth pressures, experts believe that there is still enough freshwater to support that growth in urban areas—the key being water conservation and efficiency.[64,65] The U.S. Geological Survey (USGS) reports that from 1950 to 2015 the U.S. population doubled, yet freshwater withdrawals peaked in the 1980s and then declined to 1960s levels, illustrating considerable gains in water efficiency over time.[66] Increasing water conservation and efficiency will allow future population and economic growth to occur in a sustainable way.

TRENDS IN POPULATION AND FRESHWATER WITHDRAWALS BY SOURCE

1950–2015



Source: U.S. Geological Survey.

From 1950 to 2015, the U.S. population doubled, yet freshwater withdrawals peaked in the 1980s and then declined to 1960s levels, showing gains in water efficiency over time. For more information, visit www.usgs.gov/mission-areas/water-resources/science/trends-water-use.

Studies also show that water use is much more efficient in dense, urban development patterns, rather than sprawling development.[67] Not only does dense development save water by decreasing future water use, but it can also lead to "decreasing impacts of water shortage events on municipal water supply systems by decreasing intensity, duration, and frequency compared to the sprawl development pattern during the long duration of water shortage events."[68] Since development and land use patterns have such a substantial influence on the efficiency of water use and the impact of water shortages, real estate developers and land use professionals have a significant role to play.

A 2021 survey of ULI members found that respondents see adapting to and mitigating climate change as one of five top global infrastructure priorities, alongside increasing affordable housing, increasing renewable and green energy, maintaining existing infrastructure, and improving public transportation. As real estate developers and property owners are thinking ahead to a drier future, but also hoping for continued growth, there are major opportunities to reduce pressure on the existing water supply, use it much more efficiently, and treat used water for safe reuse. Although some of these measures are more costly than others, with water becoming a scarcer commodity, these measures will realize meaningful cost savings, creating more value and ensuring access to a basic need in the face of uncertain times.

Strategies for water-smart development and landscaping are organized into the following sections: pre-development, indoor, outdoor, and ongoing property and water management.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Sustainable site selection allows communities to be more resilient in the face of climate change.

Pre-Development Strategies

What happens before and during development is often a determining factor in the project's ability to be water wise.

SITE SELECTION

The built environment impacts ecological systems, including shared water sources and ultimately the health and well-being of all living beings.

Selecting previously developed sites for redevelopment takes advantage of existing utilities and infrastructure and preserves natural ecosystems and farmland. Compact, mixed-use, walkable, and transit-oriented development accommodates growth without increasing impervious surface cover and polluted urban runoff, helping protect watersheds and mitigate climate change. Moreover, sites within walking distance of amenities provide significant benefits to occupants and value to owners.[69]

"As urban areas spread outward, we will see increased challenges in maintaining water quality and quantity."

CHARLES G. GROAT
Director, U.S. Geological Survey,
U.S. Department of the Interior

The Sustainable SITES Initiative

SITES is a certification program that encourages land use professionals to adopt practices that protect ecosystems and enhance the benefits they provide to communities, such as climate regulation, carbon storage, and flood mitigation.

SITES-certified landscapes help reduce water demand, filter and reduce stormwater runoff, provide wildlife habitat, reduce energy consumption, improve air quality, improve human health, and increase outdoor recreation opportunities. The SITES certification process allows projects to benchmark against performance criteria.

For more information, visit: www.sustainablesites.org.

Land conservation and restoration ensure healthier ecosystems, watersheds, and communities. Open space, riparian areas, floodplains, and native habitats should be identified, preserved, and restored as assets for flood protection, water quality improvement, groundwater recharge, carbon sequestration, and long-term water resource sustainability. To do this, building outside the 100-year floodplain and locating buildings to minimize disturbance of existing natural features are essential.

Sustainable site selection and landscapes allow communities to better withstand and recover from droughts, wildfires, floods, and other catastrophic events. They also benefit the environment, property owners and tenants, and local and regional communities and economies.

Colorado is one of the states that has water adequacy requirements for real estate development to account for limited water availability. This photo shows Cañon City in Colorado.

ADEQUATE AND SUSTAINABLE WATER SUPPLY

The availability of freshwater has always been a deciding factor for the location of human civilizations. Less than 3 percent of the Earth's water is freshwater, and less than 1 percent is available for use.[70] Due to limited freshwater supply, a growing population, and an increase in pollution, access to and availability of potable water is a defining issue for this generation and those to follow.

The states of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming, among others, all have water adequacy requirements for real estate development to account for limited water availability.[71] These state laws require new developments to demonstrate that they have access to adequate and sustainable water supplies before they can be approved. Since new development adds to water demand, these state governments are ensuring adequate and sustainable water supplies for both existing and new property owners and tenants.

Mandatory long-term renewable water supply to serve projected growth can be an issue in areas experiencing extreme drought and depleted groundwater supplies, however. To incentivize water conservation and support communities during droughts, water suppliers can account for the water efficiency of development projects and downsize tap fees in accordance with lower water use. For more information, see the "Conservation-Oriented System Development Charges" section of this report.

Selecting sites with access to municipal water and sewer infrastructure, on-site wells, purchased or leased water rights, and water reuse systems are all potential options for proving access to adequate water supplies as required by local governments. By collaborating early in the development process with water management partners, developers can learn about and explore local and site-specific options.

The Water Efficiency Rating System

The Water Efficiency Rating System (WERS) is a third-party verified tool that developers can use to predict water use for new and existing properties. It allows developers to identify water efficiency goals and determine what design modifications will allow them to reach that water demand goal. WERS was developed and used by the city of Santa Fe and Green Builders Coalition but is now available for universal use.

For more information, visit www.wers.us.

CALCULATING SAVINGS AND SECURING FINANCING AND UNDERWRITING

Saving water saves money and generates value for assets, communities, and the environment.[72] Increasing water efficiency can reduce operating costs, stretch available water supplies, and enhance reputation. In many areas, water and sewer rates are increasing faster than those for energy, making investment in water efficiency a smart business decision.[73] As a result, water conservation measures in real estate projects are likely to lead to better financing, faster and higher lease rates, more competitive insurance premiums, lower utility costs, and greater returns on investment.[74]

While the specific return on investment varies depending on the water-saving strategy and the site itself, the following equation can be used to calculate the payback period based on the project cost and anticipated annual savings. Calculating simple payback periods can be an effective method for prioritizing potential projects and practices, and for estimating return on investment.

"Projects built and maintained with resilience in mind enjoy advantages such as greater marketing, sales, and leasing success by offering assurance about the integrity of the project and its ability to continue to function through or recover quickly from severe weather. More resilient projects also can benefit from better financing options, more competitive insurance rates, greater long-term savings on maintenance, and higher overall value compared to more vulnerable properties."

ULI'S REPORT *RETURNS ON RESILIENCE: THE BUSINESS CASE*

CALCULATING SIMPLE PAYBACK PERIOD IN YEARS

To calculate the simple payback period for a specific project or practice, gather the following information and use the equation below. Units: **Project cost** (dollars), **Water savings** (gallons per year), and **Cost of water and wastewater** (dollars per gallon).

$$= \text{Project cost} \div \left(\text{Water savings} \times \text{Cost of water and wastewater} \right)$$

1. Determine the total project cost, subtracting any available rebates or incentives that make the project more cost-effective.
2. Estimate the water savings from the project, which can be calculated using equations that are available in sections 2 through 8 of the U.S. Environmental Protection Agency's "WaterSense at Work" report. If the project has an associated energy impact, as many water projects do, the annual energy savings can be included in the calculation as well.
3. Identify the cost of water and wastewater. In some cases, the water utility deducts sewer charges for water that is not discharged to the sanitary sewer (e.g., water evaporated from the cooling tower or water applied to the landscape). In these cases, only consider the water cost when calculating simple payback of the project.

For more information, see the U.S. Environmental Protection Agency's "WaterSense at Work" report.

Source: U.S. Environmental Protection Agency.

One study found the average potential water savings from conservation measures in commercial and institutional facilities ranged from 15 to 50 percent, with the most typical savings ranging from 15 to 35 percent.[75] The actual savings depend on the age of the building, the site characteristics, and the improvements.

To capitalize on these savings, water-smart projects can attract environmental, social, and governance (ESG) investments, green loans, Property Assessed Clean Energy (PACE) financing, and underwriting that accounts for projected savings and building performance, especially if both water and energy efficiency are accounted for in the projects.

Since 1995, total assets held in sustainable investments have increased 25-fold.[76] That growth is expected to continue.[77] Sixty percent of CBRE's 2021 Global Investor Intentions Survey respondents stated that they have adopted ESG criteria as part of their investment strategies, with the Americas, EMEA (Europe, Middle East, and Africa), and Asia Pacific all recording a stronger focus on ESG issues than in prior years.[78]

Calculating the True Cost of Water

Increased water efficiency can reduce operating costs beyond the costs for potable water and wastewater. The true cost of water may include the following items:

- Energy for heating and cooling water;
- Energy and expenses for chemical treatments for cooling towers;
- Chemicals and fertilizers for non-native, irrigated landscaping;
- Waste charges for removal of oil, grease, and solids;
- Charges for biological oxygen demand;
- Process water pretreatments; and
- Depreciation of water-using equipment.

The South Florida Water Management District's "Water Efficiency Self-Assessment Guide for Commercial and Institutional Building Facility Managers" provides several equipment and process-specific water use and savings calculators, which can be useful for analyzing water savings.


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Increasing water efficiency can reduce operating costs, stretch available water supplies, and enhance reputation. In many areas, water and sewer rates are increasing faster than those for energy, making investment in water efficiency a smart business decision.

Water conservation measures in real estate projects are likely to lead to better financing, faster and higher lease rates, more competitive insurance premiums, lower utility costs, and greater returns on investment.

With ESG playing a much more prominent role in company operations, investors are embedding ESG considerations into every stage of the property life cycle, from due diligence to acquisitions and from leasing to asset management.[79] As BlackRock CEO Larry Fink wrote in a 2020 letter to chief executive officers, "climate risk is investment risk."[80]

Effective risk and cost management—including water risk and savings—can enhance a project's ability to attract resources and continue operating during disruptive situations, which is the essence of resilience.[81] Many of the most substantial risks to the built environment are climate related, with extreme weather, droughts, floods, and wildfires frequently leading to significant property damage.

As climate change risks increase, costs rise. Global property insurance premiums have grown by a double-digit percentage in each of the past seven quarters as real estate sustains physical damage from natural disasters.[82] Climate change is also contributing to higher utility costs as the demand for air conditioning increases and water supplies dwindle. Reducing water and energy requirements mitigates these risks and costs.

Government regulations and incentives, demand for green buildings, efficiency savings, and greater awareness of climate change risks are proving the business case for enhanced building performance.

Benchmarking for ESG Performance

As investors attempt to monitor and evaluate asset-level environmental, social, and governance (ESG) performance, the use of benchmarking tools like the Global Real Estate Sustainability Benchmark (GRESB) will become increasingly prominent. GRESB gathers and compares data on the ESG performance of real estate and infrastructure entities.

Real estate funds, REITs, property companies, real estate developers, infrastructure fund managers, and asset operators use GRESB to assess their ESG performance. This assessment is done in a standardized, globally recognized framework so both investors and managers can act on ESG data and insights.

Entities are given a GRESB score that measures their ESG performance and provides a GRESB rating that ranks them among peers. Participants also receive a summary analysis of performance, showing strengths and weaknesses across categories such as leadership, policies, risk management, health and safety, greenhouse gas emissions, building certifications, and stakeholder engagement.

For more information, visit: gresb.com/nl-en.

DESIGN AND CONSTRUCTION

The most cost-effective way to integrate water efficiency into a real estate project is to include it from inception. Working with the project team upfront on water issues, use, and reuse can save money in the long term. Creating a water action plan can help team members prioritize water-saving actions during design, material selection, construction, plumbing, appliance and technology installation, and landscaping.[83] A water action plan can also be useful during ongoing operations and maintenance.

Green building certification programs such as LEED, Alliance for Water Stewardship, WaterSense, SITES, the Living Building Challenge, and BREEAM include water standards and are considered best practice in the industry.[84] These certification programs not only help with design and construction choices, but they can also help with a project's overall resilience and bottom line.[85] Investors are increasingly looking to these types of ESG certifications, ratings, and data for their decision-making.[86]

Upfront life-cycle analysis of water improvements, as opposed to value engineering, can also help with water-related decision-making. Life-cycle analysis is a methodology for assessing environmental impacts associated with all stages of the life cycle of a product, process, or service. Environmental impacts are assessed from raw material extraction and processing, through manufacture, distribution, and use, to refurbishing, recycling, or final disposal of materials. For real estate and construction, the objective data and long-term perspective provided by life-cycle analysis can be helpful for meeting ESG targets and understanding long-term costs and benefits.

Coordination across architecture, engineering, and construction on a water action plan, whether it includes certification and life-cycle analysis or not, is critical for saving water and money throughout the process of development and the life of the project. Water conservation and water quality protection priorities can be included in construction specifications and all tender and contractual documentation to ensure that they are implemented.

During construction, millions of gallons of water can be wasted if systems are not in place to reduce that waste.[87] Construction costs may also be lowered by using less water or recycled water. In addition to reducing water waste, minimizing disturbance of waterways, floodplains, vegetation, and soil can help protect the local watershed. Surface water and aquatic ecosystems can also be protected by controlling and retaining construction pollutants.

"We need to continue to push ourselves to innovate and reduce water use, utilizing educated teams that have relevant experience and know how to execute."

ULI WATER-SMART DEVELOPMENT FOCUS GROUP PARTICIPANT

Alliance for Water Stewardship Certification

The Alliance for Water Stewardship (AWS) provides standards, certification, and an accountability framework to companies seeking to reduce their water consumption. AWS supports water-using sites in understanding and addressing shared water challenges as well as site-specific water risks and opportunities.

The AWS Standard supports companies in

- ➔ Understanding water dependencies and impacts;
- ➔ Mitigating operational and supply chain water risks;
- ➔ Ensuring responsible water procedures;
- ➔ Building relationships with local water-related stakeholders; and
- ➔ Addressing challenges shared with others in the watershed.

The standard can be implemented by any site, in any sector, in any watershed around the world. In addition, the standard can be used by others interested in mitigating water risks, including investors and public-sector agencies, as a framework to evaluate and plan water stewardship practices.

For more information, visit: a4ws.org.

KB Home has built net zero energy and net zero water homes in California and Texas.

KB Home Champions Water Conservation

As a homebuilder operating in some of the most water-challenged regions of the United States, KB Home prioritizes water conservation and efficiency. Each of KB Home's new homes includes WaterSense-labeled fixtures and Energy Star–certified dishwashers that save water and energy. The homebuilder also uses water-efficient landscaping in arid locations. To date, KB Home has built more than 18,000 WaterSense-labeled homes and installed over 900,000 WaterSense-labeled fixtures, conserving about 1.6 billion gallons of water annually. In a recent pilot program, the U.S. Environmental Protection Agency (EPA) found that KB Home's WaterSense-labeled homes in Las Vegas use 44,000 gallons of water per year on average, compared with typical homes in the region that use about 100,000 or more gallons annually. In 2022, KB Home started to measure and assess water usage in its homes using Residential Services Network's (RESNET) $HERS_{H20}$ water-efficiency rating system. By studying usage and efficiency ratings, KB Home hopes to be able to identify future opportunities for more water-saving innovations.

In 2014, KB Home designed and constructed its first Double ZeroHouse (net zero energy and net zero water), a home that produces as much energy as it uses in a year with solar panels and collects enough water to irrigate the landscape through an onsite graywater recycling system. The Nexus eWater graywater recycling system collects and cleans wastewater from showers, sinks, and washing machines for subterranean yard irrigation, reusing between 40,000 and 70,000 gallons of water annually. Combined with WaterSense-labeled fixtures, Energy Star–certified dishwashers, real-time water meters, and water-efficient landscaping, the Double ZeroHouse conserves up to 100,000 gallons of water annually (for a household of four) compared with a typical home.

Despite an additional upfront investment of $48,000 in conventional design and construction for the Double ZeroHouse's resilience features (not including discounts and energy tax incentives), the U.S. Department of Energy estimates that homeowners save close to $2,700 per year on utilities and over $100,000 in the first 30 years, accounting for increasing utility costs. These savings can quickly offset the initial construction and technology costs, which are financed over the life of the mortgage.

For the 11th consecutive year, KB Home has been recognized by the EPA for its commitment to building water-efficient homes. In 2021, KB Home received the WaterSense Sustained Excellence Award, the highest level of recognition given by EPA's WaterSense Partner program.

"As a homebuilder, we have worked hard to reduce water consumption at our jobsites and in our homes. We understand that we need to conserve this precious natural resource, and by doing so, we can also help our homeowners save money on their utility bills."

DAN BRIDLEMAN
Senior Vice President of Sustainability, Technology and Strategic Sourcing, KB Home

"The Onsite Non-Potable Water Reuse Practice Guide" by the William J Worthen Foundation provides guidance to building design professionals on water reuse strategies.

Indoor Strategies

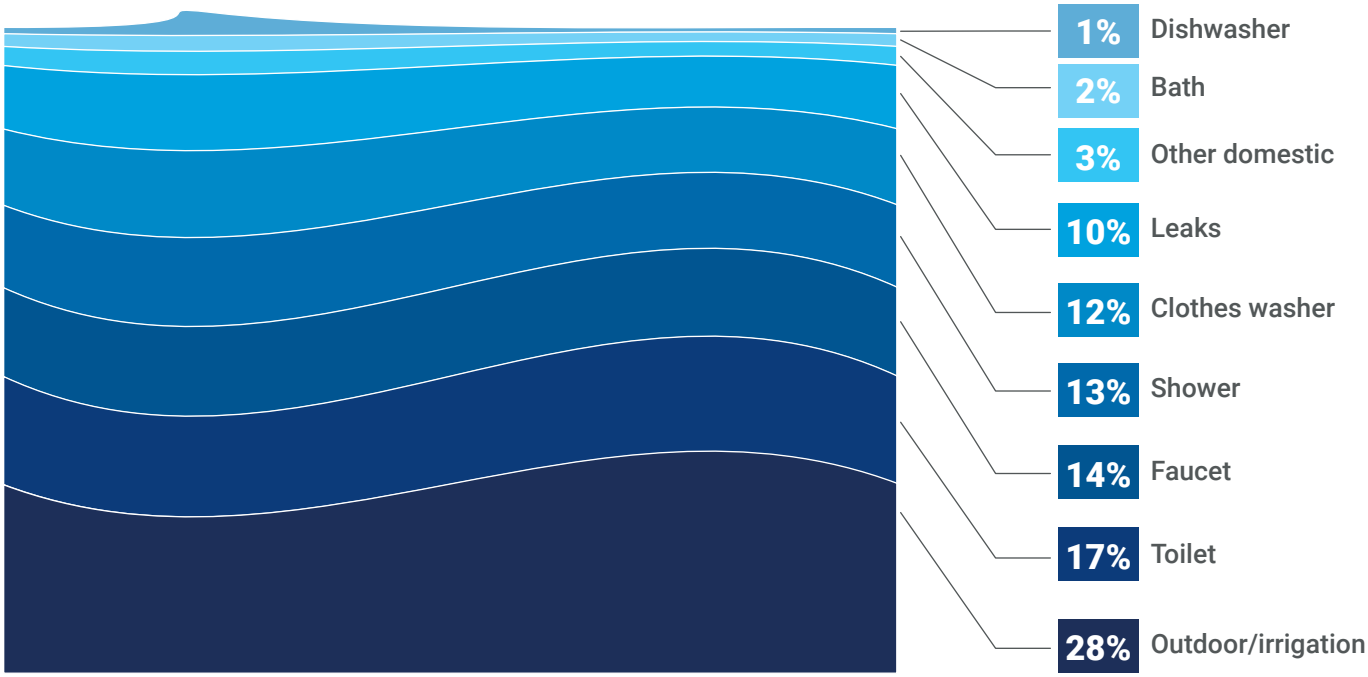
Average indoor water use in single-family homes accounts for around 70 percent of residential water use in the United States.[88,89] Since the Energy Policy Act of 1992, which established maximum flow rates for new residential toilets, showerheads, and faucets, indoor water use in the United States has decreased by a significant margin. Average indoor per capita water use decreased 15.4 percent between 1999 and 2016 in single-family residences alone.[90] This reduction in household use is largely due to more efficient fixtures and appliances and is not the result of changes in either occupancy or behavior.[91] These reductions due to fixture and appliance upgrades give hope for all facility types.

While single-family homes typically use the most water of any customer sector of North American water utilities, the lower figure on page 31 shows the average breakdown of water use by all utility customer sectors.

Despite these water savings owing to more efficient fixtures and appliances, there is still a long way to go to realize the full potential savings. As of 2016, 37 percent of homes studied had water-efficient toilets and 46 percent had water-efficient clothes washers.[92] Opportunities for greater water efficiency arise every time older fixtures and appliances are replaced.[93] Additional availability of customer-facing and real-time water use data could also support leak detection and water use reduction.[94]

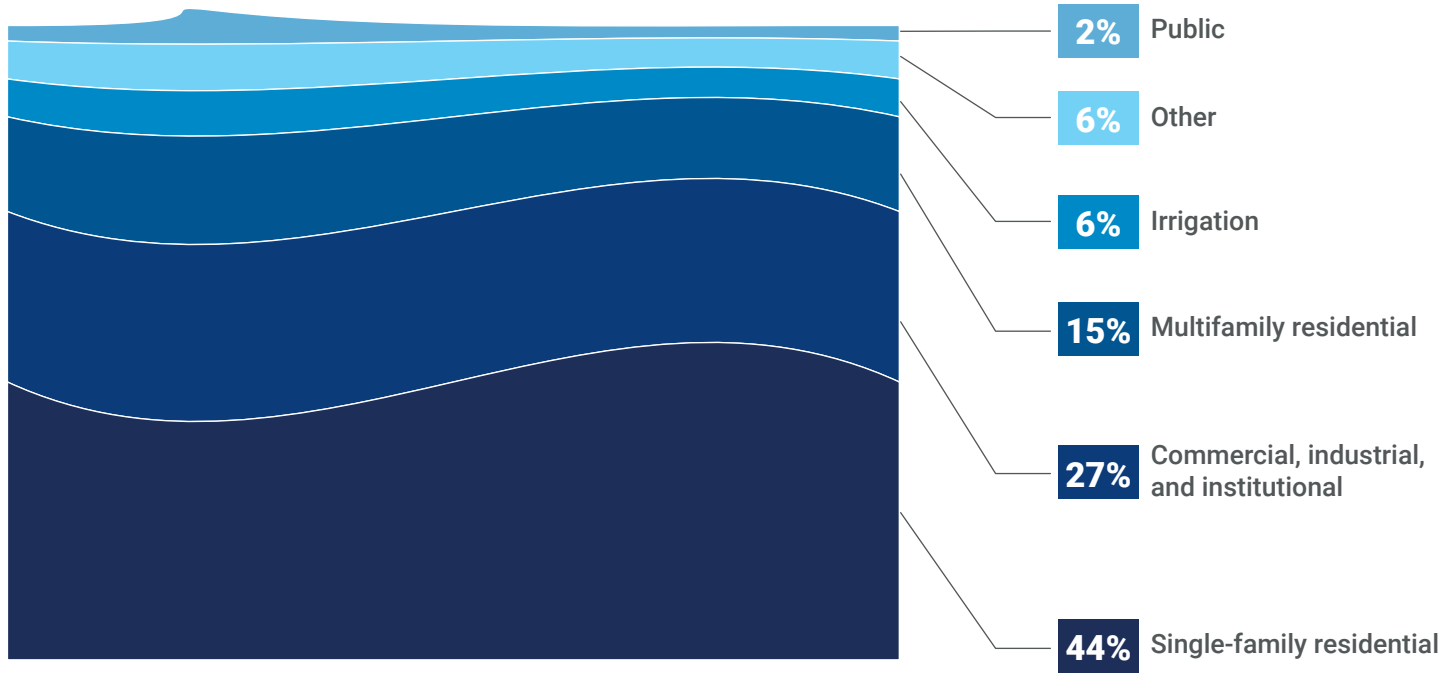
The strategies in this section provide options for improving water conservation through building systems, fixtures, and appliances.

ESTIMATED PERCENTAGES OF INDOOR AND OUTDOOR END USES OF WATER IN U.S. HOMES

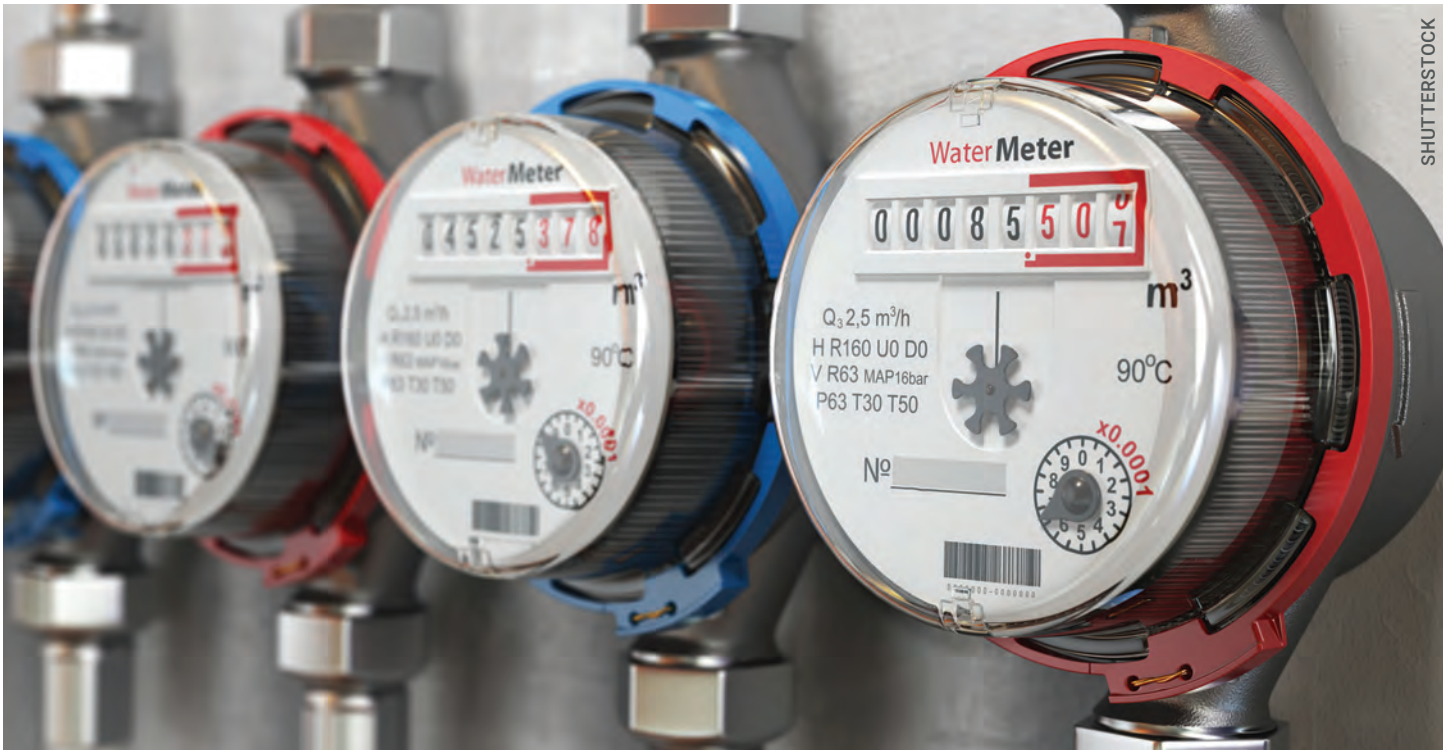


Sources: Amy Vickers, Water Research Foundation, U.S. Geological Survey.

WATER USE BY SECTOR IN THE UNITED STATES



Source: Water Research Foundation.



SHUTTERSTOCK

Whereas traditional water meters are read monthly or bimonthly by utility staff to generate water bills, smart water meters can be read more frequently and remotely, providing access to real-time water use information for both customers and water utilities.

SMART METERING AND SUBMETERING

Water meters are used to measure the amount of water used. Traditional water meters are read monthly or bimonthly by utility staff to generate water bills. Smart meters can be read more frequently and remotely, providing access to real-time water use information for both customers and water utilities. In addition to measuring the volume of water used, smart meters can record the date and time when the water use occurs. The major benefit of using smart meters is that they allow owners and tenants to track their water use in real time and make decisions accordingly. Real-time information on water consumption also allows for easier and faster identification of leaks and water waste, and greater consumption and pricing transparency for the consumer.[95] Studies have shown that smart meters have led to reductions in domestic water use of between 3 and 53.4 percent, with an average of 19.6 percent.[96]

Many facilities receive water through a single master water meter, even despite containing multiple tenants and uses. Tenants who lack accountability for their water use tend to use around 15 to 20 percent more.[97] Submeters allow each unit, apartment, or use to be metered and billed individually for water use. Submetering indoor and outdoor uses separately can also assist with identifying opportunities for water conservation. Potential hindrances to submetering include plumbing system design and costs, and diverse state and local laws. However, many states have introduced or enacted legislation to accommodate submetering, many water suppliers have undertaken submetering efforts, and facilities are increasingly adding submeters.[98]

Where submetering is not possible, each unit's water use can be estimated by placing flow sensors or end-use meters on major water-using fixtures and appliances such as water heaters, faucets, showers, and toilets. Once the data on water use is collected at a central location, each unit's water use is estimated and then adjusted to the master meter consumption records. States have different regulations regarding estimated submetering.

"If we have the ability to daily or weekly look at our water use, we have the ability to change our habits."

THOMAS DIPRIMA
Past President, Southern California Division, KB Home

LEAK DETECTION AND REPAIR

Aging infrastructure, improper installation of piping and fixtures, and lack of dedicated meters for individual uses can make finding and fixing leaks challenging. Leaks can go unnoticed, sometimes for years, leading to physical and financial damage, not to mention water waste. The leaks in a single residence can easily waste thousands of gallons of water each year.[99]

Although no easy method exists for detecting all leaks, preventive measures and solutions are available, including the following:

- **Water budgets:** A water budget for a facility can be developed during the design process and by looking at water use trends over time. Availability of water use data through water bills, meters, and submeters assists the development of an accurate water budget, making identification of leaks easier when spikes in water use occur beyond the normal water budget. If a leak is suspected, contact the local water utility for assistance; many perform audit services free or for a minimal fee.
- **Water audits:** Water utilities often provide water audits as part of their water conservation programs, but contracted water auditors are also available. Auditors can test for and find leaks and offer recommendations for repair and water efficiency, if not provide the repair directly.
- **Leak detection devices:** Modern water leak detectors instantly alert building managers about leaks, frost, and unusual water flow before these issues escalate and cause major damage. By installing leak detectors in high-risk areas, building operators can receive alerts at the first sign of a leak, allowing them to take immediate action. Better yet, linking this data to a building automation system enables automated responses like shutting off a supply valve or leak-related equipment to prevent widespread damage before a technician arrives.
- **Plumbing, fixture, and appliance repair and replacement:** Water auditors and plumbing technicians can identify and repair plumbing leaks, but leaks are frequently simpler to repair when they come from fixtures, appliances, and equipment that need to be replaced. Slow-dripping fixtures waste surprising amounts of water. A faucet dripping at only one drop every two seconds will waste more than 1,000 gallons of water per year.[100] Several studies have found that 20 to 35 percent of all residential toilets leak, sending wasted water directly into the sewer line without detection.[101] A worn flapper valve is the most common cause and can be easily and cheaply replaced.

Leak prevention, early detection, and swift remediation are all keys to water conservation and financial security.

POTENTIAL LOSSES FROM WATER LEAKS

MALFUNCTION	LEAKING FLOW RATE (gallons per minute)	WATER LOSS	ESTIMATED COST OF WATER LOSS*
LEAKING TOILET Small (e.g., worn flapper) Medium (e.g., misaligned flapper) Large (e.g., stuck fill valve)	 0.02 gpm 0.2 gpm 3.0 gpm	 860 gallons per month 8,600 gallons per month 4,300 gallons per day	Up to $1,700 per month
DRIP IRRIGATION MALFUNCTION	1.0 gpm	43,200 gallons per month	$6,800 per year
UNATTENDED WATER HOSE AT NIGHT	10.0 gpm	5,400 gallons per day	$26,000 per year
BROKEN DISTRIBUTION LINE FOR: One day One week One month	 15.0 gpm 15.0 gpm 15.0 gpm	 21,600 gallons 151,200 gallons 648,000 gallons	Up to $100,000 per year
TEMPERING WATER LINE ON A STEAM STERILIZER STUCK IN THE ON POSITION	2.0 gpm	86,400 gallons per month	$14,000 per year
STUCK FLOAT VALVE IN A COOLING TOWER	5.0 gpm	216,000 gallons per month	$34,000 per year

Source: U.S. Environmental Protection Agency.

* Based on an average rate of $13.11 per 1,000 gallons of water and wastewater determined from data in the American Water Works Association's 2020 Water and Wastewater Rate Survey.

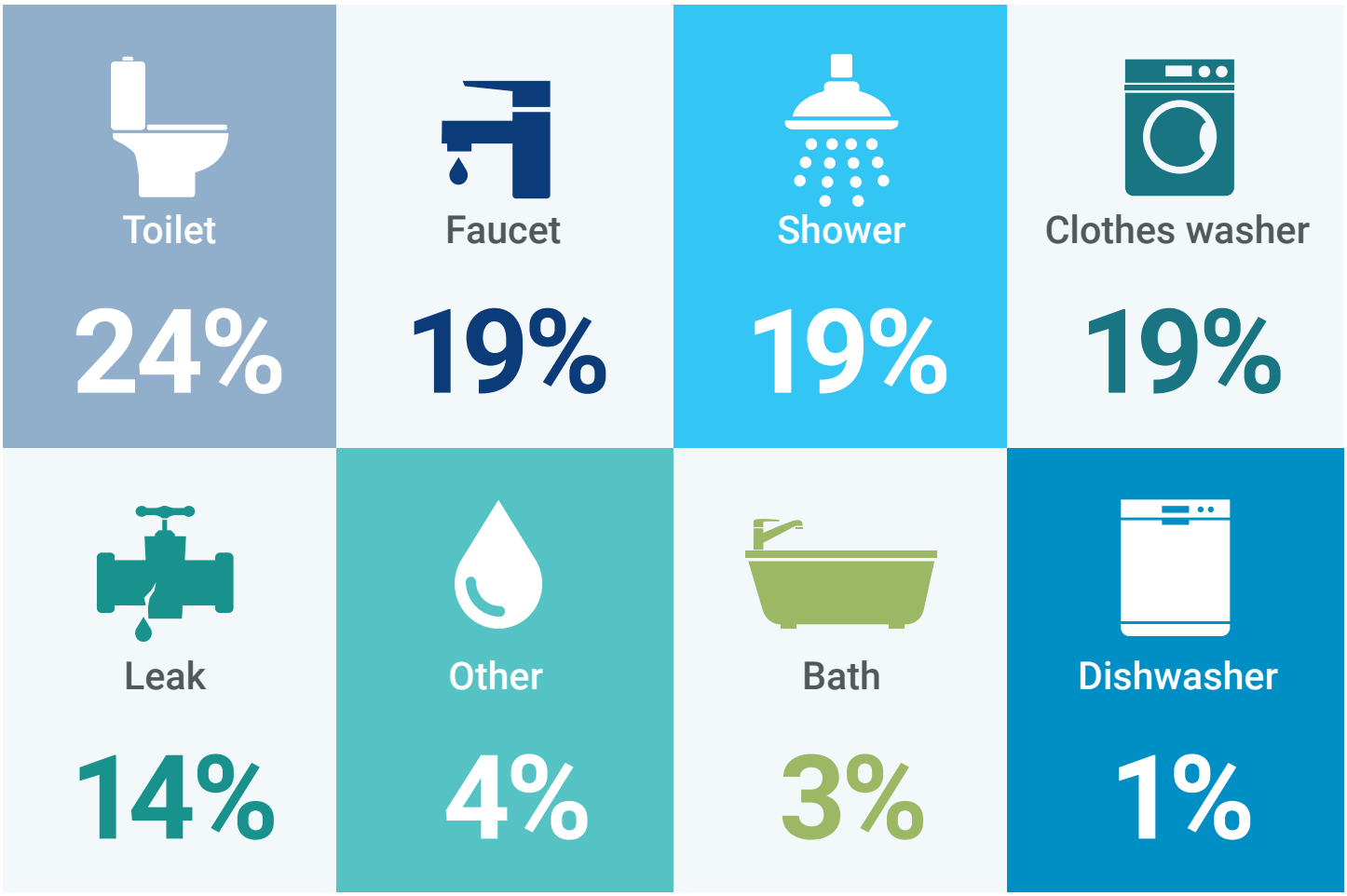
WATER-EFFICIENT FIXTURES AND APPLIANCES

As mentioned earlier, reductions in indoor water use are largely due to more efficient fixtures and appliances.[102] The more properties use water-efficient fixtures and appliances, the more water, energy, and money can be conserved.

See the following resources related to water-efficient fixtures and appliances:

- For a comparison of standards and guidelines for plumbing fixtures and appliances beyond the U.S. National Standards, see this chart by the Alliance for Water Efficiency. These standards and guidelines are part of voluntary programs such as WaterSense and LEED, and codes such as the International Association of Plumbing and Mechanical Officials' Green Plumbing and Mechanical Code Supplement and the International Code Council's International Green Construction Code.
- WaterSense, a voluntary partnership program sponsored by the U.S. Environmental Protection Agency (EPA), is both a label for water-efficient products and a resource for water conservation. The WaterSense label makes it simple to find water-efficient products, new homes, and programs that meet EPA's criteria for efficiency and performance. WaterSense-labeled products and services are certified to use at least 20 percent less water, save energy, and perform as well as or better than regular models.

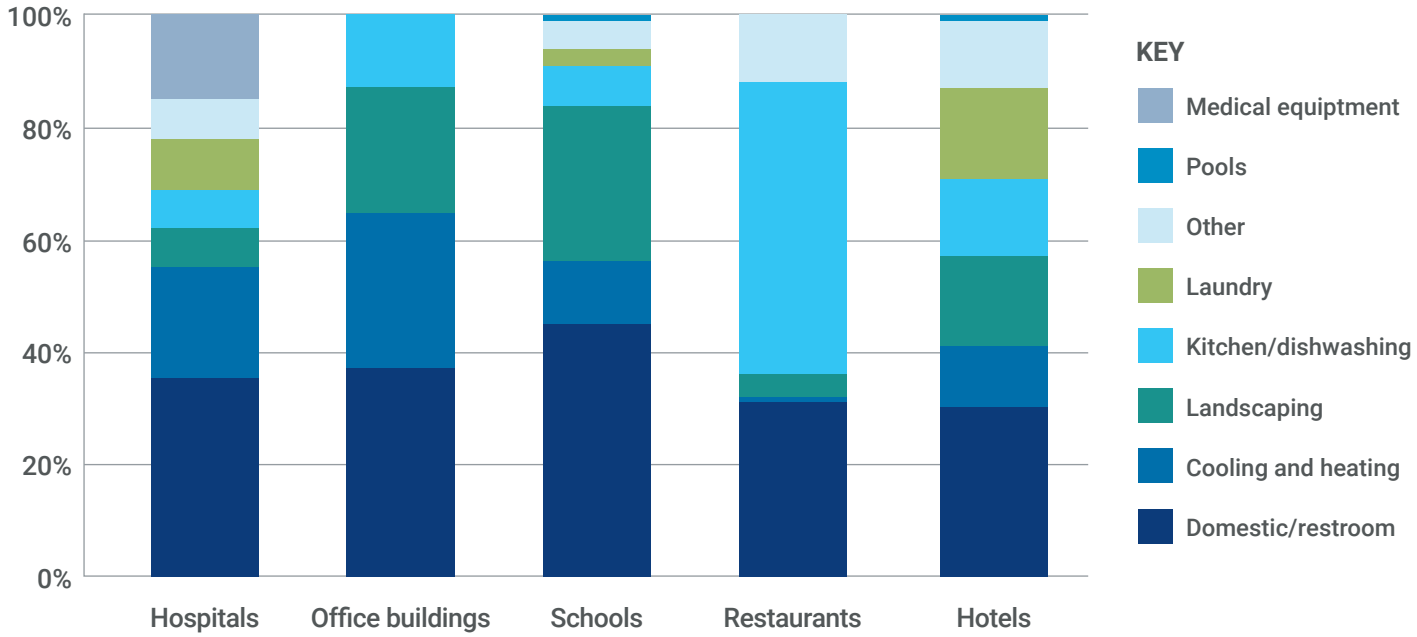
INDOOR PER CAPITA WATER USE BY FIXTURE IN THE UNITED STATES



Source: Water Research Foundation.

Toilet flushing is the largest indoor residential use of water, followed by faucets, showers, clothes washers, leaks, other/miscellaneous, bathtubs, and dishwashers.

WATER USES BY COMMERCIAL AND INSTITUTIONAL FACILITIES IN THE UNITED STATES



Source: U.S. Environmental Protection Agency.

Primary indoor water uses in commercial and industrial facilities include restrooms, cooling and heating, and kitchens.

ESTIMATED WATER SAVINGS FROM RETROFITTING FIXTURES AND APPLIANCES IN NONRESIDENTIAL BUILDINGS

FIXTURE TYPE	ESTIMATED POTENTIAL WATER SAVINGS
TOILETS (TANK AND VALVE TYPES)	20–65%
URINALS	50–100%
FAUCETS 0.5 gpm[1] aerator Sensor control	 30–75% 10–50%
SHOWERHEADS	20–30%
ELIMINATION OF ONCE-THROUGH EQUIPMENT[2]	95–100%
COMMERCIAL DISHWASHERS	15–50%
ICE MACHINES[3]	15–20% or 85–90%

1. gpm (gallons per minute) **2.** includes cooling towers **3.** 15 to 20 percent if replacing an air-cooled unit; 85 to 95 percent if replacing a water-cooled unit (AWUWCD 2006)

Source: South Florida Water Management District.

Replacing older fixtures and appliances with water-efficient alternatives can result in significant water savings.

The bathrooms at the Westin O'Hare, a Clarion Partners hotel, use low-flow toilets and other fixtures that create significant water and financial savings.

Water-Efficient Fixtures Reap Rewards for Clarion Partners' Hotels

A single hotel room uses an estimated average 396 gallons of water per day. In the United States, hotel water usage accounts for about 15 percent of total water use in commercial and institutional real estate. The hospitality industry plays an essential role in advancing water-smart strategies, especially in areas that experience water stress. Real estate investment management company Clarion Partners has 56 hotel properties in its portfolio, which includes over 8,300 guest rooms across 25 states in the United States. As part of a larger renovation program from 2014 to 2018, Clarion Partners replaced bathroom fixtures across its hotel portfolio to improve water conservation and efficiency.

More than 90 percent of hotels in Clarion's portfolio have implemented low-flow toilets, which are estimated to achieve an annual average savings of $9,000 per hotel. Hotels' improved faucet aerators have helped reduce annual water consumption by about 91,000 gallons, equating to an annual average savings of $1,000 per hotel. On top of this, showerheads were also replaced across 95 percent of hotels in Clarion's portfolio. These upgraded showerheads save an astounding 500,000 gallons of water and result in $5,550 in savings. Further, the hot water heater uses less energy when water use is reduced, leading to an additional $1,700 in natural gas savings for a total annual average savings of $17,250 per hotel. Clarion Partners' hotel renovation program demonstrates that seemingly small changes to ubiquitous appliances found in hotel rooms present a massive opportunity to conserve water, energy, and financial resources at scale.

For more information on how to improve the environmental performance of a hotel asset, see ULI's report, *Sustainability in Hotels: Opportunities and Trends Shaping the Future of Hospitality*. The report assesses the state of sustainability in the hotel sector; identifies best practices in energy efficiency, water conservation, and waste reduction; and highlights industry trends to watch.

"Implementing sustainable practices that help our environment while ensuring guest comfort shouldn't have to be mutually exclusive. Hotels host millions of travelers annually, so we have a real opportunity to not only demonstrate that we are taking quantifiable action to improve our planet, but we are doing so in ways that complement the guest experience."

CHUCK LATHEM
Managing Director, Clarion Partners

WATER REUSE

Water conservation and efficiency efforts are the most cost-effective, accessible, and environmentally friendly options for meeting water needs.[103] However, water reuse can be a sensible option in some circumstances, especially for facilities that have large water requirements.

States and municipalities have different rules and regulations about water reuse. For maps of states with water reuse regulations and guidelines, see the EPA's website on water reuse.

Once water efficiency options and local water reuse regulations have been explored, facilities can take advantage of water reuse to further reduce potable water use. Alternative water sources include water discharged from one application or process that is captured, treated, and used for another application.[104] Alternative water sources vary in quality and must be carefully matched with an appropriate end use.[105] The EPA has published guidelines for water reuse to assist identification of potential sources and uses of reused water.[106,107]

Alternative water sources include the following:

- **Reclaimed/recycled/purple pipe water:** Some municipalities offer reuse of reclaimed water from municipal wastewater treatment facilities to help reduce potable water use. Municipally supplied reclaimed water is a more cost-effective option than creating an on-site water reuse system, although each municipality has different parameters for reuse.
- **Rainwater:** Rainwater harvesting has been practiced since pre-historic times. Current rainwater harvesting typically features rain barrels or cisterns that capture runoff from rooftops. Rainwater is commonly used to supplement or replace irrigation water with little treatment or filtering. Because of more frequent, prolonged droughts, it may be advisable to pair rainwater and stormwater collection with other water reuse methods.
- **Stormwater:** Stormwater harvesting refers to rainwater collected from non-roof surfaces, such as parking lots, hardscapes, and landscapes surrounding buildings. Stormwater can usually be captured and distributed to on-site features, such as berms, swales, and rain gardens, or can be diverted to a long-term storage detention pond, where the water can be pumped for landscape irrigation and other uses. The quality of stormwater is more variable than that of rainwater because the former can contain pollutants from the ground.
- **Foundation drain water:** Foundation drains are pipes that are installed in foundations or basements to collect infiltrating groundwater to prevent flooding. While the water typically is moved off site, it can be reused.
- **Graywater:** Graywater is defined as untreated wastewater that has not come into contact with toilet, kitchen sink, or dishwasher waste, or similarly contaminated sources. Graywater includes wastewater from bathtubs, showers, and bathroom wash basins, clothes washers, and laundry tubs. Graywater is usable water that would otherwise be directed to the sewer. If considering installing a graywater treatment system, consult local health and code department officials to ensure that the system meets appropriate regulations.
- **Treated blackwater:** Blackwater is wastewater from kitchen and utility sinks and dishwashers, urinals, and toilets. The on-site treatment of blackwater for reuse requires project-by-project analysis. Many commercial projects have used technologies ranging from septic tanks and near-surface dosing of the effluent for subsurface irrigation to the installation of full-capacity wastewater treatment plants, followed by conventional landscape irrigation. Another example is treating effluent to a quality sufficient for toilet and urinal flushing. Involvement of health department, code enforcement, and water quality officials is vital in the design and development of any blackwater treatment and reuse project to ensure that all applicable public health and environmental concerns are taken into account, that appropriate technologies are used, and that regulations are met.

- **Condensate from air-conditioning equipment:** When water vapor in the air contacts an air conditioner's cooling coils, the water changes from a gas to a liquid, referred to as condensate. This condensate must be removed to prevent water from damaging the equipment or building. Most often, the condensate is captured in a drip pan, where it is then discharged to the sewer system; however, it can also be reused. Condensate is generally high quality and is generated in highest volumes during periods of high cooling loads, making it a good source for cooling tower makeup water.

When to Pursue Water Reuse

The following questions can be used to evaluate when to pursue on-site water reuse:

- ➔ Are there end use(s) that can be substituted or supplemented with the on-site alternative water source?
- ➔ What are the volume requirements of the end use, particularly if the demand is seasonal in nature? Can the on-site alternative water source be matched to meet the demand of the end use in terms of quantity and availability?
- ➔ What are the water quality requirements of the end use? Can the on-site alternative water source meet those requirements?
- ➔ What treatment of the on-site source is necessary? Note that most alternative water sources will require treatment of some kind, ranging from simple filtration to full treatment in compliance with NSF International/American National Standards Institute (NSF/ANSI) 350, Onsite Residential and Commercial Reuse Treatment Systems.
- ➔ What are the basic design factors for capturing and delivering the on-site alternative water source to the end use? This includes the proximity of the source to the end use and piping, tanks, and construction that may be necessary to convey the water.

Source: the U.S. Environmental Protection Agency's "WaterSense at Work" report.

- **Cooling equipment blowdown:** Water that is drained from cooling equipment to remove mineral buildup is called blowdown water. The cooling equipment that requires blowdown is most often cooling towers, evaporative air condensers, evaporative coolers, evaporative cooled air conditioners, and central boilers. Although blowdown water is usually discharged to the sewer, it is often of sufficient quality for irrigation. Blowdown water could be treated to make it suitable for other uses, particularly for reuse as makeup water for the cooling equipment.
- **Filter and membrane (e.g., reverse osmosis system) reject water:** Water treatment systems, such as reverse osmosis systems that use filters and membranes to remove impurities, will have residual water that remains after the purified water has gone through the membrane. This residual water is less clean than the source water that entered the system but can still be reused for other purposes. Residual water can be appropriate for uses requiring higher water quality, such as toilet and urinal flushing, cooling equipment makeup water, irrigation, ponds, fountains, and waterfalls, or other processes or uses not requiring potable water.

Potential uses of water from alternative on-site sources include:

- Irrigation;
- Cooling tower makeup water;
- Toilet and urinal flushing;
- Makeup water for decorative ponds, fountains, and waterfalls;
- Processes or other uses not requiring potable water; and
- Fume hood scrubbers.

The following charts show water quality considerations for each on-site alternative water source and potential treatment options for intended end uses based on their water quality requirements. While each situation is unique, these charts provide guidance on typical considerations.

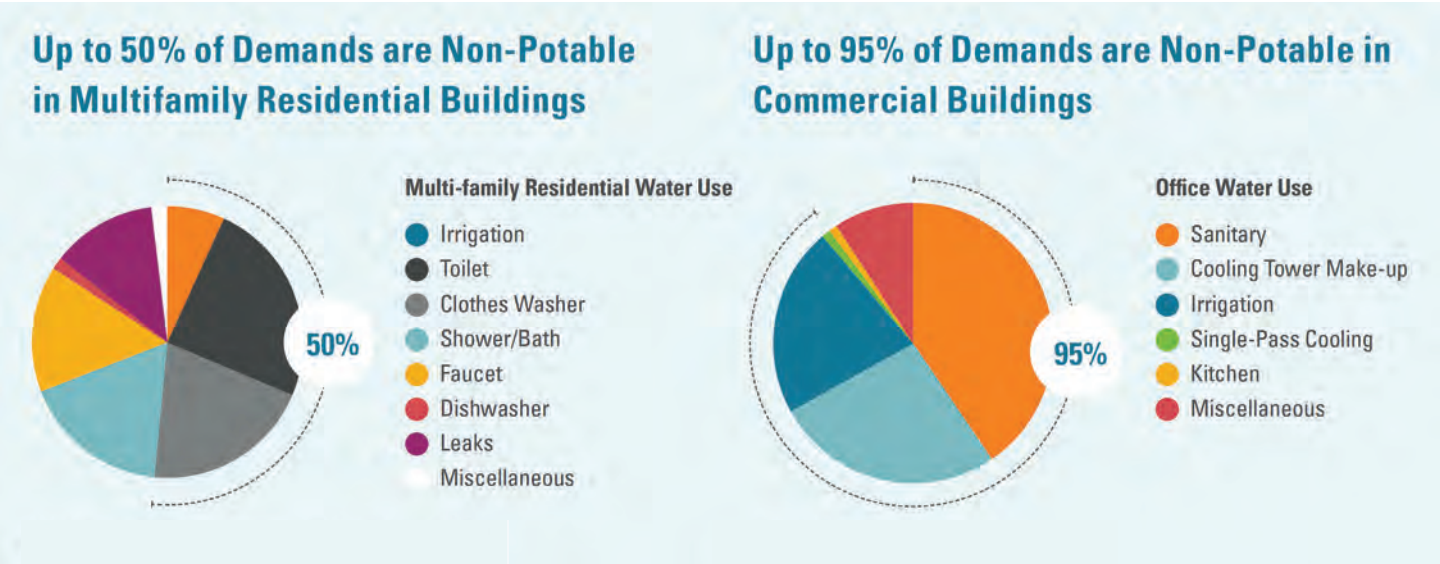
WATER QUALITY CONSIDERATIONS FOR ON-SITE ALTERNATIVE WATER SOURCES

POSSIBLE SOURCES	LEVEL OF WATER QUALITY CONCERN					
	SEDIMENT	TOTAL DISSOLVED SOLIDS (TDS)	HARDNESS	ORGANIC BIOLOGICAL OXYGEN DEMAND (BOD)	PATHOGENS (A)	OTHER CONSIDERATIONS
RAINWATER	Low/Medium	Low	Low	Low	Low	None
STORMWATER	High	Depends	Low	Medium	Medium	Pesticides and fertilizers
AIR HANDLING CONDENSATE	Low	Low	Low	Low	Medium	May contain copper when coil cleaned
COOLING TOWER BLOWDOWN	Medium	High	High	Medium	Medium	Cooling tower treatment chemicals
REVERSE OSMOSIS AND NANOFILTRATION REJECT WATER	Low	High	High	Low	Low	High salt content
GRAYWATER	High	Medium	Medium	High	High	Detergents and bleach
FOUNDATION DRAIN WATER	Low	Depends	Depends	Medium	Medium	Similar to stormwater

KEY **Low:** Low level of concern **Medium:** Medium level of concern; may need additional treatment depending on end use **High:** High concentrations possible and additional treatment likely **Depends:** Dependent upon local conditions **(A):** Disinfection for pathogens is recommended for all water used indoors for toilet flushing or other uses

Source: U.S. Environmental Protection Agency.

Note: Single pass cooling water is also a possible source of clean on-site water, but facility managers should first consider eliminating single-pass cooling because of its major water-wasting potential. For that reason, it is not included in the list.



Source: William J Worthen Foundation.

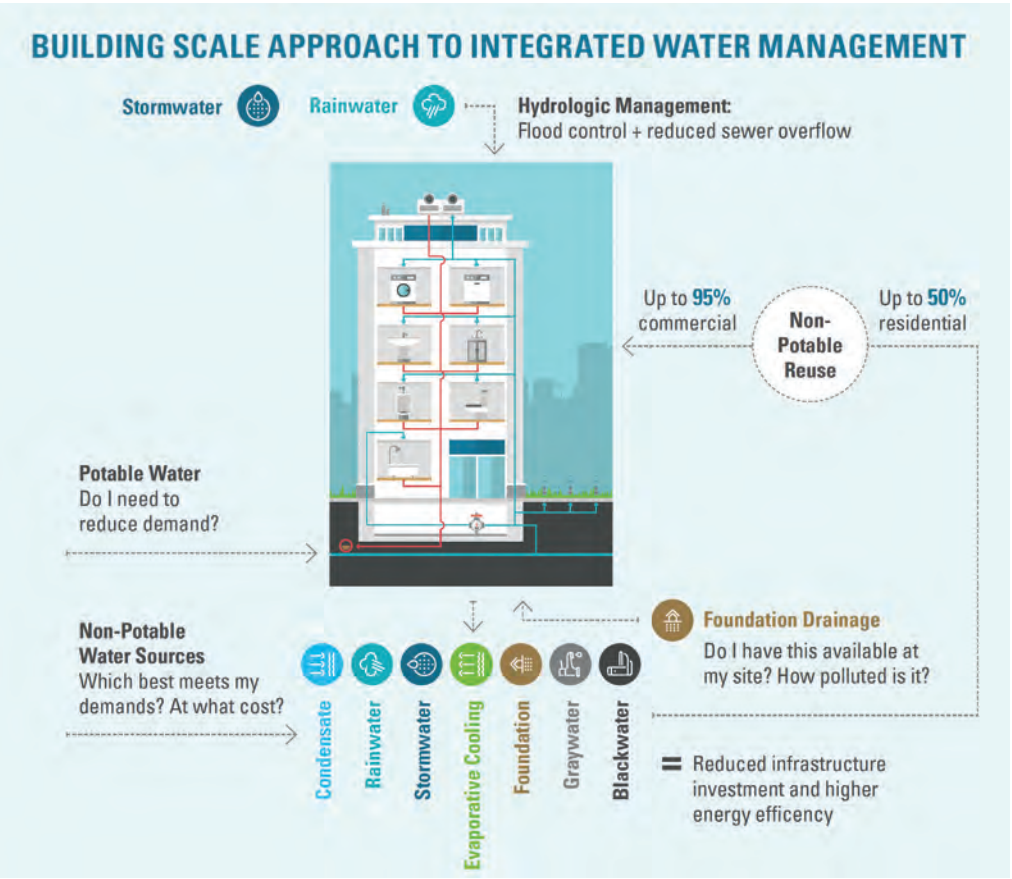
Since 50 to 95 percent of water demands in commercial buildings do not require potable water, non-potable water reuse provides excellent opportunities for additional water.

TYPES OF AVAILABLE TREATMENT BASED ON INTENDED END USE QUALITY NEEDS

POSSIBLE SOURCES	FILTRATION	SEDIMENTATION	DISINFECTION	BIOLOGICAL TREATMENT	OTHER TREATMENT CONSIDERATIONS
RAINWATER	Depends	Depends	Depends	No	May be used for irrigation without additional treatment
STORMWATER	Yes	Depends	Depends	Depends	For non-potable use only
AIR HANDLING CONDENSATE	No	No	Yes	No	Segregate coil cleaning water
COOLING TOWER BLOWDOWN	Depends	Depends	No	No	Consider TDS monitoring
REVERSE OSMOSIS AND NANOFILTRATION REJECT WATER	No	No	No	No	Consider TDS monitoring
GRAY WATER	No	Depends	No	Depends	Biologically unstable for long periods of storage unless treated; subsurface drip irrigation requires the least treatment
FOUNDATION DRAIN WATER	Depends	No	Depends	No	May be hard if in alkaline soils

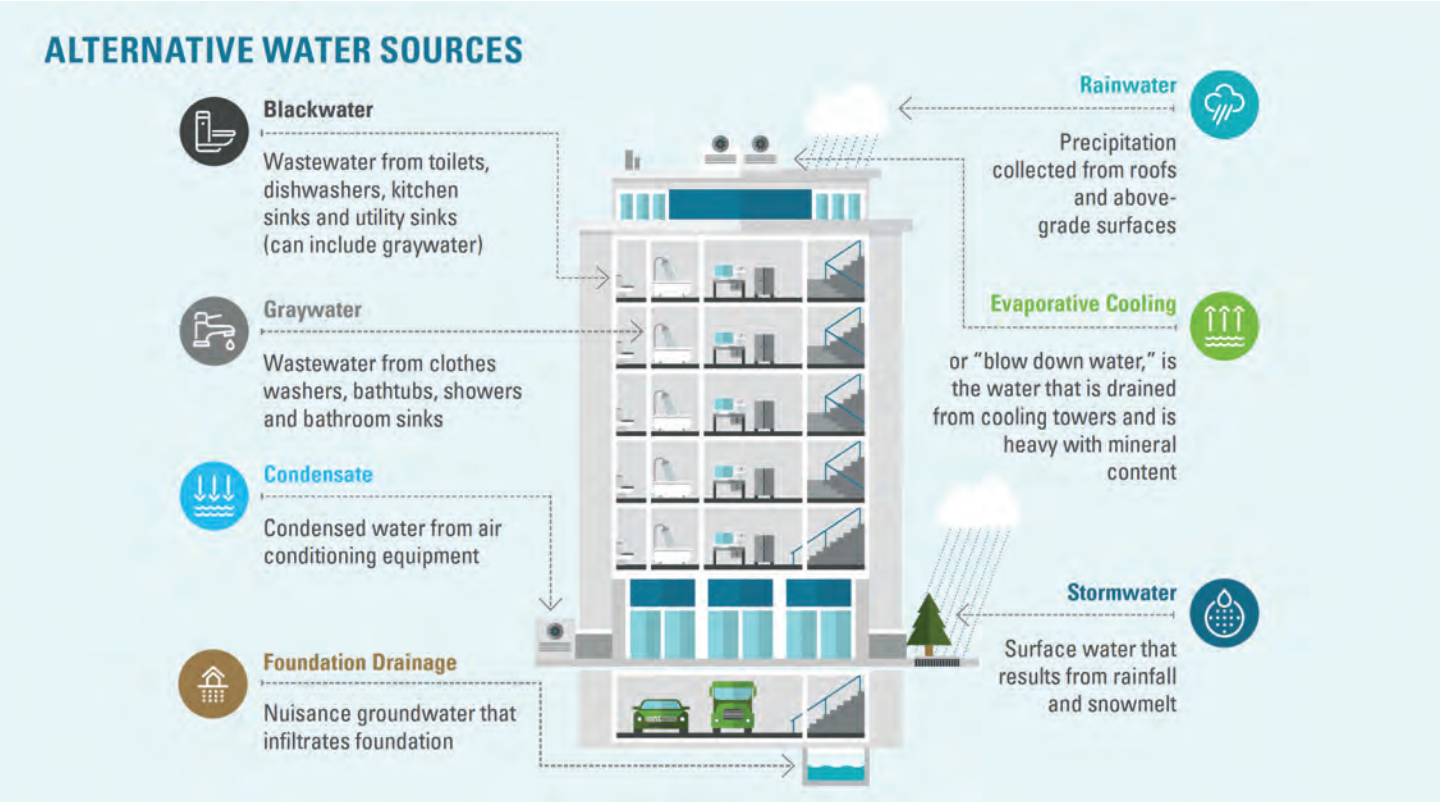
KEY **Yes:** Level of treatment likely needed **No:** Level of treatment not likely needed **Depends:** Treatment depends upon ultimate use

Source: U.S. Environmental Protection Agency.



Choosing the right water source for each end use involves assessing potential water sources and demands in an integrated approach that supports the project's water management goals.

Source: William J Worthen Foundation.



Source: William J Worthen Foundation.

This diagram shows the main alternative water sources available in a typical urban building.

Since each site's ability to capture and convey on-site alternative water sources varies, it is wise to evaluate the feasibility of potential sources to determine cost implications and payback periods. On-site water treatment and reuse systems can require significant design effort and upfront costs. Operating and maintenance costs for more involved systems can also be high, with system payback potentially extending for many years.[108] These systems can also become contaminated if mismanaged. Despite these potential challenges, the global market for wastewater recycling and reuse technologies is estimated to grow from $21.3 billion in 2021 to $40.5 billion by 2026.[109]

For more information about the specific considerations for each type of alternate water source and methods for reuse, see the following resources:

- U.S. Environmental Protection Agency's Water Reuse website includes guidelines for water reuse, maps of states with policies and regulations related to water reuse, and many more resources related to water reuse.
- U.S. Federal Energy Management Program's Alternate Water Sources website provides alternative water source maps and tools that help with planning where to implement alternative water projects.
- NSF International/ANSI 350: Onsite Residential and Commercial Reuse Treatment Systems establishes minimum materials, design and construction, and performance requirements for on-site residential and commercial water reuse treatment systems.
- The International Association of Plumbing and Mechanical Officials' Water Efficiency and Sanitation Standard provides guidance on the construction, alteration, and repair of alternative water source systems for non-potable water applications.
- The Onsite Non-Potable Water Reuse Practice Guide, developed by the Worthen Foundation in partnership with a variety of industry and institutional partners, provides information, step-by-step guidance, and examples for water use systems of all types and scales.
- The WateReuse Association is a nonprofit trade association for water utilities, businesses, industrial and commercial enterprises, nonprofit organizations, and associations that focuses solely on advancing laws, policy, and funding to increase water reuse.
- The Alliance for Water Efficiency provides information and resources related to water reuse.

Native plants and cottonwood groves are featured in the park spaces of RiNo ArtPark in Denver, Colorado, connecting the park to the adjacent South Platte River and contributing to the neighborhood's stormwater system.

Outdoor Strategies

Outdoor water use accounts for a significant portion of a site's total water use. Average outdoor water use for single-family homes across the United States accounts for around 30 percent of residential water use.[110,111] Throughout arid and semi-arid regions of the western United States, however, watering residential landscapes is the single greatest household use of water, often accounting for more than 50 percent of household annual water consumption.[112] While outdoor water use for commercial properties differs based on property type and the size of the landscape, it tends to follow the same trends based on local climate.[113]

Cities with the highest levels of per capita water use are dominated by residential areas with turfgrass and water-thirsty landscapes.[114] Local weather conditions, the size of the irrigated area, the cost of water, and the types of plants are all major drivers of outdoor water use.[115] By altering outdoor water use, significant water savings are possible, with estimates ranging from 35 to 75 percent of current per capita water use.[116] Since outdoor use is typically more flexible than indoor use, it provides excellent opportunities for water conservation.

Water-smart and drought-resilient landscaping includes everything from soil preparation and the selection of plants to the installation and maintenance of irrigation systems, green infrastructure, and permeable hardscapes. These strategies have a variety of benefits, including reduction of water demand, productive use of stormwater, decreased flood risk, and recharge of groundwater and other natural ecosystems.

Fundamentals of Water-Wise Landscaping

The basic blueprint for designing and maintaining a water-efficient landscape can be summed up in eight steps.

1. **Group plants according to their water needs.** Place native and drought-tolerant plants together, separating them from thirsty ones. This is called hydrozoning, and it makes irrigation easier and more water efficient.
2. **Use native and low-water-use plants.** Native species include an abundance of turfgrasses, shrubs, perennials, ornamentals, trees, and other plants that can thrive in their native or adaptive environments with little or no water other than rainfall once they have become established.
3. **Limit turf areas to those needed for practical uses.** Lawns claim the lion's share of landscape irrigation water. By limiting turf to areas used for recreation and other functional purposes, customers can reserve the rest of the landscaped area for alternative plants that are beautiful but less water-needy and easier to maintain.
4. **Use efficient irrigation systems.** If a landscape requires watering, at least be sure the irrigation system is as efficient as possible. Well-designed and well-installed irrigation systems, drip rain sensors, automatic shutoff valves, properly programmed controllers, and regular maintenance of hoses and sprinkler heads are essential components of an efficient irrigation system.
5. **Schedule irrigation wisely.** Even the most water-efficient irrigation system can waste water because the amount of water it uses depends on how often and how long it is allowed to run. Watering once, possibly twice, a week for 15 to 30 minutes is adequate for most residential landscapes, particularly those that are not accustomed to being waterlogged. Lawns and plants that have been overwatered often need to make the transition to receiving less water slowly to avoid shock. Once they have been properly "water-stressed" and have deeper roots, they should be able to get along with less water.
6. **Make sure soil is healthy.** Healthy soil is like a great pair of shoes for plants—it will anchor and support them so they can thrive. Healthy soil amended with organic matter such as compost and other nutrients helps plants retain moisture and resist evaporation. Soil that gets compacted, like that under turf or in other areas used for walking, should be aerated occasionally with a pitchfork or other equipment.
7. **Remember to mulch.** Place mulch over the soil around plants (leaving some space around the trunk) to reduce evaporation, limit heat stress, and inhibit weed growth. Organic mulches include compost, shredded bark, leaves, and sawdust.
8. **Provide regular maintenance.** All landscaped areas need maintenance to look good and stay healthy, plus maintenance helps minimize water use. Control weeds so they will not steal water from cultivated plants. Minimize the use of fertilizer to avoid plant overgrowth and increased water needs. Repair hose and sprinkler-head leaks. Make sure your irrigation system is programmed properly and is adjusted in response to changing temperatures and rainfall over the seasons.

Source: Amy Vickers, *Handbook of Water Use and Conservation* (WaterPlow Press, 2001).

Soil needs to be healthy to absorb water, enable plant life, and support buildings without damaging foundations.

HEALTHY SOIL

With increasing drought and aridification, soil is increasingly at risk of losing the vitality that allows it to support life. Soil needs to be healthy to absorb water, enable plant life, and support buildings without damaging foundations. Healthy soil also happens to be one of the Earth's largest carbon sinks.[117] Once soil is dried out and depleted of nutrients, flood and erosion risks increase, and the many benefits of healthy soils are lost.

The best way to prevent structural damage during a drought is to maintain healthy soil. When soil becomes extremely dry, it contracts. This is known to cause foundation settlement and cracking in areas with clay soil unless action is taken.[118] To keep soil properly hydrated, landscape with shrubs and other small plants around foundations and mulch and water them efficiently. Plant roots hold the surrounding soil in place and keep it from pulling away from the foundation. Plants and mulch also shade soil and slow evaporation. More information about plant selection and water-smart irrigation are in the following sections.

The best ways to support healthy soils include the following:

- **Soil testing:** To determine soil quality and composition, conduct soil testing. Lab testing is offered by many university extension offices. Soil acidity can also be measured with a soil meter on site. Once more is known about the soil, then appropriate amendments can be added.
- **Soil amendment:** Healthy soil retains water—reducing irrigation needs—and better supports plant life. Soil amendments include organic materials and minerals, like compost and lime, respectively, that can be used to adjust soil composition and acidity. Reducing or eliminating the use of fertilizers, pesticides, herbicides, and fungicides minimizes the risk of groundwater contamination and reduces irrigation requirements.[119,120]
- **Reduce compaction without tilling:** Aerators can be used to reduce soil compaction without tilling, which causes erosion, evaporation, and greenhouse gas release from soil.[121] To further avoid these issues and maintain a site's soil health, it is advisable to stockpile topsoil during construction and grading and then to return the nutrient-rich topsoil during the final grading process.[122,123]
- **Mulch:** Mulch slows down evaporation and protects plant roots from high and low temperatures. Organic mulches absorb moisture and retain it longer than soil that has not been mulched. Mulching also helps prevent weed growth and can protect against erosion. In drought conditions, organic mulch is recommended over rocks, which increase soil temperatures and contribute to urban heat island effects, affecting soil and plant health.[124] Rocks, however, can be useful within a five-foot perimeter around structures to resist wildfire damage.

NATIVE AND DROUGHT-TOLERANT PLANTS

Plants have a significant effect on the amount of irrigation required and the overall water use of a site. Studies have shown that water-smart landscaping can achieve a 20 to 50 percent reduction in water use compared to conventional landscaping practices—savings that are frequently accompanied by a reduction in landscape maintenance and chemical costs.[125,126,127]

Native and climate-appropriate plants that are adapted to the local environment require less water, are more likely to survive drought conditions, and are more pest and disease tolerant than non-native species.[128] Reducing the amount of turfgrass and irrigated areas reduces water consumption and costs and results in time and dollar savings from mowing, applying pesticides and fertilizer, waste removal, and maintenance.[129] Throughout the United States, water-intensive landscapes are being replaced with water-efficient and climate-appropriate landscapes.[130,131]

"I'm optimistic that the world of native plants will not only survive, but will thrive for environmental and economic reasons, and for reasons of the heart. Beauty in nature nourishes us and brings joy to the human spirit; it also is one of the deep needs of people everywhere."

LADY BIRD JOHNSON
Lady Bird Johnson Wildflower Center

In areas where water-thirsty Kentucky bluegrass is still considered normal, signage can help explain native and drought-tolerant landscaping to residents and visitors. Northern Water in Colorado has created sign templates that can be installed in landscapes to highlight native grass areas, water-smart planting areas, and wetlands areas. Demonstration gardens can also be used to show compelling low-water landscapes and gain buy-in. As an example, the Lady Bird Johnson Wildflower Center in Austin, Texas, has demonstration gardens that were created to inspire the conservation of native plants, accompanied by research, education, and outreach programs, including a native plant database.

In terms of the costs of conversion to water-smart landscaping, developers and owners have stated that with lower water bills and available incentives, it is not uncommon to recover costs within a single year.

What to Plant in Your Area

Each state and even areas within states differ in their ability to support different plant species without the need for supplemental water and fertilizers.

The EPA WaterSense program lists resources for native and climate-appropriate plants by state and nationwide.

For more information and to search the database, visit www.epa.gov/watersense/what-plant.

The Lady Bird Johnson Wildflower Center in Austin, which is designated as the State Botanic Garden and Arboretum of Texas, brims with more than 970 unique species of native Texas plants.

Drip irrigation is one type of water-efficient irrigation available.

WATER-SMART IRRIGATION

Many native and drought-tolerant plants can survive with little to no supplemental irrigation; however, irrigation systems and devices can be tailored to apply supplemental water only when and where it is needed.

Water-efficient irrigation options include:

- **No supplemental irrigation:** Relying on rainwater to irrigate landscaping is the most cost-effective and water-saving option, made possible with the use of native and drought-tolerant plants. During droughts, it is common for irrigation restrictions to be instated. Without the need for supplemental irrigation, native and drought-tolerant landscapes will thrive regardless of restrictions.
- **Water reuse:** Why use potable water for landscaping? See the "Water Reuse" section of this report for more information about possible alternative on-site water sources for irrigation.
- **Manual irrigation:** Manual irrigation is usually the most water-efficient but time-intensive standard irrigation option since water is delivered exactly when and where it is needed.
- **Automatic irrigation:** Well-designed automatic irrigation systems can be water-efficient, but this requires correct installation, programming of the controller, and regular inspection and maintenance.

Automatic irrigation systems are usually not programmed for optimal water efficiency, which can lead to substantial water waste. Measures that can improve the water efficiency of irrigation include improved irrigation system placement, sensors that shut off irrigation systems when it rains, soil moisture sensors, weather-driven irrigation system programming, automatic hose-shutoff nozzles, soaker hoses, drip irrigation, improved sprinkler heads, rainwater harvesting, cisterns, leak repair, and regular maintenance. Most efficiency upgrades for irrigation systems are highly cost-effective and lead to significant water savings For example, many WaterSense-labeled irrigation controllers cost less than $200 and save as much as 50 percent of water through hyperlocal weather forecasting and hydrozone programming.[132] Conversely, the costs of overwatering include not just the cost of the wasted water, but also the damage resulting from overwatering, which can include both plant and structural damage.[133]

Water-efficient irrigation scheduling involves setting the frequency and duration of irrigation according to plant water requirements and site-specific details such as microclimates. Knowing when and how much water is needed for each hydrozone and adjusting irrigation schedules based on changing plant, weather, and seasonal characteristics is essential for efficient water use and plant health. While there is no single right way to schedule irrigation effectively, many irrigated landscapes can thrive on a watering schedule of once or twice per week for 15 to 30 minutes. Irrigating in the early morning can help limit evapotranspiration. Watering like this can allow plants, including grass, to develop deeper roots that allow them to survive on less water, even during droughts.[134]

GREEN INFRASTRUCTURE

As climate change increases precipitation variability, many places experience dramatic swings between droughts and extreme precipitation.[135] Places plagued by drought face an increased risk of flooding during periods of increased precipitation because hard-packed, dried-out soil lacks the ability to absorb water, leading to flash floods and mudslides. These extremes create the need for strategies that enable community resilience in the face of both droughts and floods. Green infrastructure is one of those key strategies.

Green infrastructure is used as a catchall term for approaches to managing stormwater with natural systems as an alternative to traditional gray drainage infrastructure, such as pumps and pipes.[136] Green infrastructure includes rain gardens, bioswales, berms, tree pits, natural retention and detention ponds, blue and green roofs, rainwater and stormwater cisterns, and permeable pavement. These natural drainage systems capture, retain, filter, and slow the release of stormwater, using the storage, infiltration, evaporation, and carrying capacity of distributed natural elements rather than buried pipes.[137] According to the conservation organization American Rivers, green infrastructure can "provide clean water, conserve ecosystem values and functions, and provide a wide array of benefits to people and wildlife."[138]

Green infrastructure can also enhance the attractiveness and value of properties and reduce operating costs.[139] Using green infrastructure can be a more cost- and space-efficient means of stormwater management than gray infrastructure.[140] It offers cost savings by lowering infrastructure and water costs and freeing up more developable land than traditional water management solutions.[141] In addition, green infrastructure provides attractive landscape amenities, reduces the need for potable water use, lowers the urban heat island effect and stormwater runoff, improves water quality, decreases flooding, sequesters carbon, and recharges needed groundwater reserves.

Overall, green infrastructure has the capacity to protect and even regenerate natural systems while providing value to humans.[142]

"We need to be doing more to work with the land, not against it. Returning water back to the land and not losing it down a storm sewer is a strategy we all have to think about."

SUSAN MAXMAN
President, Susan Maxman & Partners, Architects

Harvesting the Value of Water

ULI's report *Harvesting the Value of Water: Stormwater, Green Infrastructure, and Real Estate* explores the real estate sector's increased participation in stormwater management through the incorporation of green infrastructure. It provides information about green infrastructure, its business case, and project profiles.

Drought-tolerant plants and a cistern that captures rain and air-conditioning condensate for irrigation help protect the park amenity at the Residences at La Cantera from drought.

Water-Wise Landscaping at the Residences at La Cantera

Knowing that drought in San Antonio "is a way of life," as noted by Hailey Ghalib, managing director of USAA Real Estate, the project team for the Residences at La Cantera set out to ensure that water conservation would be embedded at the Residences. The four-story, 425,697-square-foot multifamily building holds 323 apartments and 3,700 square feet of retail space and is situated in the 150-acre master-planned community of La Cantera. In the surrounding master-planned community, USAA Real Estate and the Cambridge Development Group created an attractive resort landscape to enhance residents' and visitors' overall experience of the space without compromising the need to conserve water, given the region's vulnerability to droughts and extreme temperatures.

J. Robert Anderson Landscape Architects brought to life an innovative landscaping strategy around the 1.5-acre park on the site featuring a plaza, lawn space, adventure playground, pond, and picnic areas. The team grew native and drought-tolerant plants and installed mulched landscape beds that were at least four inches deep to retain moisture from irrigation. A 10,000-gallon cistern next to the site's wet pond captures rooftop runoff and condensate from air-conditioning equipment piped from the site's buildings. The water collected is then used to irrigate the park and renew the pond's water source.

These strategies have also created opportunities for the team to focus on key climate resilience metrics informing this and future projects. For example, the cistern was retrofitted to monitor water levels and the amount of water being added on a daily basis, helping the team understand that watering requirements range from 1,000 to 4,000 gallons a day. Since the cistern collects up to 4,500 gallons a day, owners can be confident that they can meet their irrigation needs moving forward. While the Residences' smart water techniques translate to building physical resilience to droughts, the annual cost savings benefit the owners and users alike as the site saves an estimated $8,840 in annual water charges by using air-conditioning condensate and collected stormwater to help irrigate its surrounding landscape. The owners also estimated $500,000 in added asset value.

> "Drought in San Antonio is a way of life and addressing that within the building design made total sense to us."
>
> **HAILEY GHALIB**
> Executive Managing Director and Head of Housing Investment and Development, USAA Real Estate

Ongoing property and water management is critical for maintaining water efficiency over time.

Ongoing Property and Water Management Strategies

One concern echoed by a variety of developers is that they could create the most water-efficient property in the world, but without appropriate operations and maintenance, that property will likely lose its water efficiency. The incentives to maintain water efficiency grow over time as the water savings add up, but education of and communication with property owners, managers, tenants, and others is crucial for reducing the water footprint of real estate.

ONGOING WATER MANAGEMENT

To maintain or improve a property's water efficiency over time, ongoing water management is essential. Water management addresses water use in four primary areas:

- Reducing water losses (e.g., leaks);
- Increasing the water efficiency of fixtures, equipment, systems, and processes;
- Educating colleagues and occupants about water efficiency to encourage water-saving behavior; and
- Managing on-site water reuse processes (e.g., reusing treated graywater or rainwater for landscape irrigation).

Water Tracking Tools for Benchmarking and Evaluation

Energy Star Portfolio Manager is a free online tool for tracking and benchmarking building water and energy use, as well as waste, material, and greenhouse gas data over time.

EcoLab's Smart Water Navigator is a publicly available tool that helps businesses understand water-related risks in financial terms to inform responsible growth and generates an actionable step-by-step guide for each facility, tailored by industry, location, and current water performance. This process includes identifying water-related business risks, setting water withdrawal targets, implementing practical projects to advance corporate water targets, and tracking performance over time.

U.S. Green Building Council's Indoor Water Use Reduction Calculator and Outdoor Water Use Reduction Calculator are spreadsheet models that can be used to track water use from plumbing fixtures and irrigation.

The Federal Energy Management Program developed the Water Balance Tool to provide a free online method for estimating potable water consumption across multiple end uses at the building and campus levels. The final water balance provided by the tool helps users identify the highest-consuming end uses, assisting with prioritization of water-saving opportunities.

The WaterSense Water Budget Tool can be used to ensure a measure of efficiency and regional suitability for the amount of water applied to a landscape based on local climate data.

Effective water management is easily paired with energy and waste management. Water management follows the same framework used in the Energy Star Guidelines for Energy Management prepared by the U.S. Environmental Protection Agency (EPA) and the U.S. Energy Department (DOE), and consists of these seven steps provided by the EPA's WaterSense at Work guide:

1. **Make a commitment:** Any water management program's success relies on its organization's long-term commitment to use water more efficiently. Commitment should come from all levels within the organization to ensure that water management goals are established, and that continuous improvement is made. A team leader is necessary to advocate for improvements, provide guidance, maintain momentum, support project implementation, and celebrate successes.
2. **Assess water use:** Reviewing how water is actually used is essential for water management. A water assessment accounts for all known water uses. It allows the water management team to establish a baseline from which progress can be measured and an annual water budget. It also enables the water management team to set achievable goals and identify and prioritize projects based on water savings opportunities and cost-effectiveness.
3. **Set and communicate goals:** On the basis of a solid understanding of current water use, key decision makers and the water management team can work together to set water management goals and policies. It is highly recommended to include employees from all different parts of the organization in this process to obtain a range of perspectives and promote a sense of ownership. The goals and policies must then be communicated to the entire organization with the support of leadership to give legitimacy to the policies and priorities. A feedback mechanism can be instituted to encourage input, suggestions, and reporting of problems.
4. **Create an action plan:** The water management team can create a detailed action plan with the guidance of the water assessment. The action plan typically includes prioritized projects and changes in operation and maintenance that address the opportunities for improvement identified during the water assessment and that can help achieve established water management goals. Creating an action plan includes the following steps: identifying projects and calculating costs and potential savings; identifying financing sources; calculating simple payback (see the "Calculating Savings" section of this report for more information); and prioritizing projects.

As of 2021, Kilroy Realty's stabilized real estate portfolio reduced water consumption by 17 percent from 2015 levels using a variety of indoor and outdoor water conservation strategies, including water-efficient irrigation and low-flow fixtures.

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Signage can be used to inform visitors, tenants, and staff about water conservation efforts, like these signs for drought-tolerant landscaping.

5. **Implement the action plan:** The water management team can then develop a prioritized implementation strategy for the action plan, which can significantly increase the chances of project success and goal achievement. This could include rallying support for specific projects and practices.
6. **Evaluate progress:** The water management team should periodically conduct a formal review of water use data and action plan implementation in the context of progress toward established water management goals. This review enables the organization to evaluate progress, set new goals, and consistently improve. The water management team can also use the review to promote successes of the water management program, which can encourage long-term support for the program and future projects and initiatives.
7. **Recognize achievements:** To gain and sustain support for the water management program, the water management team can provide recognition for water management activities and achievements. This could include recognizing the contributions of those who have helped with progress toward and achievement of water management goals, as well as promoting successes of the program both internally and externally.

Tips for Water Action Plan Implementation

To maximize the potential for success when implementing the water action plan, consider the following:

- ➔ Ensure that the necessary resources, such as time, money, and personnel, are available to complete projects and practices included in the action plan.
- ➔ Complete identified projects and practices in order of priority.
- ➔ Promote key components of the action plan to employees and other relevant stakeholders to gain support for specific projects.
- ➔ Create incentives to encourage staff or those responsible for specific projects and practices to take action and do their part to help achieve water management goals.
- ➔ Be creative and consider other resources that may be available to assist in implementation, such as other employees, utility and government programs, interns, and engineering students.
- ➔ In the event of a drought or other water-related emergency, implement measures specified in an emergency contingency plan.

For more information and tips, see the U.S. EPA's WaterSense at Work guide.

DENVER WATER

Denver Water has invested in award-winning signage and public education to advance water conservation.

USER EDUCATION AND OUTREACH

Water conservation is not only made possible by the facility and its systems, but it also relies on the behaviors of people within those systems. Studies show that efforts to enhance community awareness and provide information about water conservation lead to increased adoption of water-conserving practices.[143,144,145] Educating property owners, managers, contractors, tenants, visitors, and other water users about water scarcity issues and the impact of their water use on water and energy resources is a key component of any water management and conservation program.

Offering simple, straightforward ways in which users can help reduce water use, along with good reasons for doing so, is a cost-effective way to enhance water conservation efforts. Even small changes in user behavior can result in significant water savings.[146] Some methods for communicating about water conservation and water saving tips follow.[147]

Outreach to employees and occupants:

- Share management's commitment to water conservation and the organization's water management program through meetings, events, posters, emails, newsletters, and other communications. Include specifics on water conservation goals, and create a culture of pride around water-efficient practices.
- Graph and post monthly water use figures so that building employees and occupants can stay informed about progress toward goals and become invested in water conservation efforts.
- Create point-of-use reminders and tips to reinforce water-saving behaviors (e.g., signage with instructions next to dual-flush toilets). Place signs on new water-efficient equipment and submeters about how to use them.
- Train maintenance personnel, operators, and supervisors on any new or revised procedures involving water conservation and on the use of new water-efficient technology and equipment. Ensure that relevant manuals, including irrigation control system manuals, are saved and shared with users over time.

- Encourage communication between property managers when there is a property sale to ensure that the property's water efficiency continues.
- Encourage relevant custodial, cleaning, and maintenance personnel, as well as everyday users, to identify and report leaks. Make it easy to report problems by setting up a user-friendly communication system such as a hotline. Ensure that leaks are repaired promptly.
- Institute a suggestion and incentive system to acknowledge and encourage water savings. For best results, respond to submissions and provide information on how suggestions are addressed.
- Provide robust homeowner maintenance guides with new homes. Include information about how to shut off the water in the case of an emergency.
- To help occupants learn more about how they can be water-efficient at work and home, direct them to the EPA's WaterSense website for more information.

Outreach to visitors and external audiences:

- Work with local utilities to participate in commercial and institutional water conservation programs and with other facilities to share and learn from success stories.
- Create displays highlighting water saving strategies in public areas, such as lobbies, water-smart landscapes, and bathrooms. Include information about why water conservation is important and resulting savings and benefits.
- Use signage, brochures, and other promotional materials to inform visitors, customers, and others about the organization's water conservation program and actions people can take in restrooms and other areas to save water.
- Train leasing staff to be able to speak to potential tenants about the benefits of water-efficient features.

Tips for Water Management Achievement Recognition

A few ways to recognize water management efforts include:

- ➔ Establish an internal recognition program to award personnel or teams that provided significant contributions toward achieving water management goals.
- ➔ Respond to suggestions and reports of issues to encourage all parts of the organization to participate in the efforts.
- ➔ Explore opportunities for external recognition, such as the WaterSense Partners of the Year Award, which recognizes top water savers.
- ➔ Report progress publicly to interested stakeholders to gain support for initiatives and recognition for water-efficiency achievements.
- ➔ Report progress to facility staff and building occupants by using a newsletter or other means of outreach.

For more information and tips, see the U.S. EPA's WaterSense at Work guide.


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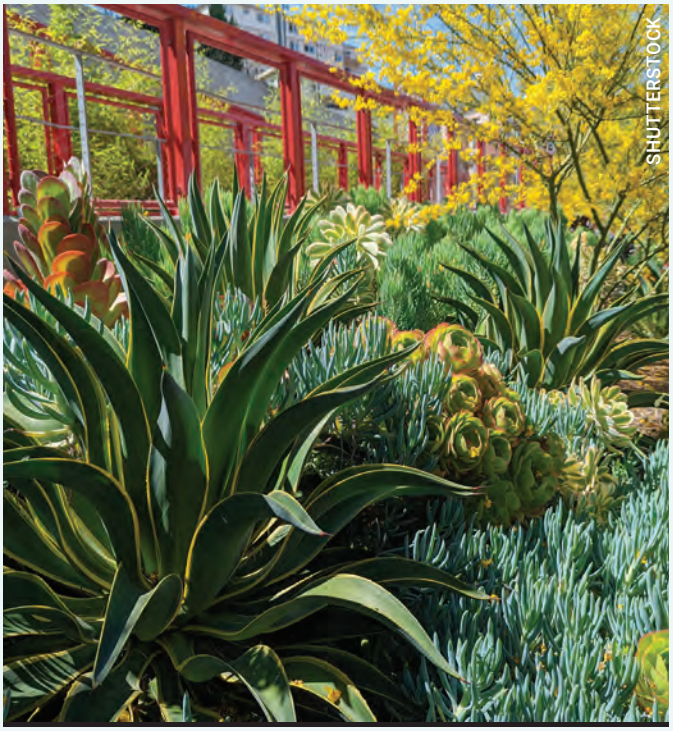
Certifications for Water-Efficient Landscape Professionals

Professional education can be important for both employees and contractors of water-efficient facilities. Certification can also be required or recommended by the local water provider, municipality, state, or employer. EPA WaterSense-certified training programs for landscape professionals include the following:

- The Qualified Water Efficient Landscaper (QWEL) program is an EPA WaterSense-labeled professional training and certification on reducing landscape water demand.
- Watershed Wise Landscape Professional training and certification offered by G3 (Green Gardens Group) presents a holistic watershed approach to outdoor water use efficiency, emphasizing plant, soil, water relationships, and rainwater as a resource.
- The Irrigation Association offers a number of certification programs for professionals specializing in turf, landscape, and golf course irrigation. Certified irrigation contractors, designers with a landscape and turf irrigation specialty, or golf and landscape irrigation auditors qualify for the EPA WaterSense label.

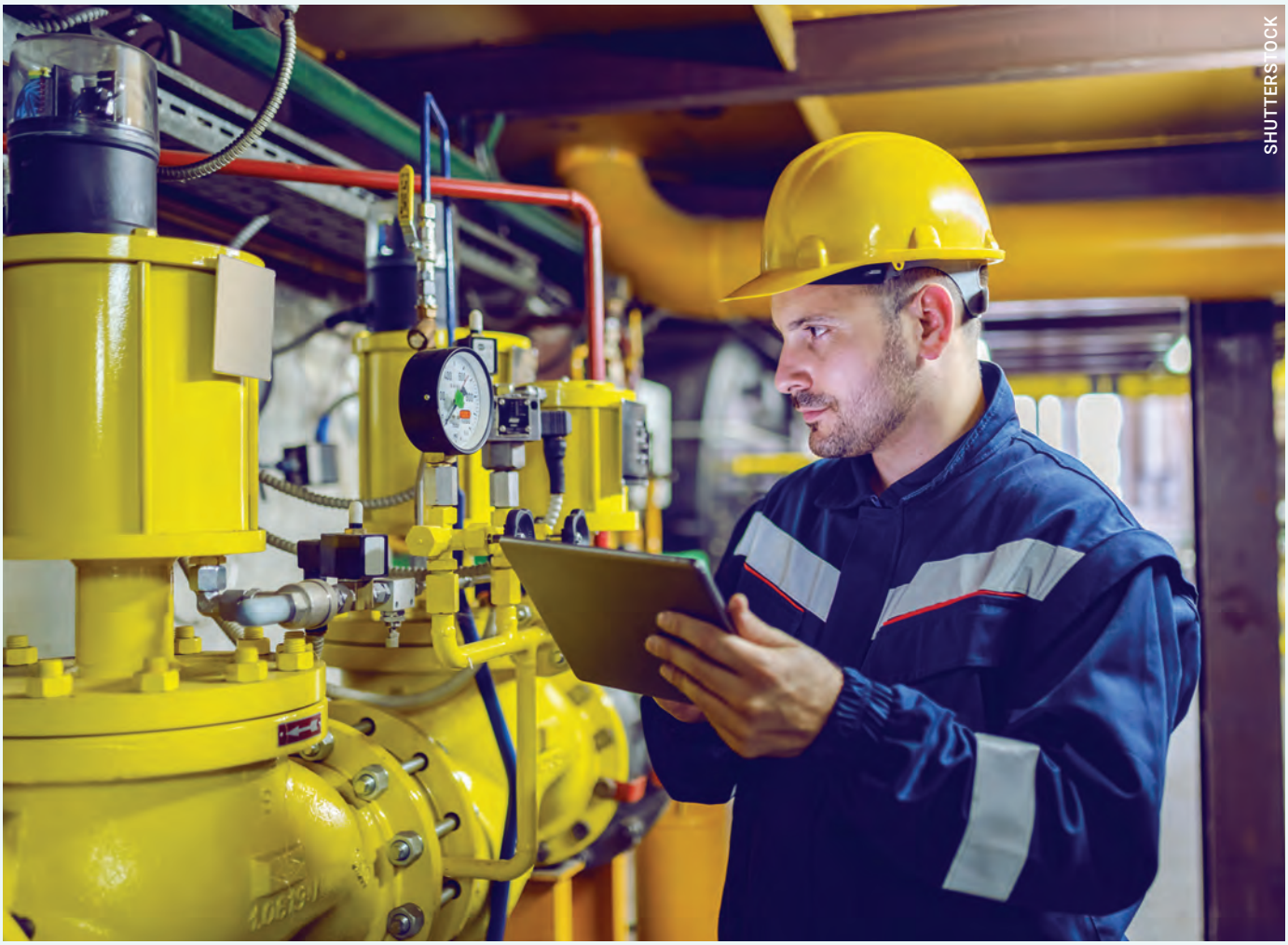
For more information about landscape professional certification, WaterSense-certified training programs, and a directory of certified professionals, visit EPA's WaterSense Professional Certification webpage.



Continuing Education for Green Building Property Managers

Green building managers may take advantage of the following:

- The National Affordable Housing Management Association (NAHMA) and National Apartment Association Education Institute (NAAEI) offer the Credential for Green Property Management (CGPM) to on-site managers, maintenance staff, and supervisors of frontline staff based on green building principles and best practices, and U.S. Department of Housing and Urban Development (HUD) Office of Affordable Preservation (OAHP) established guidelines, with training offered by OAHP-recognized trainers. Students learn techniques and technologies for making cost-saving green improvements, including water efficiency, at properties.
- Courses and training programs that include water efficiency are sometimes available through utilities and property management associations.



Continuing Education for Green Building Contractors

Training programs for green building contractors include the following:

- Green building certification programs such as LEED, WaterSense, SITES, the Living Building Challenge, and BREEAM include water standards and are considered best practice programs.
- The Alliance for Water Stewardship provides standards, certification, and training on water conservation and efficiency for companies and sites.
- The International Association of Plumbing and Mechanical Officials' (IAPMO) Water Efficiency and Sanitation Standard provides guidance on the construction, alteration, and repair of alternative water source systems for non-potable water applications. IAPMO also offers Green Plumbers Training.
- NSF International/ANSI 350: Onsite Residential and Commercial Reuse Treatment Systems establishes minimum materials, design and construction, and performance requirements for on-site residential and commercial water reuse treatment systems. NSF International also offers Water and Wastewater Training.
- The San Antonio River Authority administers a training program for the site planning, design, construction inspection, and maintenance of Low Impact Development (LID) permanent stormwater best management practices.
- The California Stormwater Quality Association offers these training programs in stormwater quality management for construction and industrial professionals: the Construction General Permit Training Program, the Industrial General Permit Training Program, and the Industrial General Permit Qualified Industrial Stormwater Practitioner.

Water levels across the American West have been dropping dramatically over the past 20 years.

PART III

THE DROUGHT POLICY LANDSCAPE

Best Practices in Public Policy at the Land-Water Use Nexus

Collaborating across the Public and Private Sectors to Address Drought

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Public officials at all levels of government increasingly recognize drought as an existential threat to their communities and are enacting drought-related policies to address water stress. While historically many of these policies focused on supply-side water management (acquiring water supplies through diversions, dams, and desalination), most policies at the local levels are now focused on demand-side water management (water conservation, efficiency, and reuse), much of which relates to the built environment.[148]

Several places—for example, Oakley, Utah; Fountain, Colorado; and East Palo Alto, California—have halted new development because of drought and lack of sufficient water supplies.[149,150,151] In California, former governor Jerry Brown mandated a 25 percent reduction in water use in the face of a severe drought in 2015. In 2021, California's governor Gavin Newsom asked residents to reduce water consumption voluntarily by 15 percent.[152] As a result of that ongoing effort, water use in California was 16 percent lower in 2021 than it was in 2013.[153] Because of the ongoing megadrought, Arizona and Nevada will be federally required to implement emergency water use curtailments in 2022 as well.[154,155]

Many water suppliers, including those in Arizona, California, Colorado, Nevada, New Mexico, Utah, and Texas, have restricted outdoor water use and encourage or incentivize the replacement of turf lawns with water-smart landscaping.[156] Nevada officially banned nonfunctional ornamental turf.[157]

Although outdoor water use restrictions have been effective at curtailing water demand, they are largely reactive to droughts.[158] Some states, such as Arizona, California, Colorado, and Nevada, are taking a more proactive approach by requiring drought planning and the integration of water conservation and efficiency into land use planning and development standards.[159,160,161,162] Even in states where it is not required, numerous municipalities are now incorporating water conservation and efficiency into land use planning efforts, building codes, and development review processes.[163,164]

In most cases, the responsibility for planning and regulating water resources has shifted from the federal and state governments to local governments.[165] Since this is the case, local governments have many more opportunities to link water supply management and land use policies than they had in the past.

Federal Support for Drought Mitigation and Adaptation

The National Integrated Drought Information System (NIDIS) is a multi-agency partnership that coordinates drought monitoring, forecasting, planning, and information at national, tribal, state, and local levels.

The U.S. Bureau of Reclamation's Addressing Drought Portal is an interactive platform that highlights Reclamation's efforts and investments to mitigate drought impacts, increase drought resilience, reduce reliance on declining water sources, and increase the efficiency of water deliveries.

The U.S. Bureau of Reclamation's Drought Response Program supports a proactive approach to drought by providing assistance to water managers to develop and update comprehensive drought plans and implement projects that will build long-term resilience to drought.

The U.S. Federal Emergency Management Agency's pre-disaster mitigation program, Building Resilient Infrastructure and Communities, supports states, local communities, tribal nations, and territories as they undertake hazard mitigation projects, reducing the risks they face from disasters and natural hazards, including drought.

SHUTTERSTOCK

Signs warn residents of a severe drought and urge residents to limit outdoor water use in Southern California in 2016.

View of Arcadia and the San Gabriel Mountains from the Mount Wilson Trail, Los Angeles County, California.

Best Practices in Public Policy at the Land-Water Use Nexus

Private- and public-sector real estate and land use professionals across the arid western United States identified the following policies to address the intersections between land use and water stress. Although this is not a comprehensive list of best practices in public policy at the land-water use nexus, the following recommendations would likely receive cross-sector support.

WATER AND LAND USE PLANNING INTEGRATION

Historically, land use planning and water planning occurred separately. Land use decisions were frequently made with the assumption that water would be available for all projected growth. Increasingly, however, public officials are beginning to understand that the sustainability of water supplies is an important limiting factor to growth. Water-conscious land use planning and decision-making and community- and environment-conscious water management requires integration of the fields.[166] By working together, land use and water planners and managers can better anticipate potential shortfalls and help communities prepare for a variety of scenarios, including droughts. As the Lincoln Institute of Land Policy put it, "Communities that coordinate land use and water management plans increase their capacity to achieve a resilient and sustainable future."[167]

Many resources are now available that provide guidance on ways to break down silos between land use and water departments and agencies and on opportunities to work together to ensure better social, environmental, and economic outcomes. The Sonoran Institute and the Babbitt Center for Land and Water Policy, a center of the Lincoln Institute of Land Policy, offer guidebooks and Growing Water Smart workshops to support municipalities in the arid western United States as they make the transition to integrated land use and water management. For more information, visit the Growing Water Smart website.

"Communities throughout the West have found that by increasing development density, utilizing technological efficiencies, and aggressive conservation programs, they have been able to continue to grow without acquiring new [water] supplies. This approach not only benefits the environment and ensures a more sustainable future, it's also good for the triple bottom line."

SONORAN INSTITUTE AND THE LINCOLN INSTITUTE OF LAND POLICY
Growing Water Smart: The Water-Land Use Nexus Guidebook

OPPORTUNITIES FOR PUBLIC-SECTOR INTEGRATION OF WATER AND LAND USE

POINT OF INTERVENTION	TOOL	PURPOSE
VISIONING AND PLANNING	• Visioning • Information sharing and alignment • Public engagement and education • Regional partnerships • Comprehensive and general plans • Community water system plans • Local and regional water quality plans • Capital improvement plans • Hazard mitigation, response, and recovery plans • One water plans	Evaluates local water supplies, current and future demands, and related community and economic values. Establishes goals and objectives for managing the intersection of natural resources and the built environment.
ENSURING WATER SUPPLY FOR DEVELOPMENT	• Arizona water supply rules • Water budgeting • Water allocation policies • Water demand offset programs • Annexation policies	Links new development to water supply planning. Determines the requirements applied to new development for water resource management, conservation, and efficiency
LAND USE POLICY AND PROCESS	• Compact development • Water-efficient landscapes • Water-smart buildings • Development review	Directs how land is developed and the amount of water the developments will require.
WATERSHED HEALTH AND ALTERNATIVE SUPPLIES	• Watershed protection • Green infrastructure and low impact development • Alternative water supplies	Protects the regional water quality and pairs the right water supply with the appropriate use.
EFFICIENT WATER DEMAND PROGRAMS	• Conservation rate structuring • Conservation rebate programs • Water metering, audits, and leak detection • Consumer educational messaging	Empowers and incentivizes landowners and renters to reduce water consumption. Links community-wide programs to water supply planning.

Source: Sonoran Institute.

Growing Water Smart: The Water-Land Use Nexus Guidebook identifies water and land use integration opportunities for municipalities and counties. Many of these opportunities relate to real estate development and land use. The list of opportunities differs slightly in the available guides for Arizona, California, and Colorado. This chart is from the Arizona guidebook.

Around 20 to 50 percent of water escapes from water suppliers' pipes in North America.

WATER LOSS CONTROL

It is estimated that 20 to 50 percent of water escapes from water suppliers' pipes before it is delivered to buildings in North America.[168] Water suppliers know this because a significant portion of water that enters the system never reaches customers. Aging water infrastructure must be maintained for water supplies to be sustainable.

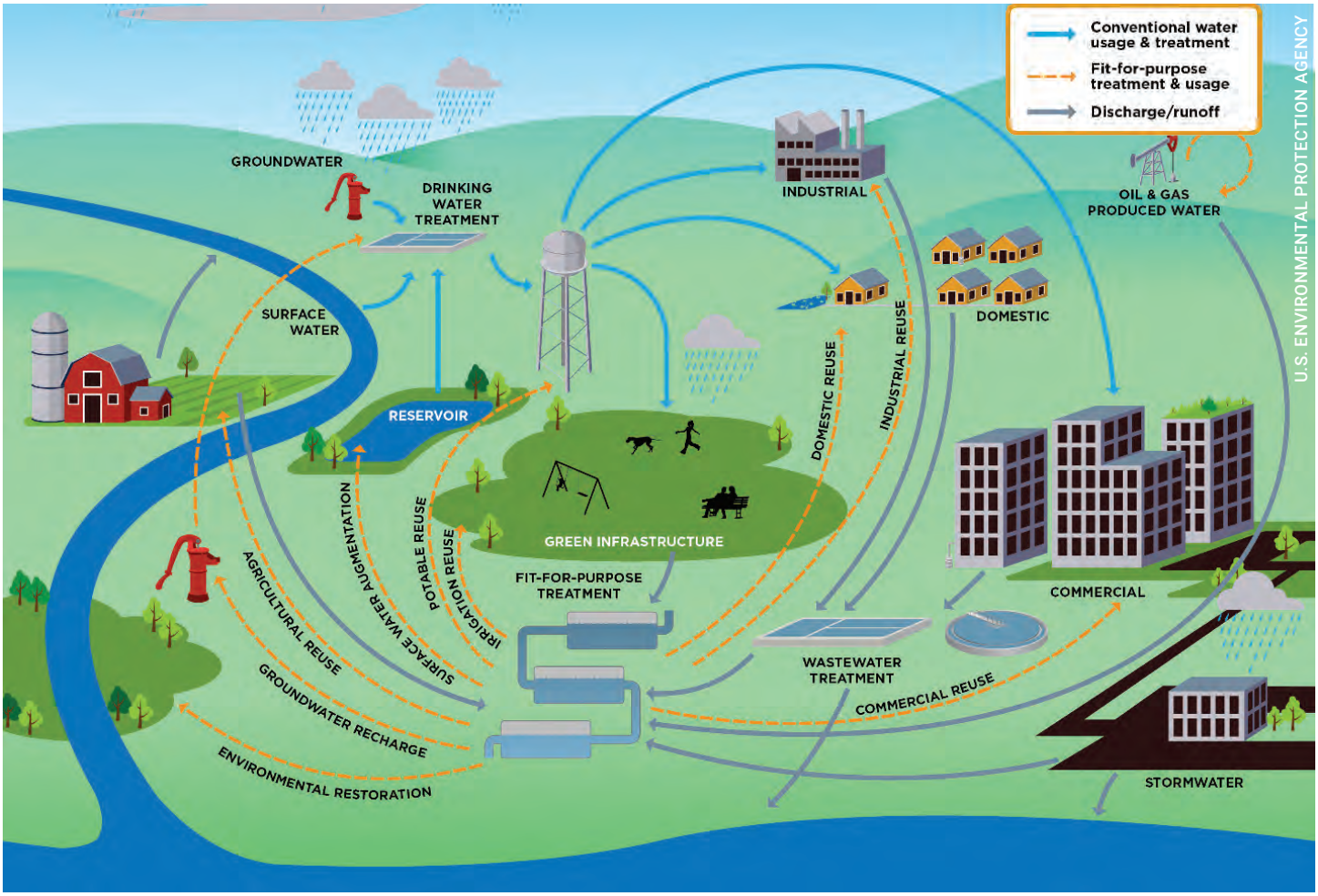
Since this is a regional public infrastructure problem, it may not be appropriate to levy fees on the development community to fund these repairs in a piecemeal manner, which would increase the cost of development, ultimately making it less affordable for end users. Rather, federal infrastructure funding can be used to fix these systems holistically.[169] Restructuring water rates, as discussed in the "Conservation-Oriented Water Rate Structures" section of this report, could also support needed infrastructure improvements.

Some states require water loss control, but many do not—creating an opportunity for future public policy. For more information, see the Alliance for Water Efficiency's interactive map of and report on state-level water loss laws in the United States.

The One Water Approach

"One Water" is a term that refers to an integrated approach to planning and implementation to manage finite water resources for long-term resilience and reliability. One Water considers all water resources as a potential water supply—rainwater, drinking water, stormwater, and wastewater—and seeks to minimize overall demand for water resources. By using a One Water planning approach, water resources can be used together, efficiently and effectively, for the benefit of the community and the environment. Within the One Water framework, all water should be considered holistically to maximize environmental, economic, and community benefits.

For more information about the One Water approach, visit the US Water Alliance's One Water Hub.



Examples of regional water sources and uses.

REGIONAL WATER REUSE

In the absence of federal standards, states and municipalities have diverse rules and regulations for water reuse. Most states lack any water reuse regulations. Some have regulations for certain water sources, such as rainwater and graywater, but not others, like blackwater. In other jurisdictions, regulations apply to water reuse only at a certain scale, such as on-site systems or at a municipal level. Several states, including California and Florida, have comprehensive regulatory frameworks for water reuse. To search reuse regulations and guidelines by state, source of water, and end use application, see the EPA's Regulations and End-Use Specifications Explorer (REUSExplorer).

Overall, by adopting standards and regulations for water reuse, states can support a system of sustainable water supply and use. Without consistent, appropriate, and easy-to-follow guidance and permitting on water reuse, it can carry too much risk and expense for real estate developers to consider as a realistic on-site option.

Regional systems for reclaimed water are more cost-effective than individual on-site treatment systems, and they have far more capture and reuse opportunities. In addition, health and safety issues can be monitored more efficiently with regional systems. Water suppliers that offer reclaimed water can help sustain freshwater supplies, lower potable water demand, and add a revenue source.

Federal Investment in Water Reuse

The 2021 Federal Infrastructure Investment and Jobs Act will invest $1 billion over five years in water reuse programs for the western United States. This is a historic investment in water reuse, which until now has received about $65 million per year through the U.S. Bureau of Reclamation.

CONSERVATION-ORIENTED WATER RATE STRUCTURES

The way in which water suppliers structure water rates influences water use.[170] Water rates can be structured to encourage lower water use and stabilize utility revenue, despite water conservation.

Structuring water rates to charge higher prices as a customer uses more water allows the water supplier to accomplish multiple goals: incentivize water conservation, steady revenue generation, and ensure equity for lower-income customers. While some customers at the highest income levels may be price insensitive, charging more for their water use allows the water supplier to offset lost revenue from customers who reduce water use in response to the higher prices. Any additional revenue can be used to invest in infrastructure, such as fixing leaks and treating reclaimed water.

The *Growing Water Smart Guidebook* provides the following list of rate structuring options:

- **Drought demand pricing:** Rates are higher during drought periods.
- **Excess use:** Rates are higher for above average water use.
- **Inclining block:** Rate per block increases as water use increases.
- **Indoor/outdoor:** With separate meters, or submetering, rates for indoor use are lower rates than for outdoor use.
- **Penalties:** Customers are charged for exceeding allowable limits of water.
- **Scarcity pricing:** The cost of developing new supplies is added to bills.
- **Seasonal pricing:** Water rates are higher during the season with the most demand.
- **Sliding scale:** The unit price increases based on an average consumption.
- **Spatial pricing:** Water rates are determined by the actual costs to supply water to specific locations.
- **Time-of-use:** Water rates are higher during peak days or specific hours of the week.
- **Water budget:** Block rate is defined for each individual customer based on efficiency projections/ expectations for that customer.

The Financing Sustainable Water website was created to provide resources for water suppliers on water rate restructuring efforts. The handbook available for free on the website, *Building Better Water Rates for an Uncertain World: Balancing Revenue Management, Resource Efficiency and Fiscal Sustainability*, provides guidance on developing, evaluating, and implementing conservation-oriented rate structures. The website also provides case studies on successful ratemaking and financial planning, and guidance for decision-makers, including elected officials and water customers.

> "If it is really important, more water use should cost more."
>
> **ULI WATER-SMART DEVELOPMENT FOCUS GROUP PARTICIPANT**

Water bills are typically lower than other utility bills, leaving room for rate structures that charge more for higher water use.

Boulder Public Library's main branch in Boulder, Colorado, is surrounded by native plants, popular playscapes, and Boulder Creek's rich ecosystem, demonstrating how attractive and inviting such landscapes can be to the community.

PUBLIC DEMONSTRATION PROJECTS FOR WATER INNOVATION

Although some private-sector developers pursue innovative water-smart strategies, most developers are more likely to incorporate strategies that are already tested and proven by others and supported by the public sector to minimize risk. To support the transition to water-smart development, the public sector can lead the way with demonstration projects for water innovation on public property. The benefits from demonstration projects can be numerous—among them, lessons learned that can be shared with others who want to follow in the footsteps of the project. In some cases, laws can be changed based on these lessons learned, such as laws related to water reuse.

Public demonstration projects for innovation in water have a long history. Future demonstration projects might include the following:

- Centralized and decentralized water treatment and reuse;
- Wastewater and contaminated water treatment and reuse;
- Remediation of groundwater contamination;
- Native and drought-tolerant plantings on parkways and public land;
- Use of stormwater to irrigate public landscapes;
- Double net zero (net zero energy and net zero water) public buildings;
- Ecosystem restoration for green infrastructure benefits and climate change mitigation and adaptation; and
- Carbon and water offset programs.

PUBLIC EDUCATION ON WATER CONSERVATION, EFFICIENCY, AND REUSE

Lack of public awareness about the benefits of water conservation, efficiency, and reuse is a significant challenge for real estate and land use professionals who want to employ low-impact development strategies, but fear that the public still demands Kentucky bluegrass lawns and high-flow water fixtures. The public sector can support water-smart development by promoting the importance and benefits of water conservation, efficiency, and reuse to the public. Such education campaigns can also influence homeowner behavior, and since single-family homes use the most water of any customer sector of North American water utilities,[171] there is no downside to public education.

Public education opportunities might include the following:

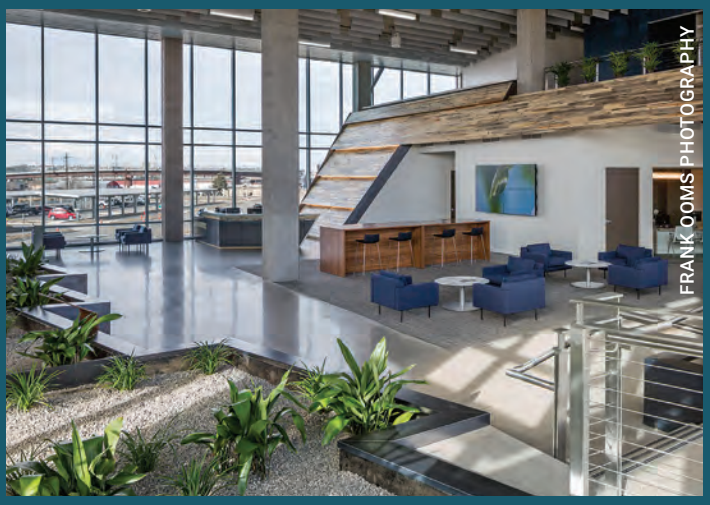
- Promote the reasons why water conservation is necessary, the benefits of conserving water, the risks to the community if water is not saved, and the actions needed to achieve water conservation goals.
- Provide tips on indoor and outdoor water conservation measures.
- Provide clear, accessible information about water reuse and its benefits.
- Collaborate with retailers to sell and promote WaterSense and other water-saving products.
- Collaborate with nurseries to sell and promote native and drought-tolerant plants.
- Partner with water suppliers to provide information about water use and conservation opportunities.
- Educate the public about how the water system is interconnected.
- Educate homebuyers on the costs of maintaining non-native green lawn versus a water-smart landscape during the life of a 30-year mortgage.
- Present homebuyers with cost savings based on water-smart property use.
- Develop a citizen's advisory process to inform land and water planning integration.
- Provide K–12 teacher education on water conservation, efficiency, and reuse.
- Integrate principles of water conservation, efficiency, and reuse into undergraduate and graduate school programs.
- Provide trainings to homeowners associations and special districts on the benefits of water-smart landscaping.

"Efforts that raise community education and awareness are likely to have a long-term positive effect on converting landscapes and reducing household water use."

BRIAN H. HURD
"Water Conservation and Residential Landscapes: Household Preferences, Household Choices"

Examples of Public Education Initiatives for Water Conservation

- WaterSense for Kids
- US Water Alliance's "Value of Water" Campaign
- California's Save Our Water campaign
- Arizona's Water: Use it Wisely campaign
- Colorado WaterWise's "Water: Live Like You Love It" drought campaign
- Texas's "Water IQ"
- Alliance for Water Efficiency's Never Waste campaign
- 50L Home
- Colorado's Garden in a Box program
- Garden Style San Antonio
- Houston's Green Building Resource Center



Denver Water headquarters' blackwater is treated on site through various closed and open aerobic tanks, a constructed wetland, as shown in the photo, and a final filtration process before reuse.

> "We've seen across our portfolio that owning and operating high-performance properties is a sound investment strategy that can lower utility bills, improve tenant attraction and retention, and improve net operating income when executed correctly. We really believe this and we're seeing it adopted more and more widely."
>
> **LEE FERGUSON**
> Vice President, Denver Office, Trammell Crow Company

Denver Water Headquarters Demonstrates Water Conservation and Efficiency Strategies

Denver Water is Colorado's oldest and largest water utility as well as one of the state's most innovative champions for sustainability and resource conservation. The five-year redevelopment of Denver Water's 35-acre operations complex pushes the boundaries of what is possible in water efficiency and reuse, especially in the 187,000-square-foot administration building, which serves as the beating heart of the updated campus.

The complex has been home to various Denver Water operations since 1881, and over time, the buildings became outdated and inadequate to support the operational and administrative needs of the agency. The full redevelopment included the demolition of 15 obsolete and inefficient buildings, renovation of two existing buildings, and new construction of four industrial buildings, a parking garage, a wellness building, and the LEED Platinum and net zero energy administration building.

The pioneering water conservation and reuse strategies incorporated into the campus are inspired by Denver's One Water plan, a management framework that fosters collaboration between public agencies that oversee the region's water systems. The most visible applications of One Water strategies are in the administration building, which features rainwater capture for irrigation and on-site wastewater treatment and recycling.

The large-volume rainwater capture and graywater and blackwater recycling in the administration building had never before been attempted at this scale regionally.

A key component of the One Water philosophy is the integrated approach to all forms of water: drinking water, wastewater, groundwater, reclaimed and reused water, rainwater, stormwater, and floodwater. The development team included Trammell Crow Company as owner's representative and master developer, Stantec as project architect, and Mortenson Construction as general contractor, along with a team of more than 200 design and construction subcontractors. Together, they incorporated a wide range of water-smart design strategies. The project aims to use the most appropriate source water for each water use, like rainwater for irrigation and toilet flushing. Other strategies reduce as much water demand and discharge to the environment as possible through recovery and reuse. For example, the project features low-flow plumbing fixtures throughout, rainwater-capturing systems on the roof of the administration building and parking garage, porous paving, bioswales, and a native detention pond on site.

The water recycling system (WRS) is the most unique and innovative element of the campus. Wastewater from restrooms and the cafeteria is diverted to the WRS, an on-site treatment system in which water travels through various closed and open aerobic tanks before routing through a constructed wetland and a final filtration process. The system is capable of recycling up to 7,000 gallons per day, which is more than enough to meet current demand.

View of the Araby Trail above Palm Springs, California.

Collaborating across the Public and Private Sectors to Address Drought

Now more than ever, cross-sector collaboration is vital to address drought and water stress for the future security of our shared communities and environments. This section addresses how best to bridge the gap between the public and private sectors to advance best practices in water-smart development and policies that protect our water future despite projected water shortages, population increases, and climate change.

CONSISTENT WATER RULES ACROSS DEPARTMENTS AND AGENCIES

Developers note that it is not uncommon for different departments and agencies within the same jurisdiction to have conflicting standards and regulations, especially when it comes to water. These conflicts can lead to significant inefficiencies as developers and others need to reconfigure their plans multiple times to comply with each standard individually and collectively. Local governments can minimize such conflicts by reviewing and reconciling opposing policies.

UP-TO-DATE STANDARDS AND REGULATIONS

It is important to update policies and regulations related to water with newly available information and science. Examples of outdated policies and regulations include old plumbing codes that do not work with newer water-efficient fixtures, building codes that require residential sprinkler systems or larger meters than needed, and stormwater regulations that do not allow green infrastructure use. Private-sector professionals can work with public-sector staff to align codes and ordinances with current best practices and technology. Existing codes and standards, such as those in the International Green Construction Code, can also be adopted.

When updating codes and regulations, ensuring that there are avenues for innovation in land and water use will allow that innovation to occur. Examples of innovation in water and land use could include stormwater management, water reuse, net zero water and energy development projects, and water credit trading and offsets. In addition to allowing innovation, incentivizing the types of land and water use projects that are desired, such as with expedited entitlements, density bonuses, and tap fee reductions, will increase the probability that those projects are realized.

International Green Construction Code

The 2018 International Green Construction Code is an adoptable, usable, and enforceable standard for green building design and construction, including water efficiency and conservation.

For more information, visit www.iccsafe.org/products-and-services/i-codes/2018-i-codes/igcc.

WATER AVAILABILITY DATA

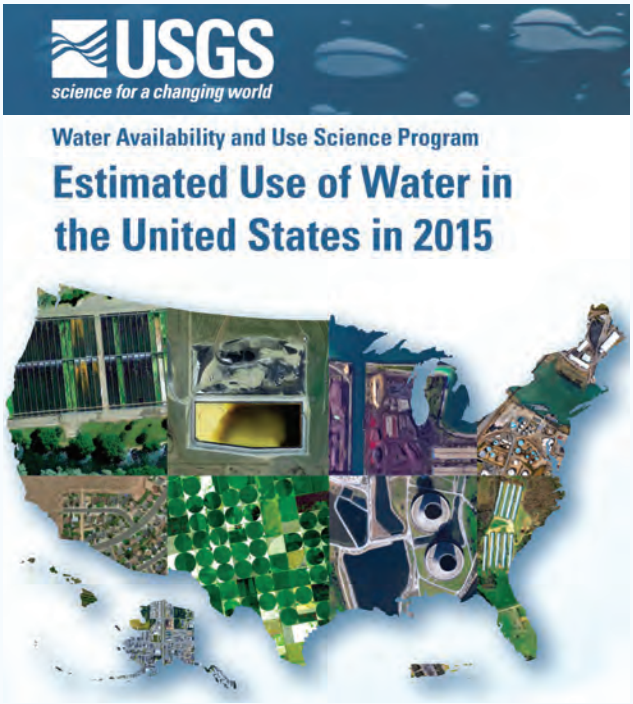
With regard to drought, improving information on water availability and use can support more accurate projections, scenario planning, and decision-making.

Increasing the amount of local data on water availability, including baselines, recharge rates, supply and demand status, and trends, would improve water-smart land use decision-making. This data could be collected, updated, and made available by the state to support decision-making on whether and when to plan for on-site water reuse or other alternative water sources. Maps of locations where water infiltration is desirable and relatively easy to accomplish, and where infiltration is not desirable because of groundwater contamination or other issues could further support water-smart decision-making.

Water Use Data

The U.S. Geological Survey (USGS) works with local, state, and federal agencies to collect water use information. Every five years, USGS compiles the county-level data into a national water use database and publishes the state-level data in a national report, *Estimated Use of Water in the United States.*

For more information, visit www.usgs.gov/mission-areas/water-resources/science/water-use-united-states.



Incentivizing Water-Efficient Development in Castle Rock, Colorado

In 2016, to encourage water conservation in new developments, Castle Rock Water developed a water conservation option that rewards lower water use requirements with a reduced fee. The innovations are left to developers, and the fee discount is proportional to the amount of water the developer saves.

The discounted fee is applicable only if a water efficiency plan is created for the new development. The water efficiency plan must meet a set of minimum standards, including Indoor Water Efficiency, Outdoor Water Efficiency, Resident Education, Third-Party Verification, and Monitoring and Enforcement.

CONSERVATION-ORIENTED SYSTEM DEVELOPMENT CHARGES

Frequently, water suppliers require water dedications for real estate development projects that are significantly greater than needed. Greater water dedication requirements increase the cost of water for the project and disincentivize water conservation and efficiency measures. Developers support the use of conservation-oriented system development charges (also known as tap fees) to incentivize water-smart development.

As Western Resource Advocates and Raftelis Financial Consultants explain in *A Guide to Designing Conservation-Oriented Water System Development Charges*, instead of basing tap fees on a standard meter size for the customer class (for example, all commercial developments with the same meter size pay the same fee), the fees can instead be scaled in proportion to the volume of water that each new development is projected to use. This method rewards water-efficient developments with a lower tap fee and lower monthly water bills as long as they maintain water efficiency. Lower fees are a powerful incentive for developers to integrate water conservation and efficiency into their projects, since fees affect their bottom line and, ultimately, project feasibility as the cost of water continues to rise and availability becomes scarcer.

One of the benefits to the water suppliers that institute conservation-oriented system development charges is lower demand on infrastructure, which can reduce the need for new infrastructure. This can free up funding for needed system improvements and enable communities to grow sustainably as desired. Many communities have already redesigned their water system development charges to incentivize water-efficient development, including Aurora, Castle Rock, Fountain, Westminster, and Little Thompson Water District in Colorado.

WATER-SMART ZONING, BUILDING CODES, DESIGN STANDARDS, AND CODE ENFORCEMENT

Regulations that foster compact development, preserve open space, and require water efficiency and conservation measures in development can allow water-stressed communities to continue to grow. The following strategies can support water-smart zoning and building codes, design standards, and code enforcement.

Compact development:

- Prioritize infrastructure investments in existing communities before supporting greenfield development.
- Develop future land use plans that establish designated future growth areas where adequate infrastructure exists for accommodating growth at higher densities.
- Update zoning codes to permit smaller lot sizes, higher densities, multifamily housing, and mixed-use development in designated areas.
- Reduce or remove barriers to compact development such as parking requirements, minimum lot sizes, and lot setbacks.
- In rural areas, update zoning codes to permit and incentivize cluster and conservation development.

Open-space preservation:

- Preserve regional open space by clustering development and maximizing unpaved areas for stormwater retention. Limit development in sensitive areas by clustering homes within a smaller geographic zone, incentivizing infill development in less sensitive areas, and providing low-impact design standards or guidelines.
- Protect and restore sensitive natural areas including wetlands, riparian corridors, infiltration zones, watersheds, groundwater basins, and flood- and wildfire-prone areas.
- Adopt plans for wildfire mitigation, watershed management, stormwater management, and floodplain management that designate sensitive areas and goals for mitigation. These plans should reference other land and water plans so that priorities and objectives build on one another and so that the environment is viewed and treated holistically.
- Adopt development standards for watershed buffers and setbacks to protect water quality.

Water-smart development entitlements:

- At pre-development review, make rezoning, annexation, and Planned Unit Development applications conditional on meeting water conservation standards.
- Permit water-intensive commercial and industrial uses based on meeting standards for water conservation and efficiency.

Indoor water efficiency and conservation:

- Use the International Association of Plumbing and Mechanical Officials' (IAPMO) Green Plumbing and Mechanical Code Supplement as a guide or adopt the green plumbing code requiring high-efficiency water fixtures.
- Consider adoption of the International Green Construction Code, which supports green building design and construction, including water efficiency and conservation.
- Adopt building code standards that permit the use of water treatment and reuse systems. IAPMO's Water Efficiency and Sanitation Standard provides guidance on the construction, alteration, and repair of alternative water source systems for non-potable water applications.
- Allow the use of alternative water sources for appropriate applications including outdoor irrigation, toilet flushing, and commercial and industrial processes.
- Adopt building code standards for submetering of multifamily units and of indoor and outdoor uses.

Outdoor water efficiency and conservation:

- Adopt water-efficient landscape standards that ease compliance by developers. Analyze water use rather than providing prescriptive approaches. This could include a landscape design guidebook on recommended water-efficient plant types, planting seasons, soil enhancement, mulching, and watering times appropriate for the local climate. All aspects of landscape design standards should aim to reduce water demand, retain stormwater runoff, decrease flooding, and recharge groundwater.
- Adopt site-level soil erosion mitigation standards for new development to reduce sedimentation and runoff and protect water quality from land disturbance.
- Remove turf and other water-thirsty plants from open-space requirements.
- Limit the types and amount of turf allowed based on square footage or total landscaped area. Remove cut grass length requirements.
- Provide approved plant lists with native, climate-appropriate, and drought-tolerant plants.
- Adopt irrigation timing restrictions, such as allowing watering only before 10 a.m. and after 6 p.m., to limit evapotranspiration.
- Encourage low-flow and efficient irrigation systems like drip, bubbler, and low-flow sprinklers with rain sensors or evapotranspiration sensors that can shut off irrigation when it is not needed.
- Update codes to allow real-time control of cisterns used for both stormwater detention and rainwater harvesting in the same vessel.
- Provide model landscape standards and maintenance agreements for homeowners associations and others to use in contracting landscape services.
- Require third-party water-efficient irrigation systems and landscape certification.
- Require training and certification for landscape professionals on water-smart landscaping.
- Provide a training program for postoccupancy management of irrigation systems.
- Require an operations and maintenance plan that includes irrigation systems and stormwater system maintenance.
- Incentivize permeable pavement.
- Use the minimum street width possible, and direct stormwater runoff to green infrastructure.
- Incorporate water storage areas into landscapes, such as creek beds, recessed athletic fields, ponds, cisterns, and other features.

Code enforcement:

- Train inspectors in water-smart building strategies so they can ensure that the approved site plan design is constructed.
- Train code enforcement officials on water-smart landscaping and green infrastructure so they can monitor water efficiency over time.
- Include irrigation in plumbing codes for code enforcement.
- Enforce and fine for violations in water waste. Offer courses on water conservation and efficiency, and if violators attend, waive fines.

California's Green Building Code

CALGreen is the nation's first state-mandated green building code. The purpose of CALGreen is to encourage sustainable development and construction practices in California. The code addresses water efficiency and conservation, planning and design, energy efficiency, material conservation and resource efficiency, and environmental quality.

California's Model Water Efficient Landscape Ordinance (MWELO) is included in CALGreen. The purpose of the ordinance is to increase water efficiency and improve environmental conditions in the built environment. The ordinance encourages choosing climate-adapted plants, improving soil conditions, using and maintaining water-efficient irrigation equipment, and managing the irrigation schedule to fit the plants' water needs and local climate. The ordinance also encourages the use of rainwater, stormwater, graywater, and recycled water for outdoor irrigation.

INCENTIVES FOR WATER CONSERVATION AND EFFICIENCY

In addition to or instead of codes, standards, and regulations, municipalities can use incentives to encourage and support water-smart development and landscaping. Incentives such as the following could promote additional water conservation and efficiency in land use.

Incentives for water-smart developers:

- Conservation-oriented system development charges (also known as tap fees) that are lower for less potable water use;
- Block water rate structure to offer lower water bills for lower water use;
- Reduction of property taxes with proof of water conservation and efficiency;
- Density bonuses for enhanced environmental practices;
- Expedited entitlement process for development projects that meet or exceed water conservation and efficiency requirements;
- Permitting and regulatory incentives for water-neutral development;
- Waiver of fines for water waste if attend trainings and reduce water waste;
- Free water audits for water conservation education, leak detection, and repair; and
- Free training on indoor and outdoor water conservation and efficiency.

"Local governments should provide financial, process, and assistance-related incentives to developers in return for implementing water conservation and efficiency strategies in their projects."

ULI WATER-SMART DEVELOPMENT FOCUS GROUP PARTICIPANT

Incentives for local residents and homeowners associations:

- Rebates or free replacements for water-efficient fixtures, toilets, and appliances;
- Block rate water structure to offer lower water bills for lower water use;
- "Cash for Grass" programs offering rebates for replacing turf with water-smart landscaping;
- Rebates or discounts for native, drought-tolerant plants;
- Free training on indoor and outdoor water conservation and efficiency strategies;
- Free training and rebates for rainwater harvesting;
- Free water audits for water conservation education, leak detection, and repair;
- Free or affordable plumbing services for leak repair;
- Rebates or direct install programs for smart meters; and
- Rebates for smart and low-flow irrigation systems.

Example Incentive Programs for Water Efficiency

- ➔ The Southern Nevada Water Authority pays $3 per square foot of grass removed and replaced with desert landscaping.
- ➔ Denver Water offers a variety of commercial and residential rebates for water-efficient fixtures and appliances.
- ➔ In addition to its regular commercial and residential outdoor rebates, the San Antonio Water System's Commercial Custom Rebate allows negotiation of a custom rebate that reflects the long-term, documented water savings from a project.
- ➔ San Jose Water offers free water-efficient fixtures and rebates for submeters. It also offers rebates of up to $100,000 per water conservation project to commercial, industrial, and institutional water customers for the implementation of process and equipment changes that reduce business water usage.

For information on incentive programs:

The WaterSense Rebate Finder provides a database of rebates for WaterSense labeled products.

IncentiFind is a national database of energy efficiency, water conservation, renewables, and many other incentives that promote green building in both residential and commercial sectors.

The Alliance for Water Efficiency provides an overview of water conservation programs carried out by water utilities, including incentive programs.

Municipalities can use the development review process to support developers in the integration of water conservation, efficiency, and reuse into their projects.

DEVELOPMENT REVIEW PROCESS

Municipalities can use the development review process to support developers in the integration of water conservation, efficiency, and reuse into their projects. Presenting water-saving strategies, regulations, case studies, costs, and incentives early in the conceptual review stage is vital to facilitating the development of water-smart properties.

Early meetings between developers and local officials can help address standards from different departments and agencies. Ensuring that decisions reconciling diverse standards remain consistent from pre-application meetings through final inspections is important for an efficient and affordable process. A written guide for navigating the regulations related to water conservation and efficiency could also help streamline the process, as could a public official who serves as a "water ombudsman" to coordinate all water-relevant reviewers of development applications and help the applicant address water-related issues.

In addition to water supply, water demand management strategies can be discussed during development review. Designated performance pathways can help expedite the review process for large development projects that integrate water conservation. If new strategies, such as on-site water reuse, are part of the project, a pilot project and partnership could be established to test the strategy and share lessons learned. Pilot projects offer opportunities to experiment and learn for all parties.

Sterling Ranch in Douglas County, Colorado.

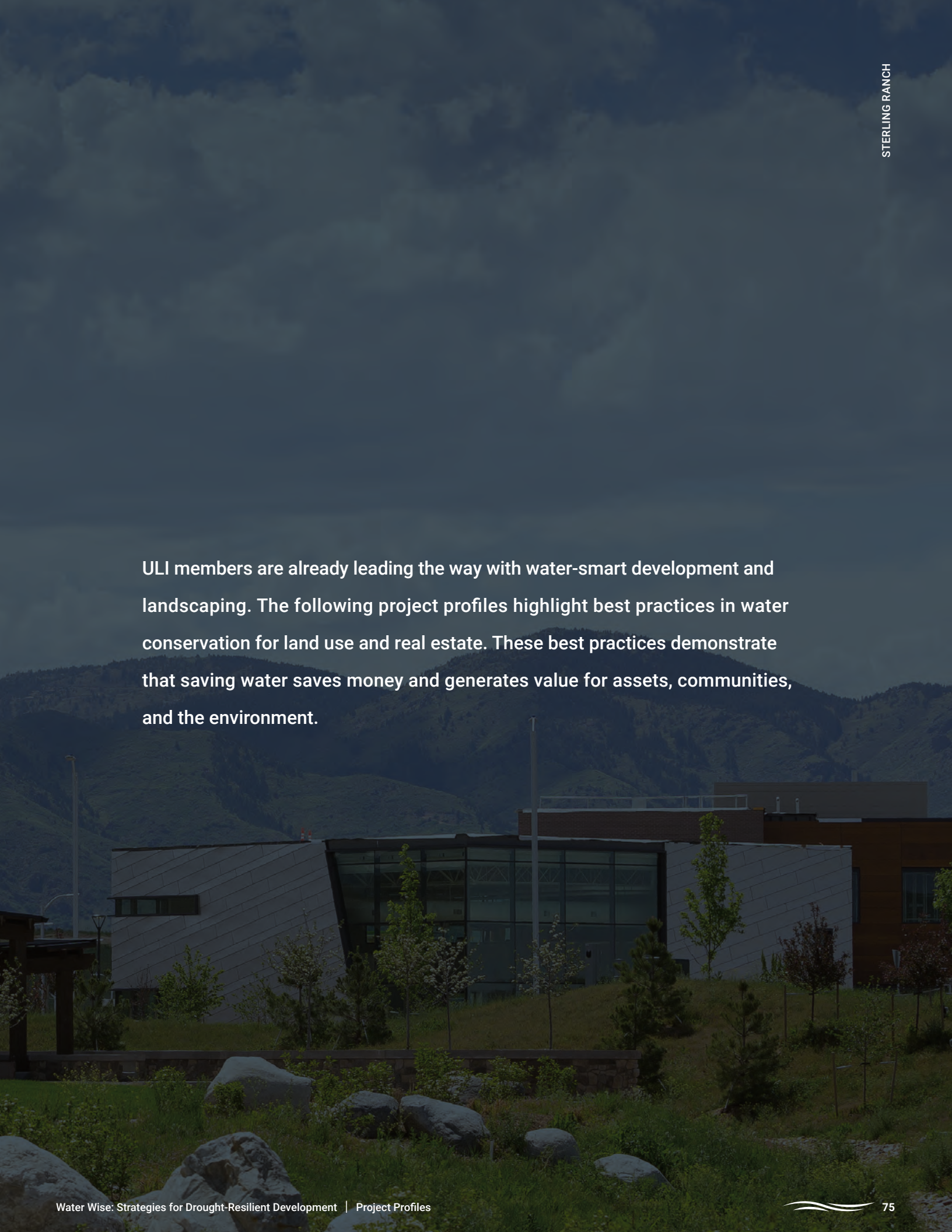
PROJECT PROFILES

Master-Planned Community: Sterling Ranch, Douglas County, Colorado

Multifamily Housing: Civita, San Diego, California

Office: Credit Human Federal Credit Union Building, San Antonio, Texas

Commercial and Industrial: Apple



ULI members are already leading the way with water-smart development and landscaping. The following project profiles highlight best practices in water conservation for land use and real estate. These best practices demonstrate that saving water saves money and generates value for assets, communities, and the environment.

PROJECT PROFILE: MASTER-PLANNED COMMUNITY

Sterling Ranch

Douglas County, Colorado

Sterling Ranch in Douglas County, Colorado.

Sterling Ranch, a 3,400-acre master-planned community located 20 miles southwest of Downtown Denver, attracts homeowners with its commitment to conservation, technology, and water-smart development. Driven by a culture of innovation and stewardship, the project has implemented many cutting-edge water demand management and drought resilience strategies that set it apart from similarly sized communities throughout the country. Sterling Ranch has sold lots to 11 different homebuilders: Richmond American Homes, Brookfield Homes, Lennar, Meritage Homes, Brookfield Homes, Parkwood Homes, Wonderland Homes, Tri Pointe Homes, Taylor Morrison, Dream Finders Homes, and Pulte Homes. Sterling Ranch will eventually include about 12,050 homes for 30,000 residents across nine distinct neighborhood villages. Since the first home closed in 2017, the development has opened three of the nine planned villages with 1,400 occupied homes, over 3,000 residential lots sold, and more than 3,000 current residents. The total project cost of buildout is estimated at over $5 billion.

Water conservation has been a top priority since the husband-and-wife development team, Diane and Harold Smethills, conceived their vision for the community more than 15 years ago. Groundwater, the main resource enabling development in Douglas County, was not readily available for Sterling Ranch when the Smethills began planning, which afforded them unique opportunities to explore novel infrastructure and conservation strategies not in use elsewhere in the Denver metropolitan area. Drought resilience is top of mind in Colorado, which has experienced severe drought conditions for more than two decades,[172] and as of December 2021, had more than 200 straight days without rain.[173]

Water-Smart Strategies

Sterling Ranch is Colorado's first and only municipal-scale rainwater harvesting pilot site project, with goals of sourcing over 70 percent of its water from renewable sources, like rainwater and snowmelt, and not groundwater. Dominion Water Sanitation District manages the community's wholesale water and wastewater, and is part of a broader regional coalition called the WISE Partnership (which stands for Water, Infrastructure and Supply Efficiency) that has worked to reduce infrastructure costs through the sharing of water assets such as Aurora's Prairie Waters Pipeline. The WISE Partnership has been essential to the project's success. "In the old days there was a saying around Colorado: 'whisky is for drinking and water is for fighting.' Rather than adopt that mentality, we found that if we worked together with cities, districts, and water suppliers, we could bring complete water systems together that could be shared at a fraction of the cost of any one of us doing it by ourselves. Sharing infrastructure costs reduces costs for everyone, including our residents," said Harold Smethills.

Technology is a cornerstone of the project and essential for meeting its water conservation goals. Sterling Ranch partnered with Siemens to deliver smart utility management throughout the community, like residential dual-meter water systems that differentiate between outdoor and indoor water consumption. Indoor use is priced lower than outdoor use, since indoor use is less elastic and to encourage outdoor water conservation. Smethills believes that "people will make the right choices if you give them the right information and don't penalize them. Residents know outdoor water is expensive. They don't have to buy water they don't need or want." Other technology to reduce outdoor water use includes Rachio smart irrigation controllers, which tie irrigation to evapotranspiration data from nearby weather monitoring stations and alert users about leaks.

In addition, Sterling Ranch reduces water demand through drought-tolerant landscaping co-developed with the Denver Botanic Gardens, a tactic that has garnered national attention. Sterling Ranch famously does not allow new homeowners to plant a full yard of water-thirsty grass and offers a palette of 150 native and drought-tolerant plants instead. The idea, said Smethills, is to "use grass as a throw rug instead of a carpet." In addition, the area's proximity to preserved open space and hundreds of miles of trails may encourage owners to reduce the size of their yards.

Native, drought-tolerant landscaping at Sterling Ranch was designed in partnership with Denver Botanic Gardens.

"We changed the conversation from water conservation to water demand management. Water demand management means figuring out how much you need. Educating residents shows them the best things they can do, in terms of sustainability," said Smethills. Empowered with information technology and smart systems, Sterling Ranch residents are embracing sustainable lifestyles and helping the development not only meet but exceed its water management goals. The result? "It looks like Colorado and won't die in a drought," said Smethills.

So far, Sterling Ranch has used about half (sometimes less) as much water as other municipalities in the Denver Metro and Douglas County areas.

PROJECT PROFILE: MULTIFAMILY HOUSING

Civita

San Diego, California

Civita features a variety of water conservation strategies, including water reuse, low-flow fixtures, smart meters, native plants, and water-efficient irrigation.

Spread across more than 230 acres in San Diego's Mission Valley, Civita is a high-density urban village where drought resilience and smart-water strategies have helped attract homeowners and commercial tenants while thoughtfully managing a limited resource. Water conservation is top of mind in San Diego, which receives less than 10 inches of rainfall annually and imports roughly 85 percent of its water from northern California and the Colorado River.[174]

The property existed as a productive sand and gravel quarry for more than 70 years before its remarkable transformation into a walkable, mixed-use community organized around a network of parks and open space. Combining innovation, sustainability, and ecological restoration, Civita is a product of Quarry Falls LLC, a partnership between Sudberry Properties and Alta Company LLC.

The property will include 4,780 residential homes and apartments, an elementary school, about 480,000 square feet for a lifestyle retail center, and 420,000 square feet for an office/business campus when complete. As of April 2022, the project is roughly two-thirds complete, with the large retail and office development remaining. At the heart of the development is the 14.3-acre Civita Park, which is connected to neighborhoods through a network of pedestrian paths and trails.

Civita achieved a Stage 1 Gold rating for the U.S. Green Building Council's 2009 LEED-ND (Neighborhood Development) pilot and received the 2009 Governor's Environmental and Economic Leadership Award. In addition, Civita has been designated as a California Catalyst Community. This program was sponsored by the California Department of Housing and Community Development to support innovation and test sustainable strategies that reflect the interdependence of environmental, economic, and community health.

A view of the completed Civita Park.

Drought Resilience Strategies

Civita uses a wide variety of strategies to conserve water across the property. In the Civita apartment communities, plumbing fixtures all meet EPA's WaterSense specifications, and residents can monitor their water consumption on a smart meter panel prominently displayed inside their units, like a thermostat. Most apartments also feature water heater recirculation systems that lower water consumption by reducing the amount of time it takes hot water to reach faucets. Within the communities, a combination of native plants and computerized, weather-based irrigation controls conserve water that would normally be allocated for landscaping.

The property is in the process of building its own water treatment plant to recycle and reuse water on site for irrigation. The Civita Water Reclamation Facility (WRF) will divert the flow of the development's domestic graywater and blackwater for on-site treatment, where it will be treated to produce recycled water in accordance with state of California regulatory requirements. This WRF is a membrane bioreactor (MBR) plant, which is an approved technology with a long history of success in water reuse projects. Wastewater travels through multiple screening, biological, and filtering processes to screen out and break down organic material and bacteria. The final step in the process after the MBR tanks is for the treated water to pass through a chlorine disinfection system, which eliminates any remaining bacteria, and the clean non-potable water is stored in a tank on site before distribution for irrigation.

Purple pipes have been installed throughout Civita to provide recycled water for all common landscape uses, including streetscapes and parks. Once the Civita water reclamation plant is in operation, Civita owners will acquire the purple pipes from the city of San Diego and provide recycled water for all common area landscaping. Water rates for the reclaimed water will be kept at or below potable water rates.

Combined with building water efficiency and efficient irrigation, the recycled water system at Civita is estimated to reduce overall water use by 26 percent, which is equal to about 100 million gallons of water per year. Quarry Falls LLC, in partnership with Puttman Infrastructure, will be the owner of the Civita water reclamation system.

As droughts continue to increase in duration and severity in Southern California, Civita's investment in the water treatment plant and conservation-focused design strategies allow the property to control its own water destiny, fostering a vibrant, sustainable lifestyle for its residents.

PROJECT PROFILE: OFFICE

Credit Human Federal Credit Union Building

San Antonio, Texas

Credit Human Federal Credit Union's headquarters at 1703 Broadway in San Antonio sets a new standard for sustainable commercial buildings in Texas.

Credit Human Federal Credit Union's headquarters at 1703 Broadway in San Antonio is a tangible representation of the company's belief that being good stewards of financial resources and good stewards of environmental resources go hand in hand. The 12-story, 200,000-square-foot building, which will be certified LEED platinum, aims to reduce environmental stress through building strategies that lower energy and water consumption and ultimately set a new standard for sustainable commercial buildings in Texas.

Steve Hennigan, president and chief executive officer of Credit Human, said he adopted a "different perspective and paradigm" in planning the building to challenge engineers and others involved in constructing the project. Hennigan urged those assembling the project to base their work not on current best practices but on what was "theoretically possible." As such, his stance was this: "Give me a reason why it can't be done." Credit Human partnered with Silver Ventures to co-develop the building complex, which also includes the Oxbow and a parking garage.

Taking a long-term view of the building has also allowed Credit Human to break through conventions and see the long-term payoff for investing in sustainable building technologies, with Hennigan noting that Credit Human occupied its previous headquarters for more than 40 years. "We have a history of buying and holding things," he said. In looking at the building through a long-term lens, it was important that the design approach addressed the demand for resources before examining the supply side. Sticking with that policy, Credit Human initially weighed elements affecting the performance of the building envelope—elements, he said, that have been "quantum in their payoff." The building walls feature four inches of continuous insulation and a thermally broken window system, a type of window construction in which a barrier between the inner and outer window frames limits the heat transfer through the window. The wall system doubles the insulation required by a Texas code baseline, allowing the building to reduce energy and water use, as well as operating costs involved with heating and cooling the building.

The payoff has been significant: the building uses approximately 96 percent less energy from CPS Energy, the municipal utility company, because of a 56 percent reduction in overall energy demand, as well as the building's ability to generate its own energy through a rooftop solar array.

A combination of rainwater capture, storage, and reuse systems make the Credit Human headquarters one of the most water-conscious developments in Texas.

Water Resilience Strategies

A combination of rainwater and condensate capture, storage, and reuse systems make the project one of the most water-conscious developments in Texas. "There is really almost nowhere on this building where we're not capturing rainwater," says Matt Dunn of Joeris General Contracting, the general contractor on the project. The proprietary solar array and gutter system is designed to soak up the sun's energy while allowing rainwater capture.

Several of the water storage tanks, including a 38,000-gallon tank repurposed from a local brewery, are visible on the exterior of the building. It was important that the water conservation technologies were integrated with the building design to showcase Credit Human's commitment to sustainability and conservation. Between the various water storage tanks, the building can store nearly 140,000 gallons of rainwater and condensate from its air-conditioning system to be used for irrigation, flushing toilets, and cooling the building.

Beyond rainwater capture, the building's geothermal heating and cooling system reduces water demand by diminishing the building's dependence on cooling towers. With fewer cooling towers, the building requires about 1 million fewer gallons of chilled water to air-condition the building during the summer months. In total, the water management systems have allowed the building to cut its demand for potable water from the San Antonio Water System by about 97 percent.

For Credit Human, the investments made in sustainable building systems have resulted in significant utility savings. Electricity and water at Credit Human's two prior buildings—155,000 square feet combined—cost about $44,000 a month. At the new building, which is 200,000 square feet, the monthly cost is about $8,600. Credit Human estimates that the systems will result in a positive return on investment in 13 years or sooner.

Apple

Apple's headquarters, Apple Park in Cupertino, California, uses municipal recycled water throughout its restrooms, cooling systems, and landscaping.

Driven by a commitment to environmental stewardship, Apple has become a leader in sustainable business practices throughout its global operations. The company has already achieved carbon neutrality for its corporate emissions and plans to bring its entire footprint, including all its supply chains, to net zero energy by 2030. The company focuses its environmental strategy on three core areas: climate change, smarter chemistry, and resources, which prioritizes renewable materials, zero waste, and water stewardship.

Among technology companies, Apple was one of the first to prioritize water conservation as part of its overall sustainability plan and continues to be at the forefront of water stewardship efforts. Through a combination of efficiency projects and the use of alternate water sources, Apple has conserved more than 132 million gallons of freshwater since 2017.

Apple leverages data to measure and monitor its water use to understand its local footprint at each of its locations worldwide. Each area has unique water conditions, so the company takes advantage of tools like the World Resources Institute Water Risk Atlas to understand geographically specific water consumption and water-related risks to inform local strategies. Using these tools, Apple prioritizes investment in water conservation technologies based on each corporate location's water risk profile.

Apple owns or operates 11 data centers worldwide, using chilled water or adiabatic cooling, including direct and indirect evaporation, to air-condition and keep servers cool and functioning properly. In total, Apple facilities used 1.29 billion gallons of water in 2020, 90 percent of which was potable freshwater. Through municipal recycled water, rainwater capture, and condensate recovery, over 9 percent of Apple's water is from recycled sources—a number that is increasing. Apple's Prineville, Oregon, data center was the first Apple-owned or operated site—and the first data center worldwide—to achieve certification under the Alliance for Water Stewardship, a third-party certification program that provides an accountability framework for companies seeking to demonstrate responsible water stewardship.

Apple has also invested in public utility infrastructure to increase the availability of both fresh and recycled water near data centers and offices. At the data center in Prineville, Apple partnered with the city to create an aquifer storage and recovery system that will hold up to 180 million gallons of water for use in peak months, reducing pressure on the local watershed.

Apple also made significant investments in recycled water infrastructure for Apple Park, its Cupertino headquarters that was completed in 2017. The company collaborated with the Santa Clara Valley Water District, the city of Sunnyvale, and the California Water Service Company to extend the region's recycled water purple pipes and make the resource more accessible to the community. The project, which required the installation of about 2.5 miles of pipeline, has allowed the Apple campus to use recycled water throughout its restrooms, cooling system, and landscaping. Recycled water has been an important part of achieving Steve Jobs's vision for the campus, which embraces nature and features native plants and fruit trees throughout the property as an homage to the site's pastoral roots.

Apple's efforts to reduce its freshwater withdrawals and return clean water to the watersheds in which it operates reflects the company's commitment to managing this shared resource responsibly.

Apple Park features native plants and fruit trees throughout the property as an homage to the site's pastoral roots.

As of 2022, Lake Mead is at 30 percent capacity.

CONCLUSION

As potable water is in increasingly limited supply globally,[175] reducing demand for water by increasing water conservation, efficiency, and reuse generates social, environmental, and economic benefits for people, buildings, and communities. These strategies are relatively affordable and provide opportunities for real estate and land use professionals to do well by doing good. With water conservation, efficiency, and reuse, we can meet our water needs sustainably. We must act quickly though—before it is too late—to ensure that our limited freshwater supplies stretch further in an uncertain future.

> "Conservation and efficiency improvements are the most cost-effective and least environmentally damaging ways of meeting new water demands."
>
> **SANDRA POSTEL**
> *Replenish*

SHUTTERSTOCK

ACKNOWLEDGMENTS

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